UNIVERSITY OF SOUTHERN QUEENSLAND

Engineering and Built Environment Project Conference 2016

Toowoomba, Australia
19-23 September 2016

Book of Abstracts
Final Year Student Research Project Presentations

Heads of Schools Welcome

A very warm welcome to the University of Southern Queensland, Toowoomba Campus for the 2016 Engineering and Built Environment Project Conference.

The annual Project Conference held on campus in Toowoomba forms the culminating point of your studies in engineering, spatial science and construction. Engineers Australia and other professional bodies have highly praised the Conference for being cross disciplinary and for the quality of your research presentations.

An important dimension of this Project Conference is the interaction that it generates between our graduating students and students who are within the penultimate stage of their studies. The interactions help provide those students with a sense of what will be expected of them in their final year.

The Conference is also an opportunity for you to showcase your skills, knowledge and achievements, and to interact with and learn from your peers. Please make the most of this week – share your knowledge and experiences with your colleagues, network with staff and other students and take the time to reflect on how far you have come in your learning journey and career.

Finally, we would like to acknowledge the efforts of the many academic and professional staff that have been instrumental in making this Project Conference a success. In particular, we would like to thank Associate Professor Alexander Kist and Ms Carolyn Saffron for their outstanding work in organising the project conference and activities. We also recognise the efforts of the project examiners, Mr Chris Snook, Professor Karu Karunasena and Dr. Andreas Nataatmadja; and your project supervisors in providing guidance during your project year.

On behalf of all the academic and professional staff we wish you an enjoyable and rewarding Project Conference.

Professor Kevin McDougall Head, School of Civil Engineering and Surveying	***Associate Professor Tony Ahfock*** Head, School of Mechanical and Electrical Engineering

Examiner's Welcome

On behalf of the course examiners, we would like to welcome you to the Engineering and Built Environment Conference 2016.

The Project Conference, inaugurated in 1998, is being attended by all penultimate and final year engineering and surveying students. This year there are about 620 students attending this multi-disciplinary conference.

These proceedings include extended abstracts of the verbal presentations that are delivered at the project conference. The work reported at the conference is the research undertaken by students in meeting the requirements of courses *ENG4111/ENG4112 Research Project* for undergraduate or *ENG8411/ENG8412 Research Project and Dissertation* for postgraduate students. The research is generally pursued over the full final year and will be nearing completion at the time of the conference.

The event also permits penultimate year students, who will undertake their research project in the following year, to experience the technical conference environment, gain appreciation of the standard and breadth of projects that may be pursued, and the presentation standards that will be expected of them.

As for any major event, success requires the effort of many individuals. We would like to thank the Assistant Examiners Dr Ian Brodie, Mr Andreas Helwig, Dr Ray Malpress and Professor Armando Apan for their contributions. Academics chairing sessions and critiquing the presentations also play an important role and we thank them for taking time out of their busy schedules to assist with these tasks.

A special thanks to the professional support teams led by Ms Carolyn Saffron and Mr Terry Byrne. Without their help we would not be able to run this event. Last but not least we would also like to thank all attendees for discussing their work, engaging with their peers and providing valuable feedback during the presentations.

We hope you enjoy this opportunity to share ideas and discuss your work with your peers and faculty staff.

Associate Professor Alexander A. Kist
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Towards two-dimensional infiltration measurement in complex and variable soil
environments

Benjamin Smith
Bachelor of Engineering (Civil)
Identifying best practice pavement design for an unsealed road network to
achieve sustainability improvements

Cameron Smith
Bachelor of Engineering (Honours) (Civil)
Utilisation of Rice Husk Ash and Fly Ash as a Partial Replacement for Cement in
Self-Consolidating Concrete

Morgan Smith
Bachelor of Engineering (Honours) (Power Engineering)
Battery SMART charge controller / combined co-gen grid connected inverter
Design and Simulation

Sathya Smith
Bachelor of Engineering (Honours) (Electrical & Electronic)
Wearable Technology and Gesture Recognition for Live Creative Performance
Augmentation

Jayanth Kumar Srelam*
Master of Engineering Science (Mechanical)
The Impact of Natural Fibre Reinforcements on the Interfacial Adhesion of Epoxy
with Metals

Abishek Sridharan
Master of Engineering Science (Electrical and Electronics)
Waste utilization in sugar industry – Biofuel from cellulosic material using microwave pre-treatment

Haren Stainwall
Bachelor of Engineering (Honours) (Civil)
Analysis of scour potential of culvert during extreme flood events using numerical simulation

Melissa Stark
Bachelor of Engineering (Honours) (Civil)
Managing Our Heritage: Monitoring, Maintaining and Restoring Our Timber Bridges

Dean Starkey
Bachelor of Engineering (Honours) (Power)
Vibroacoustic Transformer Condition Monitoring

James Steele
Bachelor of Engineering (Electrical and Electronic)
Signal Processing Techniques for Condition Monitoring

John Stephens
Bachelor of Engineering (Mechanical)
Projectile Mass Distribution Following Impacts on Hardened Steel Plate

Benjamin Stephens
Bachelor of Engineering (Honours) (Electrical and Electronics)
Sensor to improve detection of line break or earth faults for SWER lines

Ryan Stephenson
Bachelor of Engineering (Honours) (Computer Systems)
Implementation of Web-Based Keystroke Analytics for User Verification

Nikhil Suresh*
Master of Engineering Science (Mechanical)
Frying and Grinding of Lignocellulosic Materials as Pre-Treatments for Energy Purposes

Wayne Sutcliffe
Bachelor of Engineering (Honours) (Civil)
Design of a truss bridge for lowest cost using Structural Topology Optimisation

T

Naushil Bipinbhai Talavia
Master of Engineering Science (Power)
Asset Management Maturity Model: A Case study of Coal and Hydro based Power Stations in Australia

Jonikumar Tandel
Masters of Engineering Science (Mechanical)
Resilient Infrastructure Development and Management

Vamshi Krishna Tanniru*
Master of Engineering Science (Structural)
Shear behaviour of geopolymer concrete beams reinforced with spiral GFRP bars

Mark Taylor
Master of Engineering Science (Mechanical)
Effect of compression ratio on the performance, emissions and efficiency of E-85 blended biofuel

Scott Taylor
Bachelor of Engineering (Honours) (Power)
Implementation of Negative Phase Sequence Protection in the High Voltage Distribution Network

Nevin Thomas
Master of Engineering Science (Mechanical)
Influence of Preparation Method and Additives on the Viscosity of Waste Cooking oil for Tribological Applications

Toji Thomas
Master of Engineering Science (Mechanical)
Ethanol production from lignocellulosic material (bagasse) using mechanical pulverization as pre-treatment

Zaine Thompson
Bachelor of Spatial Science (Honours) (Surveying)
Integration of Trimble V10 Imaging Rover with R10 GNSS receiver for data collection under dense tree canopies

Mark Thorley
Bachelor of Engineering (Honours) (Electrical and Electronic)
Using Renewable DC Energy Sources: Improving Domestic Energy Efficiency

Austin Tippett-Whiteman
Bachelor of Construction (Honours)
Integrating scheduling with quality to minimise defects in construction

Tristan Turner
Bachelor of Engineering (Honours) (Electrical and Electronic)
Remote Data Acquisition

U

Mohammad Jasim Uddin
Bachelor of Engineering (Mechanical)
Design optimisation of human powered e-bike for all Queensland conditions

Anusha Uppalapati
Master of Engineering Science (Power)
Energy Recovery from Electronic Waste

V

Anjith Rao Vadluri
Master of Engineering Science (Power)
Analysis of Reliability and Availability of IEC 61850 based Substation Automation Systems

Daniel Verrall
Bachelor of Engineering (Honours) (Civil)
Modelling Water Allocation Increases Using Climate Predictions

Jarred Vonhoff
Bachelor of Engineering (Honours) (Electrical and Electronic)
Grid Response to Generation Transients

W

Sam Walker
Bachelor of Engineering (Honours) (Mechanical)
Integration Effectiveness between Engineering Teams on Complex Defence Programs

Zhe Wang*
Master of Engineering Science (Power)
Modeling and analysis of multi-junction solar cells (MJSCs) to improve the conversion efficiency using MATLAB/Simulink

Syed Waqar Ali shah
Master of Engineering Science (Electrical and Electronics)
Strategic Asset Management Framework for the Improvement of Large Scale PV Power Plants in Australia

Liam Watson
Bachelor of Engineering (Honours) (Civil)
Asset Condition Monitoring of Gympie Regional Council's Road Network

Bradley Wentworth
Bachelor of Engineering (Power)
Circuit Breaker Simulator – Operation & Behaviour under Faulted Power System Conditions

David West
Bachelor of Engineering (Honours) (Agricultural)
Tracking Machinery to investigate the effect of Compaction during Sugar Cane Harvesting

Jorja Wicks
Bachelor of Engineering (Honours) (Electrical and Electronic)
Remote Access Intravenous (IV) Pump Emulator Training System

Alex Williams
Bachelor of Engineering (Civil)
Development of New Methodologies to Establish Appropriate Speed Limits on Queensland Roads

Matthew Wilson
Bachelor of Engineering (Civil)
Deterioration of Timber Bridges Using a Fault Tree Analysis

Robert Wiya
Bachelor of Engineering (Honours) (Civil)
Behaviour of concrete when using RAP (Reclaimed Asphalt Pavement) as a coarse aggregate material

Reece Woolley
Bachelor of Engineering (Honours) (Civil)
Design, fabrication, performance evaluation and design optimisation of bridge culverts reinforced with GFRP bars

Sharn Woolnough
Bachelor of Engineering (Civil)
Framework for the developing a Knowledge-based Decision support System for Managing Complex Construction Projects

X

Xue Xia
Master of Engineering Science (Power)
High Efficiency Class-D Amplifier Magneto-Strictive Ultrasound Water Treatment Application

Peijie Xu
Master of Engineering Science (Power)
Deepwater Pumped Storage Investigation

Y

Michael Youngberry
Bachelor of Engineering (Civil)
Performance of Highway Embankments Constructed Over Deep Soft Soils

Zijing Yu (Yuri)
Master of Engineering Science (Civil)
Management of Engineering Assets

Z

Tari Zador
Bachelor of Spatial Science (Honours) (Surveying)
Assessing spatial labour market patterns in the Gold Coast

Shahrukh Zaman
Master of Engineering Science (Mechanical)
The performance of metal screens in mitigating firebrand attacks

*These projects have started this semester. The abstracts largely report on anticipated outcomes and not on complete projects.

Risk Management in the Construction of Communication Towers

Justin Adams

Bachelor of Construction (Management)

Supervisors: Dr David Thorpe, USQ

Keywords: Risk Management, Construction Management, Project Management Body of Knowledge

1. Introduction

The research project investigates the effectiveness of a risk management process within the construction and upgrade of communication towers and structures. The project aims to identify gaps in literature and provide a document which assists beginners and professionals in the industry, to identify and understand the risks associated with these works.

2. Background

Currently the industry has a huge demand for high speed data and mobile services to be consistently upgraded and rolled out in remote regions.. These projects are becoming more technical as technology is developed and upgraded which can add complications to the construction process and expose the principle contractor or subcontractor to risks which are not understood, identified or acknowledged. Currently there is a lack of industry documentation which can be of assistance to the industry and assist them with the control of risk.

3. Methodology

An extensive literature review was completed to provide the most relevant industry data and methodologies as a basis for the completion of a case study. Evaluation criteria were developed from the literature review and were used as a means for identifying appropriate projects and evaluating their performance.

The case study data was retrieved and evaluated to understand how the project performed against several processes and standards including the OIS Risk Management Process as shown in Figure 1.
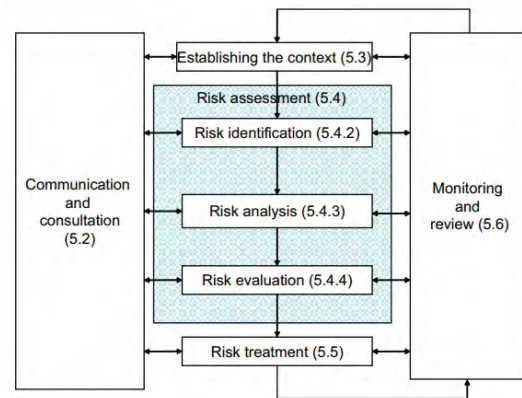
Figure 1: ISO Risk Management Implementation Process (IOS 2009)

4. Key Outcomes

The major outcomes that this research project hopes to fulfil are:

1. Understanding of the use of risk management processes.

2. Development of a document which could be used by the industry to improve project performance.

5. Further Work

As there is a minimal amount of research in the construction risks associated with construction of communications infrastructure, there are a huge number of potential projects that could be completed. There is already a significant amount of research relating to risk management, however further refinements and processes would always be of benefit to the construction industry.

6. Conclusions

The project is not quite complete yet, however it is expected that there will be a clear outcome at the completion of the project.

Acknowledgements

References

PMI 2013, *Project management Body of Knowledge (PMBOK Guide)Fifth Edition,* PMI, Newton Square, Pennsylvania.

Shenhar & Dvir, 2007, *Reinventing Project Management: the Diamond approach to Successful Growth and Innovation,* Harvard School Press.

ELECTRO-THERMAL MODELLING OF LARGE PV ARRAY DEGRADATION FOR THERMOGRAPHY AND PEAK POWER CONDITIONING MONITORING

School of Mechanical and Electrical Engineering

Glen Adcock Bachelor of Engineering (Honours) (Power)

Supervisors: Andreas Helwig (USQ)

Dr Narottam Das (USQ)

Keywords: Solar, Thermography, Degradation.

1. Introduction

One of the major problems with photovoltaic panels is that they degrade over time due to localised internal resistance rises. For large PV arrays, this can result in a single solar panel potentially seriously reducing the output from a whole series string of panels. These PV panel degradation processes may not be visual to the naked eye and currently requires time intensive intrusive testing to check each individual array.

2. Background

Thermal imaging is not a new technology also using it to monitor assets, however little has been investigated in using this method to detect installation issues or degradation of PV arrays.

3. Methodology

As illustrated in figure 1, the method relies upon the known characteristic of rising internal resistance of a solar cell increases with temperature, resulting in a power output reduction. Similarly, PV panel degradation processes should result in a rise in localised internal resistance in a solar panel cell. It was theorised this would show a corresponding noticeable localised thermography temperature gradient relative to the remainder of the individual solar panel. Such potential localised hotspots are simulated as a model using Matlab to determine theoretical sensitivity to localised rises of internal resistance of individual solar cells. Physical thermography of an accessible 240 kW PV array will be undertaken to detect any corresponding localised abnormal temperature gradients; while also observing and if possible to quantify, relative to the MATLAB model how to monitor progressive degradation in PV panels.

4. Key Outcomes

A literature review research into mechanisms of solar cell and panel degradation support the potential use of thermal imaging. The significant research contribution is to establish thermography as an appropriate life-cycle test mechanism for specific degradation processes in solar cells and panels used in long series strings for large PV arrays. This is a potential key process to identify and replace panels that may significantly degrade the optimal energy output of a series string of PV panels.

5. Further Work

Field work is yet to be performed to undertake the physical thermography scans of the assets to allow assessment of sensitivity in an existing large PV array.
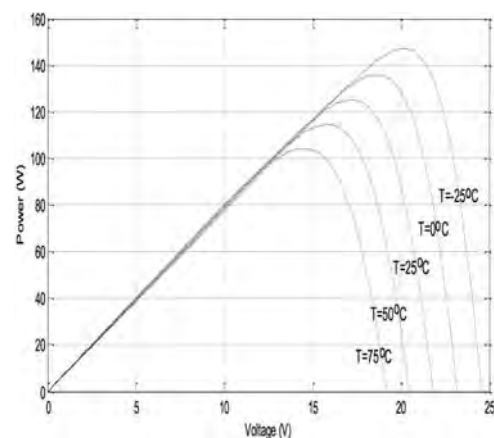
Figure 1 – Module's P-V Curves for various module temperatures at constant irradiance [1]

6. Conclusions

Localised internal resistance rise has a major impact to PV panel efficiency. The potential successful application of thermography to detect this in the PV arrays would see a major engineering service market boom. For very large PV arrays, implementing thermography using a micro UAV platform would be next potential step if this project provides positive proof of concept.

Acknowledgements

References

1. Acta Universatis Upaliensis Uppsala, 2008, Modelling and Degradation Characteristics of Thin-film CIGS Solar Cells.

Internet of Things for Cleaner Sky

Sponsor – School of Mechanical and Electrical Engineering

Moji Akbari

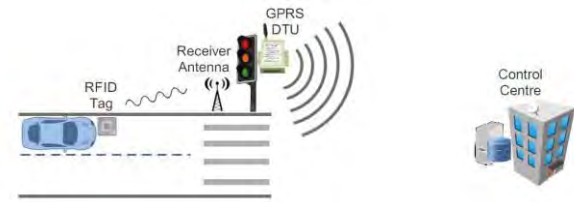Bachelor of Engineering (Honours)

(Electrical and Electronic)

Supervisors: A/Prof. Alexander Kist, USQ

Keywords: Internet of Things, IoT, Intelligent traffic systems (ITS).

1. Introduction

Internet of Things (IoT) or "future internet" is something which has attracted a lot of attention recently. Out of literally hundreds of applications that have been listed in the literature about the usage of IoT in different regions, perhaps intelligent transportation is the most tangible one in our daily lives. This research revolves around the idea of utilising the existing communication protocols between vehicles and road infrastructures to help the driver to realise how much his/her vehicle is polluting the air. Moreover this research is using a mathematical approach to optimise the number of data collection points to a certain degree.

2. Background

Many researchers believe that, there are currently more objects connected to the traditional Internet network than the entire population of the world. Some researchers believe the number of connected devices will be more than 18 billion in 2018. Yet these figures are with the assumption that we have not reached to the maturity point of IoT. As a matter of fact, some technology advisory firms like *Gartner* have predicted that IoT still needs 5 to 10 more years to get fully evolved.

3. Methodology

This research is proposing the idea of collecting vehicle's emission information and transmit this information (via RFID tags) to data receivers mounted on traffic intersections (Figure 1). However, mounting 'data collectors' on all and every single corner of the city seems impractical. Therefore, this research is utilising the theory of 'minimum spanning tree' for graphs in order to bring down the expenditure costs. To demonstrate the practicality of the idea, ARENA simulation software has been leveraged for an arbitrary traffic zone with 22 nodes.

Figure 1 – Collecting vehicle's emission data

4. Key Outcomes

It is shown in this research that IoT and ITS can be further engaged by developing the idea of collecting vehicle's emission information and extract a meaningful message out of it. Moreover, it has been demonstrated in this research that the number of data collection points do not need to be literally infinite. Instead this study argues that, with the aid of minimum spanning tree theory in mathematics (used to find the shortest route for emergency vehicles like ambulances for instance), having data collection hardware on every traffic intersection is not necessary and we may cut down the overall project expenditure cost and hence make it more feasible.

5. Further Work

Further sophisticated network simulation with more robust communication protocols and perhaps using more advanced commercial simulation packages like *Quadstone Paramics* is advisable.

6. Conclusions

IoT can help us having a cleaner sky especially in developing countries. The feasibility of notifying driver about her vehicle's emission data with special attention to expenditure cost was studied with the aid of discrete event simulation.

Acknowledgements

References

Bojan, TM, Kumar, UR & Bojan, VM 2014, 'An internet of things based intelligent transportation system', in *Vehicular Electronics and Safety (ICVES)*, 2014 IEEE International Conference on, pp. 174-9.

Elkhodr, M, Shahrestani, S & Hon, C 2013, 'The Internet of Things: Vision & Challenges', in *TENCON Spring Conference*, 2013 IEEE, pp. 218-22.

Numerical study on the Influence of porosity on heat conductivity of fibre reinforced polymer composites.

Sponsor – School of Mechanical and Electrical Engineering

Abdalrahman R Alajmi

Bachelor of Engineering (Mechanical)

Supervisors: Dr Belal Yousif *Keywords:* polymer composite, Thermal conductivity, finite-element analysis.

1. Introduction

In recent years, the use of sustainable polymer based products have gained a lot of interest and it is an active area in engineering research. Bio composites, often termed as green composites, have gained popularity in the last decade because of their attractive properties such as production at low cost, recyclability, renewability, and considerable mechanical properties when compared with the synthetic composites. In addition, the governments have made stringent environmental regulations for decreasing the large-scale dependency on synthetic fibres or their composites because of their adverse effects on the environment. Considering these issues, academic and industrial research sectors are exploring the potential applications of natural fibres into conventional or bio polymer resins for finding the environmentally friendly alternatives to the conventional synthetic material.

2. Background

Liu et al. (2012b) have done a further testing on the transverse thermal conductivity of unidirectional epoxy composite reinforced with abaca and bamboo fibres using resign transfer modelling (RTM) technique by using the based on the impact of the microstructure of natural fibre. It has been observed from the results that the transverse thermal conductivity has an interdependent relationship with bamboo as the thermal conductivity increases with increasing the bamboo fibre but decreased with abaca fibres.

3. Methodology

The first stage is modelling the fibre polymer composites in ANSYS. Applying the boundary conditions that includes temperature convections as well as setting up the times and the 5 sections that the temperature will be determined on. In additions, the most important part is that applying the mechanical properties of three materials Gypsum, Sisal fibre and Glass fibre correctly. Then insert the mathematical theory of simulating heat conductivity and examine the different results by different fabrication.
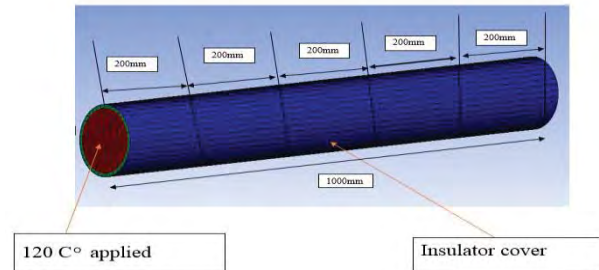

Figure 1 – Boundary Condition of the main model

4. Key Outcomes

The primarily results showed that by increment of natural fibres such as sisal fibre the thermal conductivity value will be decreased. However, by adding more synthetic fibre such as glass fibre the thermal conductivity will increase. According Azra Korjenic etc. (Korjenic et al., 2011) using jute, flax, and hemp to develop new insulting materials for buildings. Their thermal conductivity results revealed that natural fibre composites are likely to become a suitable alternative to commonly used boards.

5. Conclusions & Further Work

The numerical results approved that the addition of the sisal fibres into gypsum improved the thermal conductivity of the composites. However, regarding the limitation of license that USQ provide to the students a further work can be done on an advance license to make a more meshed models and more accuracy results.

6. Acknowledgements

I would like to thank my supervisor Dr Belal Yousif for his help to achieve valuable results.

References

1. Korjenic, A, Petranek, V, Zach, J & Hroudova, J 2011, 'Development and performance evaluation of natural thermal-insulation materials composed of renewable resources', *Energy and Buildings*, vol. 43, no. 9, pp. 2518-2523, <<Go to ISI>://WOS:000294834900056>

2. Liu, K, Takagi, H, Osugi, R & Yang, Z 2012b, 'Effect of physicochemical structure of natural fiber on transverse thermal conductivity of unidirectional abaca/bamboo fiber composites', *Composites Part A: Applied Science and Manufacturing*, vol. 43, no. 8, pp. 1234-1241,

Maintenance Optimization of Wind Farms in Australia
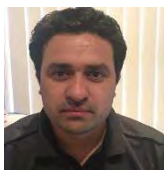
Alamgeer
Master of Engineering Science
(Electrical and Electronics)

Supervisors: Dr Nateque Mahmood, USQ
Dr Narottam Das, USQ

Keywords: wind turbine, wind farm, maintenance, optimization, simulation model.

1.Introduction

Wind energy is acceptable growing source of energy for Australia and for countries whose ratify to minimize the emission of greenhouse gases and lessen the outcome of global warming. The forever growing energy demand and the commitment from authority throughout the world, combined with universal agreements like the Kyoto Protocol to minimize the emission of greenhouse gases, has outcome in increase growth in wind energy generation. In 2015, Australia wind farms generate 33.7% of energy and contribute 4.9% of total electricity during the year [1]. As the operation and maintenance stage remains for long-term period during the life cycle of asset, the efficient maintenance strategies are critical to keep the asset life cycle cost to minimal. The ordinary maintenance strategies applied to wind farms are insufficient to support the present commercial drivers of the wind energy so a comprehensive model is present. The comprehensive model is based on hybrid approach [2], which is used to investigate feasible failure modes, sources and the resulting outcome on system performance. The approach is used in a case study to demonstrate its practical application.

2. Background

The objectives of this research is to develop a technical model, which can assess the existing maintenance of wind farms components and find out possible failure aspects. This research aims to develop an optimized maintenance model for wind farms in Australia.

3. Methodology

The modelling system using failures maintenance optimisation technique will be applied to evaluate and optimise the reliability, availability and maintainability of wind farms. The hybrid approach will use to choose an acceptable maintenance strategy. Modelling System Failures, and Delay time Mathematical Maintenance model [3] shall further use to optimise the inspection interval of critical elements of wind farm.
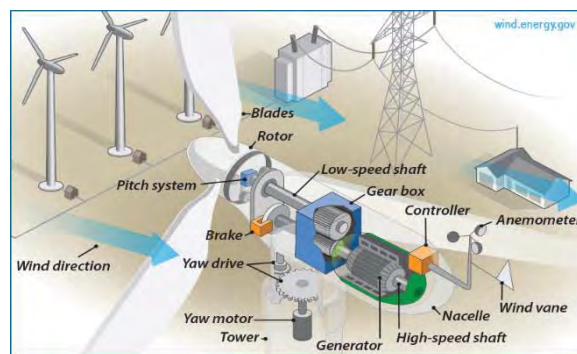

Figure 1. Components of a typical wind farm [4]

4. Key Outcomes

The expected outcomes are: a. Maintenance optimization models based on simulation results, b. Provide recommendations to develop effective maintenance strategies for wind farms in Australia based on the analysis.

5. Further Work

The background and literature review of the dissertation will be finalized in four weeks and after this a model will be developed for maintenance optimization of wind farm in the next semester.

6. Conclusions

The hybrid approach will be used to determine an appropriate maintenance strategy for wind farms in Australia. Any organization related to wind industry can get benefit and optimise their maintenance management using this model. The practical application of this model will assist the asset manager of wind farms to maintain in a cost effective way. It further helps the industry to consider maintenance issues during the conceptual stage of wind farm development.

Acknowledgements

References

[1] Clean Energy Council https://www.cleanenergycouncil.org.au/technologies/wind-energy.html
[2] Andrawus J.A, Watson, J., Kishk, M. and Adam (2006), the selection of a suitable Maintenance strategy for wind turbines, Wind Engineering, 2006. 471-486.
[3] Davidson, J., and Hunsley, C., The reliability of Mechanical system, 2nd edition, institute of Mechanical Engineering,
[4]: Energy.gov/ energy efficiency & Renewable energyhttp://energy.gov/eere/wind/inside-wind-turbine.

The Design and Performance Analysis of an Efficiency Optimized Power Supply DC-DC Regulator

Sponsor – School of Mechanical and Electrical Engineering

Abdulaziz Albasheer

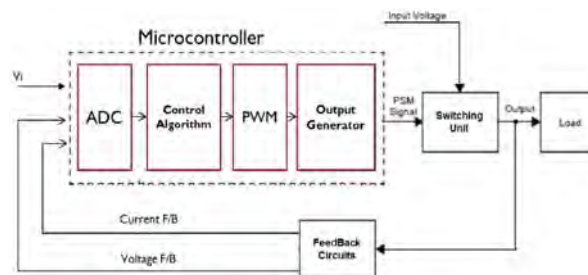Bachelor of Engineering (Honours)
(Electrical and Electronics)

Supervisors: Mark Norman, USQ

Keywords: Switch mode power supply, electronic engineering, efficiency, microcontroller

1. Introduction

Power electronics is a field responsible for converting power from a single source to the desired one. The device that converts power consist of small electronic circuits and ICs. Commonly used components are inductors, capacitors and transistors.

2. Background

Since the last decade power electronics is incorporated with digital control [1]. The main advantages of digital control circuits are flexibility of power supplies, implementation of complex control mechanisms and use of less components [2][3]. Power supplies face the problem of electromagnetic interference (EMI).

3. Methodology

Our methodology employs a microcontroller based switch mode power supply (SMPS) with a feedback circuit shown in figure 1. In SMPS, the controller is responsible for maintaining the output voltage and Switching unit is mainly responsible for converting voltage from one level to another level.

The efficiency of switching unit is evaluated on two main parameters *switching time* and *current rating*. Switching efficiency is calculated by

Efficiency of DC to DC converter=output power/ input power

A properly designed switching unit can yield 90% efficiency at maximum load.

4. Key Outcomes

The key outcomes of the project are the design and implementation of a reliable design circuit for buck converter operation along with the software design for the microcontroller for optimum operation and maximum efficiency.

Figure 1 – SMPS Block Diagram

5. Further Work

The potential future work of this project is to ensure that the power supply design of SMPS fulfils the electromagnetic compatibility standards and is free from EMI.

6. Conclusions

The project was the first instance a design of a Switched-mode DC-DC power regulator to convert 24V to 5V with an output capability for 0 – 1000mA current. The design considers EMC minimization and audio noise. The microcontroller design from a software perspective allows parameters of the switching to be adjusted to optimize power conversion efficiency. The design is implemented keeping cost minimization in mind. The whole power supply is designed to ensure maximum efficiency and minimal electromagnetic interference.

Acknowledgements

I would like to thank my supervisor Mark Norman for assisting me through the project. I would also like to thank Dusan Gleich [1] and Trip [3], as their work done on switch mode power supply helped me in designing the power supply and ensuring maximum efficiency

References

[1] Dusan Gleich, Mira Milanovic, Suzana Uran, Franic Mihalic. "Digitally controlled buck converter" IEEE power electronics society ISCAS-2004, pp-V944-V947.

[2] Tarun Gupta, R.R. Boudreaux, R.M. Nelms and John Y Hung, "Implementation of a fuzzy controller for DC-DC converters using an inexpensive 8-bit Microcontroller", IEEE Transactions on Industrial Electronics, Vol. 44, No.5, October 1997.

[3] Trip, N. D., & Dale, S. (2010). Digital Control for Switched Mode DC-DC Buck Converters, 99–102.

Measuring the Slippage in the Tractors to Avoid Wasting Energy

Sponsor – School of Mechanical and Electrical Engineering

Abdullatif Alkneemesh

Bachelor of Engineering (Mechatronics)

Supervisors: Dr Saddam Al-Lwayzy, USQ

Dr Troy Jenson, USQ

Keywords: Mechatronics – Mechanical - agriculture

1. Introduction

Tractor is nearly the most important cultivation vehicle with high fuel consumption and wasting power in tractors can be a main problem and can decrease the efficiency of the fuel consumption and then the quality of agricultural work in a normal working condition. Therefore, determining the factors in this process and analyse them and defining and optimise condition will be very useful.

2. Background

Wasting power in tractors can be a main problem and can decrease the efficiency of the fuel consumption. The efficiency of agricultural tractor is depending to some factors such as tractor travel speed, fuel efficiency, wheel slip, fuel vs. time considerations, optimal tractor speed and etc.

3. Methodology

Analysis of measuring the slippage in tractor and optimisation of wheel slip to avoid wasting power and save fuel. In depth research about sensors that can be used.

4. Key Outcomes

The rear wheel revolution in terms of pulse generated per second was recorded with the help of Data Acquisition System. For each gear, the relationship between wheel revolution and throttle position was developed and fed to the microntroller. These data represented wheel revolutions at no load condition. The program on the microcontroller is written using C program.
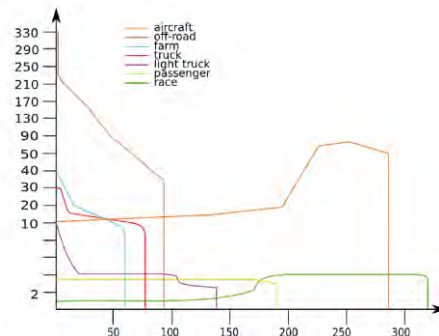
Figure 1 - Sample Diagram

5. Further Work

Preparing the actual field experiment to collect actual data. Then apply statistics to get the best results. Also will connect a LCD display to show the slippage percentage for the driver with a light alarm.

6. Conclusions

Tractors are main part of the agriculture and with using them we can increase the pollution and lose money, so we are trying here to avoid wasting money also increase the efficiency of the fuel consumption with mechatronics concepts by using sensors and data logger to find the slippage in the tires.

Acknowledgements

Firstly, I would like to thank my family for supporting me. Also my supervisors Dr Saddam H. Al-Lwayzy and Dr Troy Jenson, for being very helpful and guiding me to the right way. Then I would like to thank my friends who are always around to share ideas.

References

Pranav, P.K., Pandey, K.P., (2008), Computer simulation of ballast management for agricultural tractors. J. Terramechanics 45, 193–200.

Lacour S, Burgun C, Perilhon C, Descombes G, Doyen V. (2014), A model to assess tractor operational efficiency from bench test data. J Terramechanics 2014; 54: 1e18.

Peters, C. A. (2001), Statistics for Analysis of Experimental Data, Department of Civil and Environmental Engineering Princeton University Princeton, NJ 08544, Published as a chapter in the Environmental Engineering Processes Laboratory Manual S. E. Powers, Ed. AEESP, Champaign, IL , 2001.

Developing a strategic/concept estimating model for RMD

Sponsor – School of Civil Engineering and Surveying

Mark ALLEN

Bachelor of Engineering (Honours) (Civil)

Supervisors: Mr Trevor Drysdale, USQ

Mr Dave Woodbury, Roads and Maritime Services

Keywords: Cost estimating, model, concept.

1. Introduction

This research project seeks to investigate the current practices for cost estimation in the construction industry to combine the most suitable techniques into a software model to be used across the Regional Maintenance Delivery (RMD) division of Roads and Maritime Services (RMS) of NSW. Once a model is built, it will then be tested and evaluated, based on accuracy, uniformity and ease of use.

2. Background

It is recognised that the ability to influence cost is highest in the early stages of the project life cycle, as seen in figure 1, thus accurate estimating at the concept stage is important.

Estimating within RMD is widely varied in method and accuracy, depending on the engineer's skill, experience and time. The result is a lack of trust in cost estimates.

A way forward proposed is to create a software model to allow for a uniform base estimate, improving the general estimating accuracy and restoring trust in the cost estimates produced.

3. Methodology

This project is done in two stages; stage 1 involves researching current practices in RMD and across the wider construction industry to find the most suitable setup of the model.

Stage 2 involves analysing the model with regards to accuracy, uniformity and ease of use. This is completed by comparing estimates using the model with actual
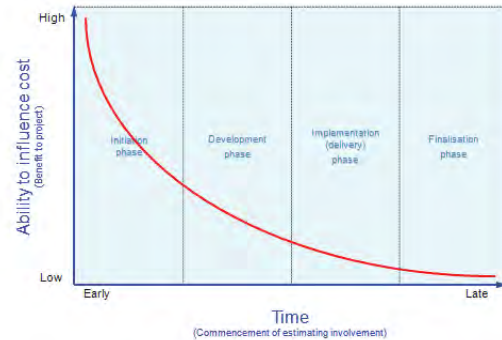
Figure 1 - Ability to influence cost (RMS 2014a)

costs, and alternative methods as well as asking the engineers using the model about their impressions.

4. Key Outcomes

The main outcome of this project will be an estimating model that has been researched and evaluated. The project aims to help build the model and suggest improvements for the model and its implementation.

5. Further Work

We found that the model would be quite suitable for other departments within the RMS. Further work is needed to adapt the model for other departments requirements and situations. There is also room for improvement on the model that could be undertaken.

6. Conclusions

The model has solved many of the key issues identified at the beginning of the project, primarily providing a go to estimating tool. There is still room for improvement however with honing the model and improving its acceptance across the engineers that would use it.

Acknowledgements

I would like to thank Mr Trevor Drysdale and Mr David Woodbury for their supervision and guidance and Mr David Pattison for his help.

References

JIN, R., HAN, S., HYUN, C. and KIM, J., 2014. Improving accuracy of early stage cost estimation by revising categorical variables in a case-based reasoning model. *Journal of Construction Engineering and Management,* **140**(7).

Roads and Maritime Services, 2014, 'RMD project estimating model', Technical Memo, Roads and Maritime Services, Parramatta, NSW, Australia.

Automated Analysis of Traffic Calming Devices to Monitor Driver's Behavioural Response

Sponsor – School of Mechanical and Electrical Engineering

Abdulwahab Alomi

Bachelor of Engineering (Electrical and Electronics)

Supervisors: Dr Les Bowtell, USQ

1. Introduction

People's reactions differ when encountering traffic calming devices. Some drivers might slow down, others may come to a complete stop and occasionally some will maintain their speed or accelerate.

The primary role of this project is to find an appropriate method to uniformly limit all vehicles to a safe limit, so the problem lies in the fact that different kind of traffic calming devices has been chosen and their effectiveness changes on the vehicle profile.

2. Background

Although used in good faith within the spirit of legislation, some traffic calming devices are positioned in wrong spots that could do more harm than good. The main focus of the study are two types of speed humps located in the campus of the University of Southern Queensland. The hypothesis states that the smaller speed hump of the two is inappropriately used and could cause safety issues.

3. Methodology

Sensing vehicle speed is not unique and has been out for years, with the help of calibration marks; video technology is used to calculate vehicle speed and driver's reactions when encountering traffic calming devices without getting sensitive data like the vehicle number plates and the driver's identity. Accelerometers and video technology are going to be used to calculate the g force in the vehicle to validate the hypothesis like shown in figure 1.

4. Key Outcomes

To validate the hypothesis: "For traffic attenuators to work effectively, there needs to be a perceived physical threshold to limit vehicle speed across the broad range of vehicles encountered". By validating the hypothesis

Figure 1 – G Force in the test vehicle driving over "Type 2" speed hump.

we can make the road safer for pedestrians, cyclists, motorists and prevent road rage.

5. Further Work

There will not be any further work in the campus of the university, but the concept of the study can be applied on any open road scenario to check if the traffic calming devices are causing problems more than actually doing the job they are meant to do.

6. Conclusions

As said before, the driver's behavioural response differ when encountering traffic calming devices depending on many variables. The safety of road users comes first, and to do that we must utilize the use of traffic calming devices.

Acknowledgements

I would like to thank my supervisor for helping me through this study and pointing me to the right direction. And a massive thank you to my friends and family for the moral support throughout the years, especially when I wanted to quit and not finish my studies.

Gasifier Automation Control

Sponsor – School of Mechanical and Electrical Engineering

Sammi W.J.A.H.A AlQattan Bachelor of

Engineering (Electrical and Electronics)

Supervisors: Dr Les Bowtell, USQ *Keywords:*
Gasifier, PLC Controls, Biochar

1. Introduction

In this research we look at converting macadamia nutshells as well as other biomass waste into syn gas efficiently and produce biochar. The gas produced will be analysed online in order to allow for process changes online. With this process we not only remove energy requirement for the whole process but we also produce between 5 and 10 % of pure carbon product in a stable form which can stay for thousands of years by evidence of tera preta

2. Background

This section describes the bigger picture and addresses question such as: Why is this project important? What is the state of the art in this area? How does this project build or extend existing knowledge or practice within your discipline?

3. Methodology

So using PLC I will look at using programmable logic to monitor and change both the bed temperature inside the gasifier as well as moisture levels in doing so I will receive data that will show me what levels of moisture and temperature will produce the best gas quality which is the main aspect of this paper. Plc sends a an analogue signal to the Burkert 3003 0-90deg Valve which has a position feedback going to the PLC. Peristaltic pump has an analogue speed reference to control rotational speed, tube diameters of 6, 8 and 10mm set the pump volume per rotation.

4. Key Outcomes

Outcomes so far are selection and bench testing of control valves, HMI work and preliminary PLC programming. The work left to do involves open loop experimental testing to enable closed loop control. As
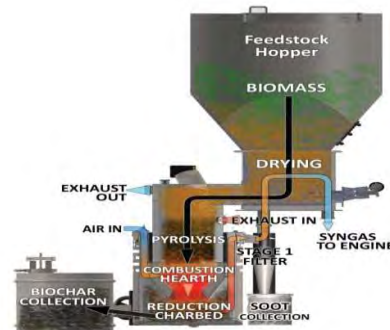
Figure 1 – Gasification Process

well as identify the correlation between the air and moisture levels and gas quality which will be observed through the gas analyser.

5. Further Work

Once I have completed all of why PLC work I should be able to test it on the gasifier at which point I will be able to complete my project.

6. Conclusions

In conclusion I want the reader to walk away seeing that there is a correlation between moisture and air levels that affect gas quality coming out of the gasifier as well as seeing the benefits and how useful it is to operate your gasifier using simple PLC controls that can in affect control the outcome of gas quality.

Acknowledgements

References

❖ 98/02047 Coal gasification apparatus, coal gasification method and integrated coal gasification combined-cycle power generation system. (1998). *Fuel and Energy Abstracts*, 39(3), p.186.

❖ 98/02873 Combustion and gasification of coal. Desulfurization in pressurized fluidized bed gasification systems. (1998). *Fuel and Energy Abstracts*, 39(4), p.266.

❖ Lu, X. and Wang, T. (2013). Water–gas shift modeling in coal gasification in an entrained-flow gasifier – Part 2: Gasification application. *Fuel*, 108, pp.620-628.

Automated sustainable Desalination of irrigation water for hydroponics vegetable production

Student Name

Zaed alsaqabi

Bachelor of Engineering
(Electrical and Electronics)

Supervisors: Dr Les Bowtell (USQ)

Keywords: biochar, salinity, power source

1. Introduction

My project is a subset of sustainable the Agricultural PhD work by Mohammed Haraz, consisting of two parts, firstly water purification and secondly greenhouse environmental controls. In part 1 I will be using sustainably sourced activated carbon in a CDI (capacitive deionization) pretreatment system to lower unwanted NaCl from the salty (approx2500ppm) river irrigation water to an acceptable level for vegetable production i.e. >1000ppm salt. Activated carbon will be used as the electrodes as well as the bulk filter media at the same time. Furthermore In the larger PhD work biochar will also be added to the hydroponic media to evaluate the vegetable growth rate influences it has in a hydroponic greenhouse, and fertilizer requirements and leachate effects. The green house will share the same PLC and will have environmental sensors used in the control program which will be used to monitor incoming and treated water quality along with environmental and plant growth data, all to be displayed on the HMI.

2. Background

This project is important as people around the world are surrounded by salty or brackish water. As an example my project is part of a PHD student's work and his home town is suffering from lack of useable water for irrigation to grow cucumber and other vegetables. I will be focusing on the water treatment component for my project and its interface into the overall PLC based SCADA system.

3. Methodology

My project is practically orientated and requires significant laboratory work and practical testing. At the start of the project I was largely unaware of the specific characteristics and applications of biochar and therefore this involved a significant amount of research to become familiar with biochar and activated carbon. The second part of my project involves experimenting and testing of biochar and activated carbon from a number of sources and involving a number of pretreatments in order to maximize the salt removal potential.

4. Key Outcomes

The novel use of biochar for electrode and filtration media in a simple pretreatment arrangement appears to be successful as a sustainable yet simple approach for removal of unwanted NaCl in hydroponic vegetable production. Energy consumption appears to be relatively low along with capital costs and maintenance when compared to RO (reverse osmosis) systems. Also of note is the important fact that this system does not remove potassium and other beneficial fertilizer and mineral components of the river water unlike RO which also requires post treatment addition of minerals.

5. Further Work

I have to complete further energy balance tests of the system to include both the removal and back flush cycles to optimize operations. Also I have to repeat the tests ready conducted for at least 3 cycles to see how well the biochar substrate handles being cycled through the adsorption and de adsorption phases, observing by how much efficiency changes. The HMI of the SCADA system is almost complete and I will need to do minor work to integrate my EC, voltage and current sensors

6. Conclusions

ED and CDI appear to both be suitable pretreatments for irrigation water for hydroponically grown vegetables in arid regions. The final conclusions as to which is best from an energy perspective will need to wait for the final cycle tests to be completed. Either way both are easily integrated into the SCADA system and allow successful lowering of salt levels to useable levels.

Acknowledgements

References

Conte, P. & Nestle, N. (2015). *Water dynamics in different biochar fractions*. *Magn. Reson. Chem.*, 53(9), pp.726-734.

Fang, Y., Singh, B., Singh, B. & Krull, E. (2013). *Biochar carbon stability in four contrasting soils*. *European Journal of Soil Science*, 65(1), pp.60-71.

Harter, R. (2013).

The application of visualisation techniques for stratum and strata boundaries within the New South Wales digital cadastre

Sponsor –School of Civil Engineering and Surveying

Elizabeth Anderson

Bachelor of Spatial Science
(Honours) (Surveying)

Supervisors: Dr Glenn Campbell, USQ

Keywords: stratum, digital cadastre, 3d visualisation

1. Introduction

High density mixed-use subdivision is becoming common with the urban infill within Sydney and leads to increased potential of conflicts between end-users regarding boundary locations and the associated rights, restrictions and responsibilities. New South Wales cadastral regulations allow vertical subdivisions in the form of stratum plans but these are complex plans that are difficult for the end-user to relate to the features onsite and understand the boundary limitations.

2. Background

The development and improvement of digital cadastres and the data they present is an ongoing area of development within surveying and the objective of Cadastre2034 is the developments of 'a cadastral system that enables people to readily and confidently identify the location and extent of all rights, restrictions and responsibilities related to land and real property' (ICSM 2015). The application of models to vertical subdivisions, particularly stratum subdivisions of mixed use developments, is becoming more critical in regards to communication methods with clients, local government authorities and purchasers.

3. Methodology

The methodology of this project sought to compare data presentation methods of stratum and strata subdivisions using case studies. These site represent both simple and complex vertical subdivisions. Each site has a 3D model created of the subdivision and Google Earth was used as a presentation format of the result. These models, such as the example in *Figure 1* were compared to the original plan format to analyse where the use of models can aid in the end-users understanding and application of the survey plan.
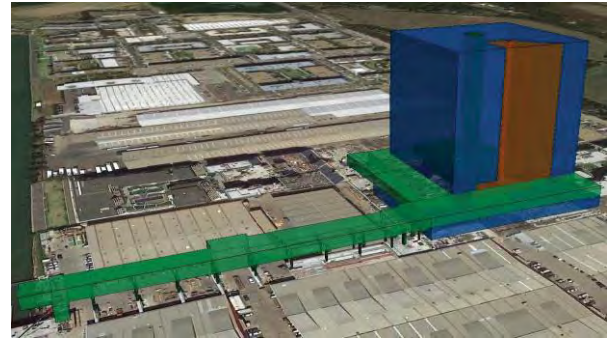
Figure 1 - Stratum subdivision including bridge and Block B development at Wentworth Point

4. Key Outcomes

The outcomes identified at this stage include an improvement in understanding of complex stratum subdivision plans. Feedback from a selection of registered surveyors working in high density development has been positive and there is client interest in the process. At this stage the application of models would be influential in the relationship between the surveyor, the developer and 'off the plan' purchasers, along with further end-users of the plan.

5. Further Work

The modelling stage of the project is complete and successfully demonstrates the use of 3D visualisation. Further research outside of the scope of the project could include investigations into software and data compatibility and the implementation of cadastre portals that would be suitable to display the models.

6. Conclusions

The models provide a parallel format to view a development that is more user-friendly than the survey plan on its own. The methodology developed has also been used for the real world scenarios, specifically at the ongoing development at Wentworth Point

Acknowledgements

References

Intergovernmental Committee for Surveying and Mapping (ICSM) 2015, *Cadastre 2034: Powering Land and Real Property,* viewed 2 May 2016, <www.icsm.gov.au/cadastral/Cadastre2034.pdf>

Investigation on aerodynamic drag reduction by passive devices in commercial vehicles

Sponsor – School of Mechanical and Electrical Engineering

Mareena Antony

Master of Engineering Science (Mechanical)

Supervisors: Dr Ruth Mossad, USQ

Keywords: Drag reduction, Passive device, Commercial Vehicles

1. Introduction

The reduction of aerodynamic drag is extremely important in the case of commercial vehicles rather than cars, precisely in Heavy vehicles such as trucks and buses. More fuel gets consumed in order to overcome high drag generated in heavy vehicles which subsequently increases the overall operating cost of heavy vehicles. Researches done so far studied the drag on realistic models of vehicles. An analysis to compare all the passive devices fitted on to a full-scale actual model of truck-trailer, bus and so on seemed to be really important in the current scenario which is studied in this project.

2. Background

According to the Survey of Motor Vehicle Use Data Cubes, Australia, a sum of 32402 million litres of fuel was consumed in the year 2014 of which more than 21% is consumed by commercial vehicles. Studies show that commercial vehicles consume relatively high fuel, because 65% of the fuel consumed is employed to overcome the drag. By reducing drag up to 40%, the government can save $10,000 per vehicle per annum. Hence, it is necessary to determine the efficient drag reducing device and its mounting features so as to reduce the financial burden on the government. Various researches have been carried out classic Ahmed body which is really basic and not relevant.

3. Methodology

Designing and modelling of different types of commercial vehicles and passive drag reducing devices of different shapes and dimensions using modelling software. Computational Fluid Dynamics (CFD) analysis will be performed on the assembled models using Ansys. Laminar flow model will be used for the analysis and then the following steps will be followed to carry out 2-D and 3-D to measure the pressure drag. First, these analyses will be performed on the baseline model alone to determine the initial drag on the vehicle to compare it with the drag generated while passive device fitted to the design.

4. Key Outcomes

An efficient passive device to reduce drag will be the outcome of this project. The investigator will be able to understand the importance analysing full scale practical model rather than analysing some impossible baseline models.

5. Further Work

Other means of reducing drag will also be investigated as an extension to this project.

6. Conclusions

It is expected to arrive at a conclusion regarding the passive device that incorporates favourable parameters towards drag reduction. The effect shape, dimensions and designing parameters of passive devices as well as the effect of speed in the drag reduction is also expected to be studied to formulate a pattern.

References

Ahmed S R, Ramm G, Faltin G, February 1984, 'Some Salient Features of the Time Averaged Ground Vehicle Wake', (SAE-TP-840300), Society of Automotive Engineers, Inc., University of Technology Braunschweig.Biggs,

Australian Bureau of Statistics 2015, 9309.0 - Motor vehicle census, Australia, 31 Jan 2015, Australian Bureau of Statistics, viewed 11 February 2016, <http://www.abs.gov.au/ausstats/abs@.nsf/mf/9309.0 >.

Zulfaa Mohamed-Kassim, Antonio Filippone, July 2010, 'Fuel savings on a heavy vehicle via aerodynamic drag reduction', Transportation Research Part D : Transport and Environment, Vol. 15, no.5, pp. 275-284.

Hsu Fu-Hung, Davis L Roger, August 2010, 'Drag reduction of tractor-trailers using optimized add-on devices', Journal of Fluid Engineering, Vol. 132, no. 8.

An investigation into the accuracies and limitations of different methods of connecting to datum.

Sponsor – Cullen & Couper Pty Ltd

Scott Archbold

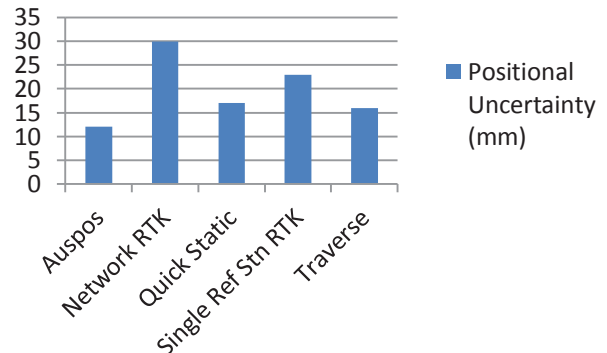Bachelor of Spatial Science (Honours) (Surveying)

Figure 1 – Positional Uncertainty

Supervisors: Dr Glenn Campbell, USQ

Mr Ray Tabulo, Cullen & Couper Pty Ltd

Keywords: State control survey, cadastral surveying, Geocentric Datum of Australia

1. Introduction

In Queensland, Cadastral Surveyors are required to connect certain cadastral survey plans to the State control survey under the requirements set out by the Department of Natural Resources and Mines. This project investigates the accuracies and limitations of the available methods of connection and reports on the optimal approach of connecting to the State control survey.

2. Background

As the requirement for connecting cadastral survey plans to the State control survey was only released by the Department of Natural Resources in June 2015, some Surveyors may have not had the opportunity to compare the available methods. This dissertation will give cadastral Surveyors a comparison of the accuracies and limitations expected under different conditions.

3. Methodology

The field and office methodology in this dissertation have been produced to facilitate the undertaking of the required surveys. The methodology utilises the Special Publication 1 Standards and Guidelines to ensure that DNRMs requirements are met.

4. Key Outcomes

The main outcome of this dissertation is to process the field data and report on the positional uncertainty values. Figure 1 shows the expected accuracies of each method.

5. Further Work

The recommendations included in this dissertation have only been made for certain conditions. Surveyors encountering different conditions may need to assess their site specific conditions and produce survey methodology which will meet their requirements.

6. Conclusions

The main conclusion of this project has been finding the optimal approach for connecting survey plans to the State control survey. The accuracies and limitations reported on for each method under different conditions are also of value to any Surveyor who is required to make such connections.

Acknowledgements

I would like to give my thanks to Dr Glenn Campbell and Mr Ray Tabulo for their swift assistance and valued guidance throughout the project. I would like to acknowledge the technical assistance provided by Mr Dean Harvey, the equipment provided by my sponsor Cullen & Couper Pty Ltd and the feedback given by James Derksen, John Broe and Phil O'Donoghue.

References

Department of Natural Resources and Mines. (2015). *Cadastral Survey Requirements.* Retrieved https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0013/105601/cadastral-survey-requirements.pdf

Intergovernmental Committee on Mapping and Surveying. (2014). *Geocentric Datum of Australia Technical Manual.* Retrieved http://www.icsm.gov.au/geodesy/sp1.html

Intergovernmental Committee on Mapping and Surveying. (2014). *Standard for the Australian Survey Control Network: Special Publication 1.* Retrieved http://www.icsm.gov.au/geodesy/sp1.html

Towards 2020: An Energy-Neutral Council Works Depot Title

Sponsor – Moreton Bay Regional Council

Brent Armstrong

Bachelor of Engineering (Honours)

(Mechanical)
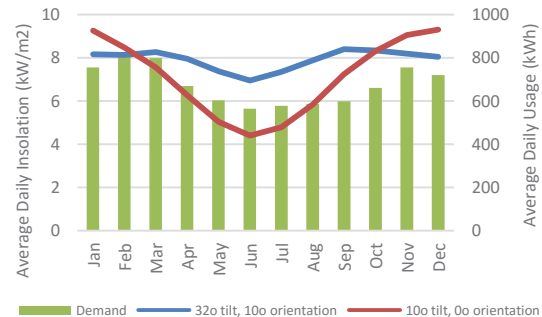
Supervisors: Dr Ruth Mossad, USQ

Keywords: Energy efficiency, renewable, sustainability, works depot

1. Introduction

Energy efficiency is gaining momentum in local government authorities as cost benefits are realised and leadership within local communities is being exercised. New construction projects are prime candidates to incorporate well-engineered site-specific energy efficient solutions based on physical location and local climatic conditions. This research project proposes and substantiates solutions for energy neutrality at a new council works depot that consolidates three existing sites into one, due for construction by 2020.

2. Background

Works depots support a large proportion of Council staff and operations, and consume a significant amount of energy. Energy neutrality will contribute towards local carbon reduction targets to minimise the effects of climate change, particularly sea level rises which will impact on local communities. The rapid progress of renewable energy and storage technologies allows evaluation and selection of site-specific technologies that will eliminate dependence on grid electricity.

3. Methodology

An audit of historical energy consumption at the three existing sites provides half-hourly baseline data. Hourly, daily and annual variations are modelled and compared to historic climatic conditions. Modelling enables the evaluation of the availability of solar irradiation on surfaces of any tilt and orientation, and is applied to all solar-dependent technologies. Figure 1 demonstrates the impact of parameter selection and compares to site demands. Concept site planning was iteratively undertaken to balance infrastructure requirements for depot operations, physical site constraints and energy generation and storage capacity.

Figure 1 – Solar energy availability versus site demand

4. Key Outcomes

Site and location constraints limit technologies suitable for implementation. However, a combination of solar PV panels, evacuated tube solar collectors, shallow geothermal HVAC loops, energy efficient practices and chemical storage provide sufficient resources for reliable energy sustainability. Only during extended periods of cloud cover would grid electricity be required. Variability in site demands largely follows the availability of renewable energy resources, making the energy neutral depot a financially feasible reality.

5. Further Work

The rapid development of energy generation and storage technologies – efficiency improvements, new technologies and cost reductions – compel the engineer to review the proposal during design phases of the construction project, and incorporate technologies that will supersede those recommended in this report.

6. Conclusions

Energy neutrality at a multi-faceted council works depot is a financially feasible reality in 2016. By construction in 2020, enhancements in technology will provide greater reliability and further cost savings.

Acknowledgements

I would like to thank my project supervisor Dr Ruth Mossad for her support and the staff at Moreton Bay Regional Council for providing guidance and authority to pursue the project with the intent of implementation.

References

Climate Risk Pty Ltd (2009). *Scoping climate change risk for MBRC: A climate risk report*. Caboolture, Qld: Moreton Bay Regional Council.

Henning, H. M. (2007). Solar assisted air conditioning of buildings – an overview. Applied Thermal Engineering, 27(10), 1734-1749.

Creep Response of sandwich panels with thermoplastic core

Sponsor – School of Civil Engineering and Surveying

Bharani Dharan Attiyannan

Master of Engineering Science (Structural)

Supervisors: Dr Sourish Banerjee, USQ

Keywords: Sandwich panels/beam, Abacus, Thermoplastic core, Creep response, Indentation

Introduction

Sandwich panels are used widely in structures that require bending resistance and lightweight property. Sandwich panels are combinations of two thin sheets to resist bending that acts as faces and shear resistance by core material in between the sheets. The material used for sandwich panels include aluminium, metallic foam core, honeycomb core,, polyvinyl chloride (PVC) and in recent years we have developed cellular thermoplastic cores.

The research aims to analyse the behaviour of sandwich panels under sustained loading. The research will include the prediction of failure modes i.e. creep. The interaction of skin and core and their influence on failure modes. The theoretical predictions will be compared with a Abacus model.

1. Background

Sandwich panels when applied with loading, the response behaviour is governed by the material in face and core. Depending on the material and load the response would be elastic or inelastic. And due to combination of two materials there is additional localised response from overall behaviour. We are interested in indentation response of the sandwich pane which is influenced by the core. In our case we have used thermoplastic core which would produce a inelastic response.

2. Methodology

In order to develop a theoretical prediction of non-linear behaviour of thermoplastic core, first I would be analysing sandwich panels in elastic response. By gathering past research works in response of sandwich panels under creep, I could recreate some models to understand the behaviour of sandwich panels. Then I could move onto the actual model. And then create Abacus models to compare the response in theoretical prediction and Abacus model.

3. Key Outcomes

So far the in literature review we have found prominent use of failure mechanism maps in past research papers, the influence of ratio of elastic modulus of skin and core and thickness of core in indentation failure. I am currently working on recreating a model with known results, so as to understand the approach taken in analysing sandwich panels.

4. Further Work

The research is still in early stages as we are in process gathering required past researched and start working on basic models and move onto the actual model.

5. Conclusions

The expected conclusion of the project is that we would be able to theoretically model the behaviour and understand the response of the sandwich panels under creep and the influence of the skin and core contact in failure modes.

Acknowledgements

References

Zenkert, Dan. The Handbook Of Sandwich Construction. Cradley Heath, West Midlands: Engineering Materials Advisory Services, 1997. Print.

Collapse Mechanism Of Sandwich Beams With Composite Faces And A Foam Core, Loaded In Three Point Bending. Part II: Experimentanl Investigation And Numerical Modelling.". International Journal of Mechanical Sciences 46.4 (2004): 585-608. Web. 12 Aug. 2016.

Soil consolidation of heavy machinery in Hydrus

Sponsor – School of Civil Engineering and Surveying

Dilpreet Singh Aujla

Master of Engineering Science (Agricultural)

Supervisor: Prof. GuangnanChen, USQ

1. Introduction

Australia is a major agriculture producer and exporter. In Agriculture sector, Crop yield is a major factor to be considered. One of the major problem that reduces cotton yield is soil compaction. Due to the compaction of soil, the oxygen amount and water penetration to the plant roots is blocked that results in increasing the mechanical resistance to root growth and hence decreases cotton yield. The major reason of soil compaction is the increasing use of John Deere 7760 cotton picker. The HYDRUS software will be used in study to find the soil compaction parameters due to heavy machinery.

2. Background

Cotton is major agriculture crop of Australia. Soil compaction is the major factor in root growth, soil physical properties and crop yield. Cotton picker (John Deere 7760) has been widely used by Australian farmers from 2008. Because of its heavy weight, the axle loads of cotton picker, it is drastically effecting the soil by compacting it. Several studies have demonstrated the influence of compaction by wheel traffic on soil, while fewer studies are available on the impact of harvest traffic on yield. HYDRUS software, which has been used to find the numerical value for simulating water flow and solute transport in variable saturated soils and groundwater

3. Methodology

1) Review the current literature and methods to measure and predict soil compaction

2) I will obtain row to row soil compaction data.

3) I will evaluate the current model with the help of HYDRUS to predict soil compaction.

4) New methods will be suggested that reduces the effect of soil compaction on cotton production.

4. Key Outcomes

Determination and quantification of the impact of cotton picker traffic on the soil compaction and cotton production row by row. Calibration will improve the results of soil compaction with the help of HYDRUS

5. Further Work

I had finished the literature review of my research area, and now onwards I will start working on the study of HYDRUS for calibration, which is the main part of my project. I will start to take row to row readings of soil compaction with the help of Ph.D. student Mohamad

6. Conclusions

It is very hard to say now, what will be the conclusion as I am assisting Ph.D. student Mohamad, who is already doing this project. As I had to study the literature review, so it seems like Austrian cotton industry has very less data related to filed management activities. I can say that, if research goes in positive way, it will be very helpful for the farmers.

7. Acknowledgements

I would like to thanks Professor Gangnam Chen and Ph.D. student Mohamad Al-Shatib who is very supportive and helps me in every part. Mohamad Al-Shatib provides me every kind of support and guides me.

8.References

Simunek, J, Genuchten, MTV & Sejna, M 2016, 'Recent Developments and Applications of the HYDRUS Computer Software Package', *Advancing Critical Zone Science,* viewed 16 August 2016

Mansell Power Lifter Actuator Failure Analysis

Sponsor – School of Mechanical and Electrical Engineering

Donald Bailey

Bachelor of Engineering (Honours)

Bachelor of Information Technology (Computer Systems)

Supervisors: Assoc/Prof John Leis, USQ

Dr John Grant-Thomson, Wenross Holdings Pty. Ltd.

Keywords: Reliability, Fault Detection, Data Logging.

1. Introduction

Reliability is a key characteristic of any successful product design, even more so when the correct operation of a piece of equipment is crucial to ensure the safety of those involved in its use. In particular, systems which are engineered for medical use need to have a particular emphasis placed on their safe and reliable operation to ensure that the health of the patient is not at risk. The aim of the project is to undertake an investigation of the failures of linear actuators in a real world medical system.

2. Background

The Mansell Power Lifter (MPL) is one component of the Mansell Infant Retrieval System which is manufactured by Wenross Holdings Pty. Ltd. to transport critically ill infants. The MPL is an electrically powered stretcher which can be raised and lowered with zero operator effort through the use of DC-motor driven linear actuators. While the operation of the MPL does not have a direct impact on the condition of the patient, its reliable operation is important to ensure that there are no delays in their transport. Despite its widespread and successful use there have unfortunately been a number of reported occurrences of linear actuator failures. The investigation of these failures will form the primary effort of this project.

3. Methodology

A literature review was conducted to gain an understanding of the failure modes of linear actuators and what factors may be at work in the case of the MPL. After investigation, it was determined that a system would need to be devised for collecting data about the circumstances under which a failure occurred. This took the form of a data logging device
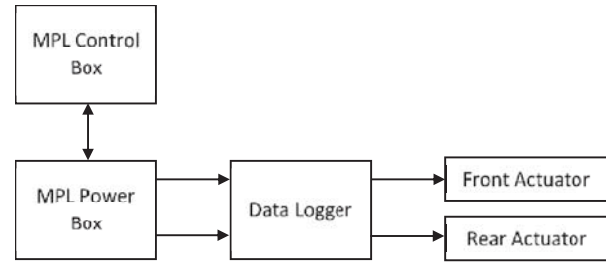
Figure 1 – Basic MPL system overview with data logger.

which was developed such that it could be connected to a MPL in the field to collect real world usage data.

The data logger was developed using a microcontroller based on the Arduino prototyping platform and designed to be placed in series with the actuator power cables as can be seen in Figure 1 and measure a variety of key parameters.

4. Key Outcomes

The key outcomes of this project were to gain an understanding of the cause and characteristics of actuator failures on the MPL and to propose a potential solution for preventing future failures. Thus far two data loggers have been built and deployed to hospitals to collect data on MPL use and are expected to return valuable data in the near future.

5. Further Work

The outstanding tasks to be completed are the analysis of the gathered data and the proposal of a potential solution to the problem. Future work could address the implementation of the proposed solution.

6. Conclusions

Successful identification of the cause of the actuator failures on the MPL will enable the safety of the system to be improved by preventing potential failures.

Acknowledgements

References

Grant-Thomson, J 2014, *Mansell Power Lifter Operator's Manual*, Wenross Holdings Pty. Ltd., Toowoomba.

Johnson, BW & Aylor, JH 2988, 'Reliability and safety analysis in medical applications of computer technology', Engineering of Computer-Based Medical Systems, 8-10 June, pp. 96-100.

Keys, C 2014, 'Mansell Power Lifter Control System Redesign', BEng Dissertation, University of Southern Queensland, Toowoomba.

A safety analysis of working on rehabilitation works on low volume sealed highways in rural remote NSW

Sponsor -School of Civil Engineering and Surveying

Jessica Baker

Bachelor of Engineering (Honours), (Civil)

Supervisor: Dr David Thorpe, USQ

Keywords: safety, roadworks, survey

1. Introduction

Due to the Bogan Shire Council's lack of experience in road works, combined with a lack of resources and funding to complete pavement rehabilitation projects, the safety procedures and methods used during major roadwork projects have not been fully developed. A lot of studies focus on the safety of the travelling public on rural roads, therefore I became interested in focusing on the safety of the workers involved in undertaking the major road maintenance projects in rural remote areas.

2. Background

The Bogan Shire Council is contracted by Roads and Maritimes Services New South Wales under the Road Maintenance Council Contract (RMCC) to undertake routine services and planned maintenance on the state highways. The council has recently undertaken three rehabilitation projects (one a year from 2014), and from evaluating incident reports and completing a site visit of one of these projects, it is evident that the health and safety of personnel working on these large-scale projects is still at risk.

3. Methodology

Firstly, a site visit in April 2016 to the rehabilitation project 'Adavale' on segment 2605 of the Mitchell Highway east of Nyngan was undertaken. During this site visit, the processes involved in each activity were outlined, photos were taken, and the council's safety system was assessed. A number of safety issues were raised during this site visit, and consultation with the RMCC supervisor and head of engineering at the council also highlighted problems in documentation and reporting. From this, an industry survey was developed that is to be undertaken by the council employees who have worked on these types of projects. Questions asked in the survey included rating the hazards/risks involved in these projects, assessing the current council safety procedures in place, and incident occurrence and reporting. The council's safety management

plan was assessed and areas in this system that need improving, changing, or better implementation have been suggested.

4. Key Outcomes

The aim of this project is to assess council's current safety system, and further develop council's induction package, risk assessments, toolbox meeting and incident reporting guidelines, safe work method statements, and a 'workers on foot' plan for rehabilitation projects specific to the Bogan Shire Council to ensure the ongoing safety of road workers.

5. Further Work

Conduct and analyse the industry survey. Develop 'workers on foot plan' and induction package.

6. Conclusions

A significant amount of cars disobey roadwork rules and signage. This has been raised as one of the main risks to personnel working on road works, along with plant operating in the work zone, hot summer temperatures, lime stabilisation techniques, and steep embankments. To solve the problem of traffic disobeying roadwork rules, a boom gate could be utilised at the beginning and end of road works, fines given from disobeying road works should be increased, cameras could be utilised throughout the work zone, and further recommendations may come after the survey is completed. The importance of the health and safety of road workers should not go unnoticed, and next time you think of disobeying roadwork rules, think about the consequences it may have on these workers.

Acknowledgements

References

Roads and Maritime Services, 2010, *'Traffic Control at Work Sites Manual'*, version 4.0, Issue 1, 28-420.

Safe Work Australia, 2013, *'Traffic Management in Workplaces – Draft Model Code of Practice'*, version 1, 4-20, <http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/traffic-management-cop>

Analysis on the behaviour of FRP reinforced concrete railway sleepers

Sponsor – School of Civil Engineering and Surveying

Trent Baker

Bachelor of Engineering

(Honours) (Civil)

Supervisors: Dr Allan Manalo, USQ

Keywords: Railway, sleepers, fibre reinforcement

Figure 1- Bending Moment results for 10 MPa support modulus.

1. Introduction
Timber, steel and concrete are the main materials used for railway sleepers, with target life spans of 20, 50 and 50 years respectively. A large number of these traditional sleepers, even with perfect support conditions, do not reach their target life due to unexpected failure modes. It is estimated that the Australian railway industry could reduce its operating cost by up to $80 million per annum by improving its operation and maintenance procedures (Ferdous and Manalo, 2014).

2. Background
While prestressed steel reinforced concrete sleepers possess characteristics that make it more suitable as a sleeper material compared to timber and steel, this alternative is still vulnerable to different failure modes. The main failure type that will be addressed is bar corrosion. The superior corrosion resistance of fibre reinforced polymer (FRP) bars presents a possible solution to the failure of sleepers from bar corrosion. This study will evaluate the potential of precast concrete reinforced with FRP bars as an alternative railway sleeper through theoretical analysis and numerical simulations.

3. Methodology
The analysis on the behaviour of concrete sleepers reinforced with FRP bars was undertaken in three main stages to determine its suitability. These stages are:

Stage 1 – Involves analysing the proposed theoretical bearing pressure distribution patterns representing different ballast conditions, to determine which pattern subjects sleepers to the highest design forces.

Stage 2 – Performing parametric study to determine optimum design of sleeper concept which meets the relevant performance requirements (AS1085.14, 2012).

Stage 3 – Compare performance of concrete sleeper reinforced with FRP bars against existing precast concrete sleeper reinforced with steel.

4. Key Outcomes
The key outcomes of this project so far are the comparison of the existing bearing pressure distribution patterns and the resulting sleeper bending moments, deflections and shear forces. The results of this comparison clearly indicate that pattern 2 gives the most conservative design forces, as indicated by the bending moment results in figure 1.

5. Further Work
If time and resources permit full–scale experimental testing will be conducted to verify the results of the theoretical analysis and Finite Element Modelling.

6. Conclusions
This research will compare and evaluate the existing methods for calculating the forces in sleepers and determine the most conservative method. The suitability of the new sleeper concept will be evaluated.

Acknowledgements
I would like to thank Dr Allan Manalo for his assistance and guidance throughout this project.

References
Ferdous M.W. and Manalo A.C. *Failures of mainline railway sleepers and suggested remedies* – Review of current practice. Engineering Failure and Analysis 2014; 44, 17-35.

Standards Australia 2012, *Railway track material, Part 14: Prestressed concrete sleepers*, AS1085.14, Standards Australia, Sydney.

Fracture of Natural Fibre Composites Sponsor –

School of Civil Engineering and Surveying

Ankur Batra

Master of Engineering Science (Structural)

Supervisors: Sourish Banerjee, USQ

Keywords: Natural fibre, fracture, Mechanical Testing

1. Introduction

Natural Fibre have valuable mechanical properties which are widely used among the industry. Researchers are conducting research to replace natural fibers with synthetic fibers. In present era, civil and chemical engineers have great challenge to make processes innovative and environmental friendly. In this project, the investigation and comparison of natural fibre with synthetic fibers will be done by studying fracture behaviour of natural fibre composites.

2. Background

The number of researches has been conducted to find new alternative synthetic fibers to replace or reduce the use of natural fibers. The work has been done to improve the interfacial adhesion with matrix and their fracture behaviour.

3. Methodology

Bamboo fibres and epoxy resin are the materials involved in the experimental study to test the different kind of fractures in the natural fibres. Different composite sample of natural fibres and epoxy resin is to be made on the basis of different fibre lengths and volume fractions. And finally check the interface bonding of fibre lengths parallel to the volume fraction.

4. Key Outcomes

The methodology mentioned above in the project will focus on the fractures in the natural fibres composites. To discuss the fracture mechanism Experimental results and theoretical theories are to be compared.
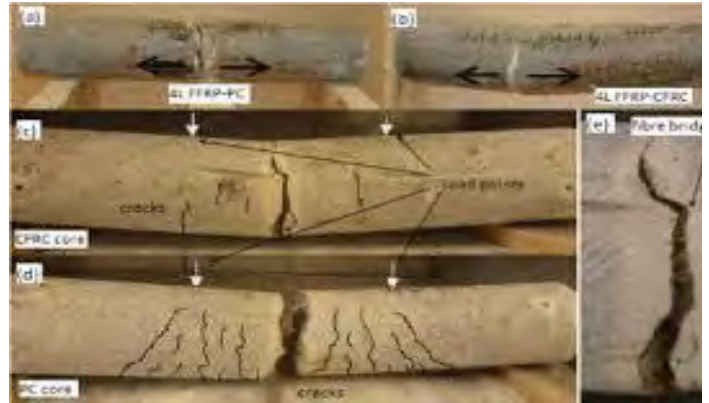
5. Further Work

At this stage, I had done the introduction part and little bit review of literature. So, next part I will focus on methodology and do the lab experiments and compare the experimental results with the theoretical results.

6. Conclusions

It is very hard to say about conclusion at this stage because I am just at the beginning of the project. I can say that composite that I will make, have better results with highest toughness and long life as compare to natural fibres which are existing.

7. Acknowledgements

I would like to thank Dr Sourish Banerjee and Dr Belal Yousif, who are very helpful at every stage. They are guiding me and give directions related to my project.

8. References

Faruk, O, Bledzki, AK, Fink, HP & Sain, M 2010, 'Biocomposites reinforced with natural fibres: 2000-2010', *Progress in Polymer science*, vol. 37, no. 11, pp.1552-1596, viewed 15 August 2016, < http://www.sciencedirect.com/science/article/pii/S0079670012000391>

Pacific Highway Glenugie; Case Study of the use of Heavy Duty Granular Pavement in Northern NSW

School of Civil Engineering and Surveying

Matthew Beaumont

Bachelor of Engineering (Honours) (Civil) and Bachelor of Science

Supervisors: Jo Devine, USQ

Mr Ben Churton, RMS

Keywords: Heavy Duty Granular Pavement, Northern NSW, Pavement Performance

1. Introduction

In September 2011 the Glenugie upgrade of the Pacific Highway was completed. This upgraded section was effectively a trial to gain a better understanding if heavy duty granular pavement design would be a feasible option in Northern NSW.

2. Background

The objective of the project is to evaluate the pavement at Glenugie performance thus far and determine the mechanisms which are the cause of any failures in the pavement, examining the root cause of the failure mechanism with the aim to improvement performance and maintenance of heavy duty granular pavements in Northern NSW in the future.

3. Methodology

Assessment of the pavements performance to date and the extent of the pavement failure in the segment of road of interest.

Assessment of the cause of the current failures in areas of the Glenugie pavement. This assessment will be based on range of soil testing which has been carried out by RMS in areas of the pavement which have shown a high rate pavement failures and will utilise Travel Speed Deflection data from the RMS RAMS data base. This test data will be used to compare with a range scientific literature, specifications and construction data to develop substantial theory supported by evidence as to the mechanism or mechanisms which are causes of the failures in these areas of pavement.

Assessment of the root cause of the failure mechanism or mechanisms. This assessment will examine if a relationship exists between the area of pavement where failure have occurred and factors in the pavement design, construction techniques used or materials used.

4. Key Outcomes

The analysis of the pavement performance and failures at Glengie hopes to benefit the ongoing upgrade of the pacific highway and high traffic roads in northern NSW.

5. Further Work

Some analysis of the failure mechanism and root cause still needs to be carried out along with a considerable amount report writing.

6. Conclusions

Until all the data is analysis no conclusion can made from the work.

References

Jameson, G & Harrison, C (2011), Guide to pavement technology. Part 5, Pavement evaluation and treatment design, Austroads, Sydney.

Nash, G, Donnelly, J, Gamble, S, Morgan, D, Kearns, G & Millichamp, S (2011), 'Development of a heavy duty flexible granular pavement for the Pacific Highway upgrade at Glenugie ', in RTA Pavements Conference 2011: *proceedings of theRTA Pavements Conference 2011* Darling Harbour, Sydney.

Huang, YH (2004), *Pavement analysis and design*, 2nd ed. edn, Pearson Prentice Hall, Upper Saddle River NJ.

Arduino Modbus Simulator

Ryan Beccarelli

Bachelor of Engineering (Computer Systems)

Figure 1 – Arduino Modbus Simulator Prototype

Supervisors: Mrs Catherine Hills, USQ

A/Prof Alexander Kist, USQ

Keywords: Modbus, Arduino, RS-485, RS-232

1. Introduction

Modbus is an industrial network communications protocol used to interconnect control systems and input/output equipment such as sensors and transducers. The aim of this project is to develop a handheld Modbus serial network test tool based on the Arduino open source development platform.

2. Background

Modbus can be described as the industrial communications protocol that has become the de facto standard in multi-vendor integration. Modbus was developed in 1979 but it still remains today as the protocol universally used to interconnect devices from different automation companies. Modbus networks can use either a serial interface (RS-485 or RS-232) or Ethernet as the transport layer. Research completed as part of this project showed that the number of Modbus networks per facility control system is increasing when new facilities are built and commissioned. Despite the increased number of Modbus networks, the existing software tools used for commissioning and troubleshooting remain limited to PC and laptop deployment. This project addresses the need for a simple hand held communicator for use by technicians and engineers.

3. Methodology

Research was completed to survey existing installations to determine which message coding format and what transport layer to choose for development. A review of what propriety and open source software existed for use and performance testing was completed. Testing of various Arduino shields and boards was also evaluated. Consultation with a US based software engineer, specialising in writing software stacks for industrial communications was also sought to help define the requirements to implement the software solution. Documentation review of the Modbus protocol, serial ports, microcontrollers and software testing methodologies was also explored. After completing this research, a software and hardware solution was engineered.

4. Key Outcomes

A hardware and software solution has been successfully developed (Figure 1). An Arduino Mega as the microcontroller using both physical serial interfaces RS-232 and RS-485. A software implementation for a Modbus Master and a different implementation for a Modbus Slave has been tested. A basic interface using a 3x4 membrane keypad with a 16x2 LCD display is complete with an enhanced interface using a 4x4 keypad and 128x64 display anticipated in the near future.

5. Further Work

User manual documentation is still to be produced at the time of writing. Time permitting, selecting an off the shelf or designing and 3D printing an ergonomic hand held case to house the hardware.

6. Conclusions

The key conclusion is the concept of using the Arduino microcontroller platform as a Modbus simulator for testing is feasible and the final solution will fulfil the requirements of the specification.

Acknowledgements

References

Modbus Organisation, Inc. (2006), 'MODBUS over Serial Line: Specification & Implementation Guide'.

Modbus Organisation, Inc. (2012), 'MODBUS Application Protocol Specification'.

Investigating Poultry Manure for sequestration of nutrients carbon and energy recovery

School of Mechanical and Electrical Engineering

Student name: Akash Raju Bejjam

Degree: Master of Engineering science (Mechanical)

Supervisor: Mr. Andreas Helwig, Lecturer, USQ

Co-supervisor: Assoc/Prof Thomas Banhazi, NCEA, USQ

Keywords: Poultry Manure, Sequestration, Nutrients, pyrolysis, Energy recovery

Introduction

Renewable energy resources that have a neutral carbon footprint have become an area of investigation. In this light, animal waste in Australia should be seen as a resource. In the agricultural poultry industry, one of the main considerations is poultry manure of egg-laying birds and free range birds' litter and manure. Arikan et.al, (2016) Large quantities of these waste by-products are produced by the poultry Industry. One area that requires further investigation is the trace elements, which when processed through gasification for the production energy, results in a biochar which may concentrate these trace elements.

1. Background

The main objective of this project is to recover energy from poultry manure. This is based on the poultry manure's various chemical carbon based components. Besides the energy, the waste contents could produce an agriculturally useful pathogen free biochar. In this manner, the biochar could be also used to sequester some of the carbon from the manure to also produce a useful carbon sink.

2. Methodology

Both of the poultry manure waste streams will be tested for the chemical content, and especially any heavy metals, or toxins present in the manure. Secondly, both the manures will undergo pyrolysis process in order to produce syngas. Taupe et.al, (2016) Thirdly, the different types of gases, which are present in syngas will be assayed and the carbon-based and hydrogen gas content analysed to estimate the thermal value.

3. Key Outcomes

The outcomes sort are a model for the investigation of both the poultry manures, of how much potential thermal energy capacity is recoverable. Huang et.al, (2015) The investigation will also establish how the feed input impacts the usefulness of the resulting biochar by-product.

4. Further Work

Currently the literature search is underway to gather existing data from China, where investigations are ongoing into the use of poultry waste. This will determine the investigation parameters.

Conclusions

The final analysis will provide additional insight about:

- Poultry waste streams as energy resources
- Whether agriculturally useful biochar can be produced
- How poultry feed impacts the biochar
- How much carbon can be potentially sequested from poultry manure.

Acknowledgements

References

Arikan et.al, 2016, 'The effect of composting on the persistence of four ionospheres in diary manure and poultry litter', Journal of waste management, Vol.03, no.03, pp.110-117.

Huang et.al, 2015, 'Biochar and renewable energy generation from poultry litter waste: A technical and economic analysis based on computational simulations', *Journal of Applied energy*, Vol.61, no.03, pp.656-663.

Taupe et.al, 2016, 'Updraft gasification of poultry litter at farm scale-A case study', Journal of waste management, Vol.03, no.03, pp.324-333.

STABILITY ANALYSIS OF SHALLOW UNDRAINED TUNNEL HEADING USING FINITE ELEMENT LIMIT ANALYSIS

Sponsor - School of Civil Engineering and Surveying

Alex Bell

Bachelor of Engineering

(Honours) (Civil)

Supervisor: Dr Jim Shiau, USQ

Keywords: Tunnel, Heading, Stability

1. Introduction

This research project is focused on analysing the stability of shallow tunnel heading excavations in an undrained soil medium with special attention being given to the blow-out effect, or the failure caused by an internal tunnel pressure.

2. Background

With increasing demand on existing above ground transport infrastructure the need for alternatives such as tunnels is necessary. Tunnels can be constructed to serve numerous purposes and are considered to be one of the most complex geotechnical engineering challenges. The stability of a tunnel face can be described by a factor of safety, with possible failure caused by either an inward (collapse) or outward (blow-out) mechanism.

3. Methodology

A two-dimensional plane strain analysis was conducted using the finite element limit analysis (FELA) software, Optum G2. A number of key parameters, including the depth ratio, strength ratio and pressure ratio, were varied to assess a broad range of situations. The failure mechanism in each scenario was determined and the relationship between the factor of safety and the failure mechanism was further investigated. A number of design charts, used to assist in the early stages of tunnel heading design, were developed.

4. Key Outcomes

Generally tunnel stability literature is focused on the collapse failure mechanism. This research has further investigated and outlined the importance of analysing both collapse and blow-out failure mechanisms when considering tunnel heading stability. Design charts, as developed in this project and presented in figure 1, are a useful tool for practicing engineers in the preliminary stages of tunnel design.
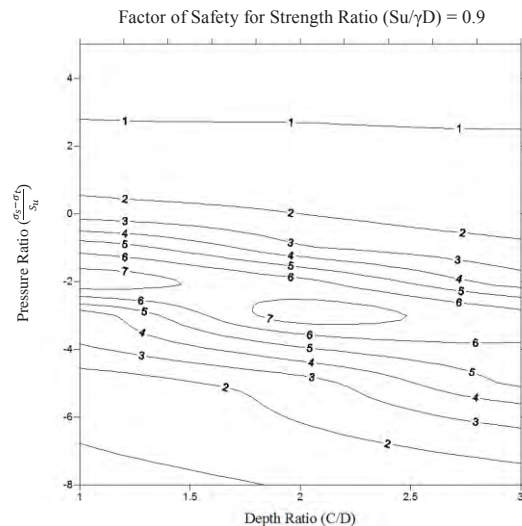
Figure 1: Example tunnel heading stability design chart.

5. Further Work

The exact behaviour of the pressure ratio/factor of safety relationship and corresponding failure mechanism is unknown at its maximum point and would be interesting to investigate further.

6. Conclusions

Due to the nature of the relationship between the pressure ratio and the factor of safety this research shows that it is necessary to consider the blow-out failure mechanism when designing a shallow tunnel in an undrained soil medium.

Acknowledgements

References

Asadi, A. & Sloan, S., 1991. Undrained Stability of Shallow Square Tunnel. *Journal of Geotechnical Engineering,* Volume 117, pp. 1152-1173.

Broms, B. & Bennermark, H., 1967. Stability of Clay at Vertical Openings. *Journal of the Soil Mechanic and Foundations Division, Proceedings of the American Society of Civil Engineers,* Volume 93, pp. 71-93.

Taylor, D., 1937. Stability of earth slopes. *Journal of the Boston Society of Civil Engineers,* 24(3), pp. 197-246.
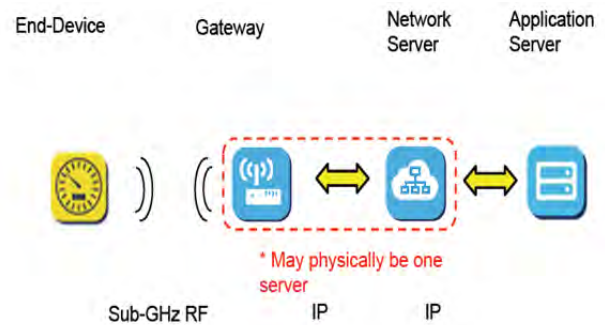
Power Utility Remote Device Communications using a low power wide area network (LPWAN) based on the LoRa communications standard.

Sponsor – School of Mechanical and Electrical Engineering

Kurt Beutel

Bachelor of Engineering
(Electrical and Electronics)

Supervisors: Mr Mark Phythian, USQ

Keywords: Research, Design & Configure

1. Introduction

With the ever growing rate of the internet of things the following project is to look into possible opportunity's to use this technology in an electrical distribution industry to see if it is able to provide benefit to the network. The project will research the newly growing Lora (Long Range) standard and look to design and configure a Low power wide area network. Electricity distributors face reduced operating budgets and Lorawan may provide a low cost opportunity to provide more data and knowledge of the working network.

2. Methodology

To complete this project there were certain tasks that were required. Initially research was undertaken into the Lora communication standard, possible devices that could be used and any particular Australian requirements. Design of a test system was then undertaken by which sourcing of equipment was required. Once equipment was sourced programming and more research was required to simulate a possible real life situation. Figure 1 shows the basic Lorawan setup that I will be configuring with one end device and one gateway only.

3. Key Outcomes

The key outcomes from this project are to successfully identify possible gateways/end devices that can be used in the Australian unlicensed spectrum. In doing this see if that technology has a place in the electrical distribution industry and possible uses for the technology. Some of the key outcomes so far are initially getting a test system working and then using this system to simulate a real situation.

Figure 1 – Lora Architecture

4. Further Work

Tasks to be completed are to try and send serial data to a network server over the test platform. The project only has an on-board network server in the gateway with no packet forwarder option. Hoping to achieve this by possibly using a PC network server rather than the one on board on the gateway.

5. Conclusions

Current achievements from this project is knowledge of Lora standard and its possible application into the electrical industry. The project has achieved the configuration of a Lora test network and communications between the end node device to a network server/gateway. The Lora technology is ever growing and devices are changing regularly with different firmware and end node applications. During this project many Lora products are still in development that in future would be able to achieve a more desired result. There is the possibility that new products will have a Lora chip standard like Bluetooth.

Acknowledgements

References

Semtech, 2015, *AN1200.22 Lora Modulation Basics.*
Lora-Alliance, 2015, (*Lora Specification V1.0*)
MicroChip, 2015, (*Lorawan 101 Class Presentation)*

VIDEO PROCESSING ROAD SAFETY SYSTEM

Sponsor - School of Mechanical and Electrical Engineering

Russell Johnsen Birkett

Bachelor of Engineering (Mechanical)

Supervisors: Dr Tobias Low, USQ

Keywords: Video Processing, Gaussian Mixture Model, Morphographical Filters, Pedestrian Tracking, Kalman Filter

1. Introduction

The need for tracking and trajectory prediction of dynamic objects is one that applies itself to a very broad range of situations and solutions. The ability to successfully plan and record the movements of pedestrians is becoming an extremely relevant technique in road safety. Simply detection of the amount of pedestrian traffic through a road way could be easily used in the decision making and implementation of safer road networks.

The current technologies available for application in this environment are near endless with many different methods each with their own individual characteristics. This is where the extreme diversity in different algorithms for not only background subtraction and entity tracking come into play with many of these being interchangeable giving a range of different strength and weaknesses for each combination. This is the goal of this project; to analysis the current technologies and create a working prototype that can be applied to road safety.

2. Background

The need for tracking and trajectory prediction of dynamic objects is one that applies itself to a very broad range of situations and solutions. The ability to successfully plan and record the movements of pedestrians is becoming an extremely relevant technique in road safety. With the advancements of extremely cost effective and quality cameras the applications of this technology to new areas is possible.

3. Methodology

The goal of this project would be to develop a working system that can detect, track and warn cars of incoming obstacles. This system in concept is very achievable with many of the technologies already being applied in various different industries. The project is heavily focused around the analysis and comparison of already tested algorithms and tracking techniques that will be utilized in a concept prototype. This prototype will in turn be analysed against a range of different situations and compared again to existing systems.
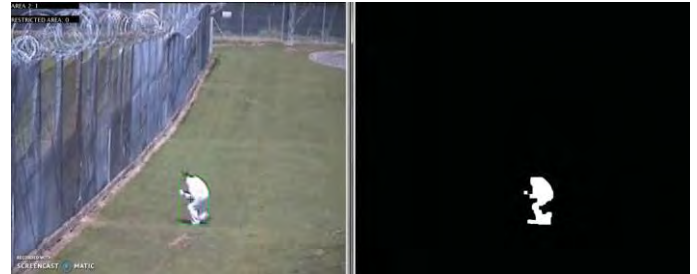

Figure 1: Tracking pedestrian

4. Key Outcomes

The most important outcome of this project is to develop a working prototype that can be tested against current systems. This prototype must show how each of the selected methods and algorithms improved the design through comparison and testing.

5. Further Work

The further applications of a system in which detections, counting and tracking can be applied are enormous. The surveillance applications are extensive having a simple system to detect when people enter undesired locations or apply to basic counting of pedestrians walking down a path. This information could then be utilized in a myriad of ways in crowd analytic and further research.

6. Conclusions

The implication of creating a working model would be extremely beneficial in accelerating and furthering the research and development of safety systems. The current technology is on the verge of being applicable to huge different areas and situations all with their own specific needed and environments. The hopeful conclusion of this project is to create a prototype that highlights that these capabilities are on the verge of mass application.

References

MathWorks. (2016). *Detecting Cars Using Gaussian Mixture Models.* Retrieved August 12, 2015, from MathWorks.com: http://au.mathworks.com/help/vision/examples/detecting-cars-using-gaussian-mixture-models.html

Maragos, P. (2005). Morphological filtering for Image and Feature Detection. *The Image and Video Processing Handbook 2nd Edition*, 135-156.

Fuhr, G. (2012). Robust Patch-Based Pedestrian Tracking using. *Institute of Informatics*, 1- 12.

Benezeth, Y., Jodoin, P.-M., Emile, B., & Laurent, H. (2012). Comparative study of background subtraction. *Journal of Electronic Imaging*, 2-4.

A Data Transfer Rate Focused Design Approach for RTS-based Tele-Operated Robots in High Latency Environments

School of Mechanical and Electrical Engineering

Fraser Border

Bachelor of Engineering (Honours) (Mechanical Engineering)

Figure 1 – Prototype System Hardware Assembly

Supervisors: Dr Tobias Low, USQ

Keywords: Real-time, Navigation, RTS-based

1. Introduction

Tele-operated robots are used in environments that are unfit for humans due to the capability of human intuition to address environmental complexities such as navigation. A user-interface between the user and robot provides the user with the data to ensure situational awareness can be attained which is required to ensure intuition can be applied. This paper focuses on improving the particular map-centric real-time strategy-based (RTS-based) navigational system by exploring how to improve robustness within environments of low connection bandwidth.

2. Background

Within literature there has been a significant focus on the development of the user-interface assuming that the environment will always provide adequate bandwidth to sustain the required data transfer rate (DTR) of the system. This is a very over-simplified assumption that is seldom seen in various tele-operated robot situations. This paper hopes improve these systems by: re-evaluating the conventional design approach of RTS-based systems to include the consideration of data transfer rate as well as further explore various techniques that may be incorporated within such a design approach.

3. Methodology

In order to re-evaluate the current conventional design approach the methodology of developing various RTS-based systems was investigated. After identifying that this design approach was based upon a quite unrealistic environmental expectation it was identified that the DTR of the system needed to also be considered within the design approach. Thus, not only was this considered a focus in this paper when developing a prototype navigational RTS-based system but various techniques were employed and evaluated in regards to the environmental interpretability to the user. Much of this prototyping was applied through Matlab programming which is then to be tested both qualitatively and quantitatively by the developer and by other users. The hardware assembly of the system is shown in Figure 1.

4. Key Outcomes

A prototype is currently being developed to test and evaluate its ability of both reducing data transfer rate whilst still providing the user with situational awareness.

5. Further Work

As this project is quite limited with time constraints much work remains for further investigation into both whether considering the system's DTR is important within the design approach and what other techniques may be employed to minimise a system's data transfer rate requirements.

6. Conclusions

This project will indicate whether highlight a potential new design approach for these systems and suggest whether there is merit in further investigating techniques to reduce systems' required DTR.

Acknowledgements

References

Poli, L. (2013). *User Interface for a Group of Mobile Robots,*

UAVs IN PIPELINE DESIGN AND REHABILITATION OF CONSTRUCTION CORRIDORS

School of Civil Engineering and Surveying

Anton Breinl

Bachelor of Spatial Science (Honours)

Supervisor: Ms Zahra Gharineiat, USQ

Figure 1 – Trimble UX5 HP UAV System

Keywords: UAV, Pipeline, Survey

1. Introduction

For a long time industrial pipelines have been used to transfer fluids including oil, gas or water across land between two nominated destinations. Basic construction techniques have also remained relatively unchanged apart from technological advances in project planning, project design, machinery and environmental considerations. Contemporary surveyors and engineers plan an integral role in the design and rehabilitation of pipeline construction corridors for major pipeline projects across the world. In all cases they are bound by regulations from strict regulatory authorities. With greater emphasis being placed on design and rehabilitation of construction corridors, requirements for more details information (and data to generate this information) has become prevalent.

2. Methodology

A 1km section on 25m wide construction corridor will be surveyed using two different surveying techniques. One technique used a standard GNSS RTK survey and the other the Trimble UX5 HP UAV system. Data accuracy comparisons were undertaken. Costs and efficiencies of using both methods were determined.

3. Key Outcomes

It is anticipated that data from both surveying techniques will be sufficient for the design and rehabilitation of pipeline corridors. It is also anticipated that both survey methods will continue to be employed in the pipeline industry for years to come.

4. Further Work

Remaining work for this project includes some statistscal analysis using the data sets and the final write up of the dissertation. The overall cost analysis is also yet to be completed.

5. Conclusions

Both UAVs and GNSS RTK methodologies have an ongoing role in pipeline design and rehabilitation.

It was noted that UAVs have the ability to collect a more complete and comprehensive data set than RTK surveys.

Another key conclusion is that UAVs collect data more efficiently whilst minimising the need to physically access sometimes sensitive and potentially dangerous areas.

Acknowledgements

References

Carvajal, F., Aguera, F., Perez, M. (2011). *Surveying a landslide in a road embankment using unmanned aerial vehicle photogrammetry.* UAV Conference, Zurich, Switzerland.

Rathlev, F., Meyer, B., Juerss, S. (2012). Innovative technologies for aerial survey of gas pipes. *Gas for Energy, 1,* 1-5. Retrieved from https://www.microdrones.com/fileadmin/web/PDF/Referenzen/veroeffentlichungen/gas4energy-thyssengas-microdrones_01.pdf

Use of Recycled Concrete and Lime to Improve Marginal Subgrades in the Toowoomba Regional Council

Toowoomba Regional Council

Matthew Brennan

Bachelor of Engineering (Honours)

(Civil)

Supervisors: Dr Andreas Nataatmadja, USQ

Mr Angelo Casagrande,
Toowoomba Regional Council

Keywords: Practical, Intuitive and Interesting

1. Introduction

Toowoomba Regional council (TRC) is responsible for maintaining the road network within its boundaries. Of the 9650 km 3330 is sealed pavement. Most importantly for pavement design is the quality of the foundation/host soil (Subgrade), of which the pavement will be constructed upon. Pavement thickness is determined directly from the subgrade strength in terms of California bearing ratio (CBR). High strength subgrades (CBR>5) can significantly reduce construction/maintenance cost in comparison to a marginal subgrade (CBR<5). Chemical stabilization with Lime can be used to improve the load bearing qualities of marginal subgrades. Mechanical stabilization (i.e. blending of materials) can also be used to compensate shortcomings in the host soils characteristics. This is mostly achieved by redefining the particle size distribution of the host material, providing better particle interlock. This project looks at the use of lime and recycled concrete aggregate (RCA) to improve marginal subgrades and the effect on cost.

2. Background

With a set budget each financial year, council aims to construct and maintain road pavements as efficiently and in the most cost effective way, to ensure satisfactory pavement performance. Cost effective alternatives are important to achieve this goal. Lime treatment in the civil engineering discipline is not new technology; however its use with recycled concrete aggregate has not been researched. Lime treatment alone is not common practise in TRC; the results of this project will add to Council knowledge and may promote more lime treatment to be used as an alternative solution.

3. Methodology

Quantitative research methodology was utilized to explore the effect of various lime and RCA contents on two host subgrade materials. The subgrade materials were sampled from Mann Silo Road and Hinz Street, both within TRC Borders. In preparation of the paper, many hours of laboratory testing and preparation was conducted on the samples. This involved site sampling of subgrade from the two roads, Initial testing/characterisation, treatment with lime and RCA, curing, final testing and results/cost analysis. Some Pavement redesigns using empirical design charts was conducted for the host roads. In addition to this a cost analysis with council unit rates was also preformed to consider the application of RCA/Lime treatment as a viable alternative.

4. Key Outcomes

Background literature in regards to lime treatment has been thoroughly examined, along with current industry standards and manuals. Initial testing of the host materials shows that they are in acceptable ranges for lime treatment. It is expected that adding RCA will yield strength gains. However, the additional cost of incorporating RCA may make it a cost prohibitive. Parallel with literature, it's found that lime increases soil strength and can reduce construction costs. These outcomes were achieved by applying standard soil testing and cost analysis/estimation technique currently used by local government council.

5. Further Work

RCA blend results are yet to be tested and analysed.

6. Conclusions

Lime treatment of marginal subgrade is a viable alternate for construction and maintenance of roads. It can return cost savings in construction and maintenance operations. Effect of lime content on in situ moisture content is also a valuable finding, In addition to this, the effect of RCA is also significant finding. This paper does not aim to solve any major issue but aims to express to council the viability of lime treatment.

Acknowledgements

Evaluation of Issues for Small and Medium-Sized Enterprises in the use of Advanced Engineering Materials

School of Civil Engineering and Surveying

Chris Brookes

Bachelor of Construction (Honours)
(Management)

Figure 1 - Sample Diagram

Supervisors: Assoc/Prof David Thorpe, USQ

Keywords: Small and Medium-Sized Enterprises, Advanced Engineering Materials, residential

1. Introduction

There is an ongoing debate that humans need to exist more sustainably if we are to reduce our carbon footprint and preserve our landscape and resources for future generations. A greener existence in theory is a magical thing, however; the challenges that it poses in its tangible construction existence proves that more work is needed.

2. Background

The use of advanced and green engineering materials (AGEMs) is not a new concept, it has been around as long as man has built and constructed. This report will discuss how AGEMs are utilised today, and the limitations that small and medium sized enterprises (SMEs) are faced with when considering the use of AGEMs.

3. Methodology

AGEMs have been identified and are specific to this project. The analysis of the chosen AGEMs provide a general evaluation of the issues for SMEs, however this same research and survey methodology can be applied to any AGEM if necessary. AGEMs have been chosen on the following basis:

1) Data sources available for materials
2) Common AGEMs currently used on any scale

4. Key Outcomes

This is the key section of your abstract that highlights your achievements and your work. Ideally this includes some of the tasks you have identified in the project specifications. What are the key outcomes that you have achieved so far? Why are they interesting and/or unique? How did you apply your methodology to achieve these outcomes?

5. Further Work

6. Conclusions

7. Acknowledgements

I would like to thank Dr David Thorpe for his assistance.

I would like to thank my family for always supporting me.

Most of all, I would like to thank my wife.

8. References

A comparison between terrestrial laser scanning and terrestrial photogrammetry

Sponsor - School of Civil Engineering and Surveying

Lachlan Broome

Bachelor of Spatial Science (Surveying)

Supervisor: Dr Albert Chong Staff Member, USQ

Keywords: Remote sensing, Laser scanning, Photogrammetry

1.   Introduction

Remote sensing has been around since the concept was first theorised by Leonardo da Vinci in 1480. Today due to advancements in technology and computing power it is now more accessible than ever to conduct a survey on a grand scale measuring millions of points in minutes using a variety of techniques. This research project aims to evaluate and compare two remote sensing techniques known as terrestrial laser scanning and photogrammetry.

2.   Background

Surveying is an integral part of any development and as technologies advance more information is expected out of a survey. Photogrammetry and laser scanning are two technologies that are proving invaluable for fast and accurate data collection.

In the author's research a lot of information was found on individual techniques, however very limited information was found that compared these two technologies together. This research paper is being conducted to help bridge the informational gap between the two technologies and serve as a decision making tool for surveyors to choose which technique will best suite an individual project's needs.

3.   Methodology

The methodology employed for this research project involved conducting two real world survey scenarios using both techniques. Scenario one was an asbuilt survey conducted on a secant pile wall in an excavation while scenario two was conducted on a façade elevation on an office building. The data was then processed and compared using free open source software known as cloud compare.

4.   Key Outcomes

The research projects key outcome is to bridge the information gap between the two techniques and provide a cost benefit analysis to help assist surveyors to select a remote sensing technique that best suits the needs of the project to be undertaken.

5.   Further Work

This project focusses on terrestrial sensing, a combination of terrestrial and aerial remoting sensing may be considered. Further work could also be undertaking to test videography remote sensing.

6.   Conclusions

When done correctly both techniques have proven to be as successful as each other in the test scenarios. The project will serve as a how too guide for surveyors conducting remote sensing surveys and aid in the selection of technique for the project at hand.

Acknowledgements

References

Luhmann, Fraser, & Maas. (2016). Sensor modelling and camera calibration for close range photogrammetry. *ISPRS Journal of photogrammetry and remote sensing vol 115*, 37-46.

Soni, A., Robson, S., & Gleeson, B. (2015). Structural monitory for the rail industry using conventional surveying, laser scanning and photogrammetry. *Appl Goemat*, 123-138.

Thiel, & Wehr. (2012). Performance capabilities of laser scanners - An overview and measurment principle analisis. *International archives of photogrammetry, remote sensing and spatial information sciences Vol.XXXVI*, 8/W2.

Automated Shark Detection using Computer Vision

Sponsor - School of Mechanical and Electrical Engineering

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Bachelor of Engineering
(Honours) Mechatronics

Supervisor: Dr Tobias Low, USQ

Keywords: Computer Vision, Object Detection, Morphology

1. Introduction

Computer vision is becoming steadily more feasible with advances in object recognition and classification algorithms. With the combination of analysis of colour models, morphology and training data sets, objects of interest can be identified and tracked for security purposes.

2. Background

Shark attacks have been on the rise in recent years which have left many families with tragic losses. To ensure the safety of swimmers state governments have put in place shark safety programs such as nets, drum lines and the culling of sharks. Unfortunately, large numbers of sharks as well as other sea life are being killed in an effort that doesn't even guarantee the safety of swimmers. This project investigates the possibility of a shark detection system to be deployed in drones for real-time processing using post-processing in MATLAB.

3. Methodology

Data collection was conducted by searching for aerial footage of sharks on the internet. With the few videos obtained, colour space models were constructed for RGB and HSV to identify consistent trends in the data. The 'Value' (also known as brightness) from the HSV colour space proved to be a consistent value for the pixels associated with sharks. An adaptive threshold was created to identify the 'peaks' from a histogram representation which set all the pixels in the frame to 0 when the derivative of 'Value' pixels exceeded a predetermined value. The 'peaks' can be easily identified in the 3D surface model in Figure 1.
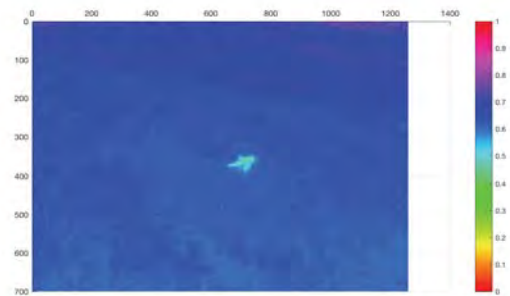
Figure 1: Birdseye view of the 'Value' matrix

4. Key Outcomes

After identifying the peaks in the 'Value' matrix, blob analysis was performed to remove noise in the data and further thresholding was performed to remove false positives. All identified blobs were saved to an external folder to be used in a training data set.

5. Further Work

The identified blobs have to be sorted into positive and negative directories as some false positives such as surfers and shadows were detected. These images will then be used to create a cascade object detector using HOG features to help reduce false positives.

6. Conclusions

Once the object detector has been created conclusions will be drawn on the success rate of the shark detector.

Acknowledgements

References

Computer Vision System Toolbox, (2014), MathWorks Retrieved 5 January 2016, from https://au.mathworks.com/store/link/products/40281558?

MathWorks (2016), 'Detecting a Cell Using Image Segmentation', http://au.mathworks.com/help/images/examples/detecting-a-cell-using-image-segmentation.html, Accessed 24 May 2016

Robbins, W. D., Peddemors, V. M., Kennelly, S. J. & Ives, M. C. (2014), 'Experimental Evaluation of Shark Detection Rates by Aerial Observers', PLoS ONE 9(2).

Analysis of Wall Formwork in the Australian Multi-storey Construction Industry

Sponsor – School of Civil Engineering and Surveying

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Bachelor of Engineering (Civil)

Supervisors:

Dr Sourish Banerjee

Figure 1 – 44 Storey 1 William St Project Brisbane

Keywords: High-rise, Construction, Formwork.

1. Introduction

The primary objectives of this study are to

- Research and evaluate the relevant Australian standards and regulations for vertical wall formwork

- Evaluate and analyse the wall formwork used in the Australian high-rise construction industry.

The primary objectives are established to expand the general understanding of vertical wall formwork use within the Australian high-rise construction industry, as well as the associated regulations.

2. Background

Concrete formwork is a temporary structure used on construction projects. Formwork provides temporary support to freshly cast concrete until the concrete cures enough so that the imposed loads can be carried by the concrete structure itself. Formwork is basically a mould for concrete. Formwork can either be incorporated as a permanent part of the design or be removed after the concrete has reached a desired strength. Formwork can represent up to 60 percent of the overall cost of the concrete structure. Savings can be achieved through the continual reuse of the formwork throughout the construction of a project.

Methodology

A research case study of 77 Australian high-rise construction sites was deemed the most suitable initial method for gathering data for this study. A combination of research and consultation with representatives from building and formwork contractors involved in the respective construction projects was employed to gather said data. Limit State Analysis and Finite Element Analysis was then used to evaluate the structural capacity of some the types of wall formwork identified as being used in the high-rise construction industry.

3. Key Outcomes

The project case study was very useful in obtaining information pertaining to formwork use as well as identifying a specific range of concrete pressures that wall formwork is subjected to in high-rise construction. Because wall formwork systems are predominately pre-engineered and prefabricated for re-use over and over again, this data is particularly useful for formwork designers.

4. Conclusions

There is currently a gap in appropriate literature for formwork designers in the Australian formwork industry. It is hoped that the outputs of this study can serve as a guide to help cover this gap in regards to vertical wall formwork

References

Hurd, M. (2005). Formwork for Concrete, Seventh Edition. Michigan: American Concrete Institute.

Standards Australia. (1995). AS3610 Formwork for Concrete. Sydney: Standards Australia.

McAdam, P. (1991). Plywood in Concrete Formwork. Plywood Association of Australia.

Terrestrial Laser Scan of As-Built Construction of West Creek

Sponsor - School of Civil Engineering and Surveying

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Bachelor of Spatial Science (Surveying)

Supervisors: Dr Zhenyu Zhang, USQ

Keywords: Terrestrial Laser Scanning, accuracy

1. Introduction

With the introduction and development of Terrestrial Laser Scanning (TLS), some surveying techniques have utilised the ability for vast amounts of information collection. The focus for this project is the use of TLS in an as-built survey, and verifying the accuracy against traditional methods, GNSS in this instance.

The study Area that has been chosen for this project is a section of West Creek, located in the centre of Toowoomba. Recently, a project was undertaken to increase the depth and width of the channel, in order to increase capacity and drainage in high rainfall events.

2. Background

With the introduction of TLS, surveyors have the capability to create models of the built environment with incredible detail. However, real world accuracies are still uncertain, and must be tested to ensure the capabilities of the TLS as a viable surveying instrument.

3. Methodology

The first step that was undertaken was to establish a number of control points throughout the project area. These would be used as stations for the TLS, as well as base stations for the GNSS survey. Using the established co-ordinates of the points, a TLS survey was completed. Finally, a GPS survey was also done of the same area.

Using Scene, a dedicated program for processing TLS data, the scans were registered. After the registration is complete the scans are imported into Maptek i-sight Studio to create the model.

4. Key Outcomes

Initial investigations have indicated that due to the inherent designs of both GNSS and TLS there are some differences in results of the two surveys. These differences appear to be consistent throughout the entire project area.
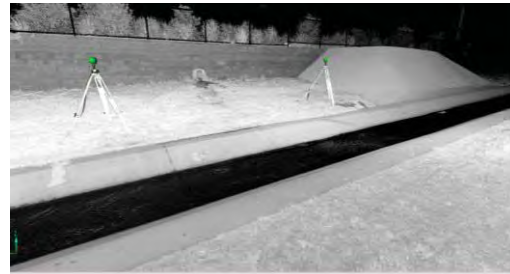
Figure 1 – Laser Scan Data in Scene Software

5. Further Work

Further detailed analysis is needed to investigate the cause of the inaccuracies, as well as investigate any further anomalies that are encountered in the data.

6. Conclusions

It is expected that the project will draw conclusions as to the reason and severity of the difference in results, and indicate the suitability for TLS in similar projects in the future

Acknowledgements

References

California Department of Transportation. (2011). *Terrestrial Laser Scanning Specificatons.* Retrieved from California Department of Transportation: http://www.dot.ca.gov/hq/row/landsurveys/SurveysManual/15_Surveys.pdf

Odlow. (2009). *Introduction to Terrestrial Laser Scanning.* Retrieved from University of Technology Dallas: http://www.utdallas.edu/research/interface/Resources/GSA%20National%202009/Oldow_TLS-Basics.pdf

San José Alonso, J. M. (2011). Comparing Time Of-Fligth and Pase Shift. I*International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 377.

Investigation of Road Wearing Surface Systems for Glue Laminated Softwood Timber Bridge Decks and Bond Strength Testing.

Sponsor – Hyne Timber

Rebecca Cherry

Bachelor of Engineering (Honours) (Civil)

Supervisors: Prof Karu Karunasena, USQ

Dr Andreas Nataatmadja, USQ

Geoff Stringer, Hyne Timber

Tony Dakin, Hyne Timber

Keywords: Road wearing surface system, glue laminated softwood timber bridge deck.

1. Introduction

Advances in engineered timber has provided products with desirable attributes that meet the needs of many applications, however with these new products comes new challenges of their own to be overcome. Modular glue laminated softwood timber bridge decking is one such product, and its need is a suitable road wearing surface system. This research identifies, investigates, tests and compares such systems.

2. Background

Glue laminated timber is not new to timber bridge decking, however the application is usually transverse planking overlain with asphalt for which reflective cracking is the dominant concern. The system used in this project is a continuous modular deck for which delamination and bond strength are the main concerns. Also, asphalt is not accommodating to factory fitment desirable for modular systems and therefore alternative options need to be considered for which very limited research in timber bridge applications were found.

3. Methodology

The approach taken was to conduct a literature review

- to identify failure modes of road wearing surface systems to help find a focus for testing and establish a suitable testing regime to suit the timber substrate under low volume traffic conditions.

- to investigate road wearing surface systems and identify the 4 best theoretical options (figure 1) for testing by matching their attributes to the needs of the stakeholders and the bridge deck.

Each product will be put through a cyclic delamination process and inspected for delamination. Shear block and pull off bond strength tests will be conducted on dry, wet and delaminated samples. Results will be analysed to

Figure 1 – The Applied Products Ready for Testing

identify performance changes under the three conditions as well as to compare the systems against each other.

4. Key Outcomes

Key outcomes include identification of road wearing surface systems for modular glue laminated softwood bridge decking in low volume traffic situations, compilation of a suitable testing regime for delamination and bond strength to timber substrate under Australian conditions, analysis and comparisons of these systems.

5. Further Work

Opportunities for further work include variations of deck preparation, further testing such as full scale tyre test or freeze thaw cycles. Also variations of bituminous seal and primer design, and the requirement of primer.

6. Conclusions

An epoxy, epoxy modified resin, polyaspartic and poly-urethane have been included for testing. Cyclic delamination, shear block and pull off tests have been selected. However as testing is not yet complete, the full conclusions to the project are not yet realised.

Acknowledgements

References

Aboutaha, R (2002). *Investigation of Durability of Wearing surfaces for FRP Bridge Decks*.

Frosch, R Kreger, M, & Strandquist, B (2013) *Implementation of Performance-Based Bridge Deck Protective Systems*. Retrieved 25 February 2016

Ritter, M (1990). *Timber Bridges: Design, Construction, Inspection and Maintenance*. Washington DC Retrieved 20 October 2015.

Modelling and analysis of multi-junction photovoltaic cells for conversion efficiency improvement

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Supervisors: Dr Narottam Das, USQ

Figure 1 – Simulation of triple lays MJSC in Simulink

Keywords: Multi-junction solar cell, double diode model, MPPT, GaAs, Matlab/Simulink, conversion efficiency

1.   Introduction

This project objects to model and analyse multi-junction photovoltaic cells to improve conversion efficiency of GaAs type solar panel. Matlab/Simulink tool is used to simulate models of solar cell. From the simulation results, it was found that the double diode model is more accurate than the single diode model. Hence, the double diode model is used to simulate multi-junction solar cells. And multi-junction solar cell (MJSC) is investigated to obtain its maximum performance compare to the conventional silicon solar cell. MATLAB/Simulink modelled results show that MJSC cell can provide almost triple maximum power compared to silicon solar cells. Maximum power point tracker (MPPT) has also been performed to improve the conversion efficiency of the PV systems. The MPPT is able to assist the PV cells to attain more power efficiently and deliver electricity to the grid. Consequently, MJSC power generation increases considerably and the conversion efficiency increases of the PV systems.

2.   Background

Solar cell is a popular sustainable energy generator that is able to convert the sun-light as renewable energy into DC current. With the assistance of solar cell, there is a high possibility of decrement in demand on fossil fuels as energy sources. However, the performance of silicon solar cells these days are still far from the satisfaction. In recent years, new tandem solar cell is widely used in high technique applications such as satellite and aircraft because of its higher conversion efficiency. It is expected to be the best device for converting solar energy into electricity.

3.   Methodology

In the modelling, Matalb/Simulink helps to setup double diode model of MJSC and compares it to single diode model in theory. By analysis of the conversion efficiency, MPPT method is used to seek an optimum in adjustment of factors affecting solar cell.

4.   Key Outcomes

Double diode model is considered as a better simulation of real condition of solar cell. And MJSC has been approved to be improved by adjustment of affected factors such as junction materials, fabrication and working temperature. Apparently, MJSC could be operated in an optimistic high conversion efficiency.

5.   Further Work

In next steps, optimization of thermoelectric generator will be designed by basing on the previous results of tandem cells.

6.   Conclusions

MJSC will be the bright future in the renewable energy industry.

References

Babar, M etc. 2014, *Analytical Model of Multi-junction Solar Cell*, Arabian Journal for Science and Engineering, Vol. 39, No. 1, pp. 547-555.

Burnett, B 2002 *The basic physics and design of iii–v multijunction solar cells*, National Renewable Energy Laboratory, Washington, D.C.

Das, N & Islam, S 2013, *Photovoltaic cell modeling for maximum power point tracking using MATLAB/Simulink to improve the conversion efficiency*, 2013 IEEE Power and Energy Society General Meeting, Vancouver, British Columbia, Canada, pp.21-25.

Investigation of Scour Mitigation Methods for Critical Road Structures

Sponsor – School of Civil Engineering and Surveying

Peggy Chou Pei-Chen

Bachelor of Engineering (Honours)
(Civil)

Supervisors: Dr Weena Lokuge, USQ

Dr Buddhi Wahalathantri, USQ

Keywords: HEC-RAS, scour mitigation, flood loads

1. Introduction

After the devastating results of the 2010-11 Queensland floods, the need to improve the scour resistance of critical road structures have greatly increased. This project seeks to identify and analyse possible solutions to reduce and minimise soil erosion on critical road structures. Additionally, the software HEC-RAS will be used to analyse and make comparisons of the chosen method. This analysis will determine whether the selected solution is appropriate for practical implementation.

2. Background

The wet season during December 2010 and early January 2011 triggered significant flooding throughout Queensland, resulting in the declaration of 78% of the state as a disaster zone (Queensland Government 2015). During this period, Queensland has seen one billion worth in damage, experiencing above average to highest on record for rainfall (BOM 2016). Through the significant financial and social damages, the legacy of the Queensland floods has increased awareness of flood risk management in Australia.

3. Methodology

This research project involves a thorough electronic literature review, including relevant sources such as journal articles and reports. The literature review will not be limited to scour mitigation methods of floodways, but also bridges and culverts as these systems behave similarly. Additionally, these resources will not be limited by their country of origin as the problem is universal.

After thorough investigation, a number of methods will be chosen for further analysis. The chosen analysis software is HEC-RAS, which specialises in water flow

calculation and simulations. Along with the analysed data from HEC-RAS and the literature review, a feasibility analysis will be conducted.
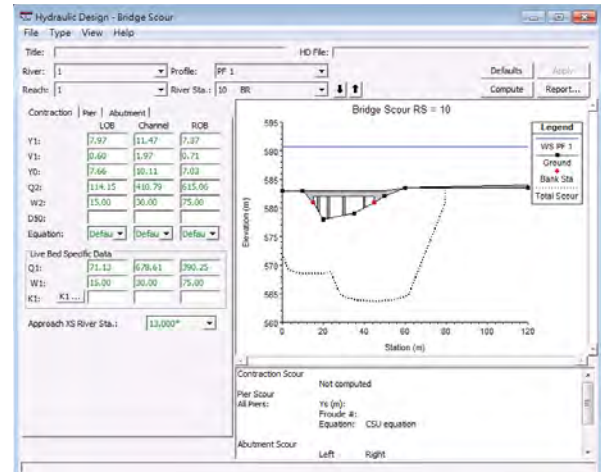
Figure 1 - HEC-RAS Bridge Scour Analysis

4. Key Outcomes

The key outcomes of the literature review and the HEC-RAS analysis are to determine an effective and efficient method for scour mitigation. It is anticipated that the HEC-RAS analysis will show scour reduction when the chosen method is applied.

5. Further Work

As HEC-RAS is a flexible and extensive software, more analysis can be completed when combining other mapping softwares such as ArcGIS, River GIS and GeoHECRAS.

6. Conclusions

The project aim will be achieved, providing evidence that the chosen scour mitigation method can be applied practically, while providing soil erosion resistance to critical road structures.

Acknowledgements

I would like to acknowledge the constant support of Dr Weena, and the guidance of Dr Buddhi Wahalathantri. Furthermore, I also appreciate the HEC-RAS support provided by Reza Shahnawaz.

References

BOM 2016, KNOWN FLOODS IN THE BRISBANE & BREMER RIVER BASIN, viewed 11 May 2016, http://www.bom.gov.au/qld/flood/fld_history/brisbane_history.shtml

Queensland Government 2015, 2010-11 Flood impacts, viewed 10 May 2016, https://www.qld.gov.au/environment/pollution/management/disasters/flood-impacts/

A Connector and System Standard for Modular Underwater Remote Vehicles

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Bachelor of Engineering (Honours)

(Mechanical Engineering)

Supervisors: Dr Andrew Maxwell, USQ

Keywords: Underwater , Rov, Connector

1. Introduction

In order to make underwater RoV's [Remotely operated Vehicles] more accessible, modularity has been determined as a potential factor limiting adoption and usability. One of the key components of working towards this goal is the connection system used between components.

2. Background

The barrier for entry into underwater exploration is currently cost prohibitive and very limited in flexibility for sensors and data capture. In order to make underwater research and exploration more accessible, underwater platforms should be able to fulfil multiple roles, this is achievable using modularity between components allowing them to be exchanged depending on the users' needs.

3. Methodology

A quantitative approach was the basis for solving this problem, using simulation programs to model the potential connector designs. The designs were evaluated to ensure they were able to meet the operating specifications.

4. Key Outcomes

The final specifications and design have been selected for a connector system that is suitable for underwater RoV systems that should maintain the specifications of low cost and ease of access and manufacturing. This should make for a system that is easy to implement, ensuring that the system is relevant to future projects.

5. Further Work

The next step for the connectors system is to build a prototype of the design and test in a real world environment and conditions. Further work into RoV modularity is needed for the electronic and control systems which would require extensive work into adaptable controls for a platform with varying physical characteristics.

6. Conclusions

A connector system has been established that is suitable for use in modular RoV's, However there is ample work to still be done to make modular RoV's feasible, the design will likely still encounter many revisions should it be considered for real world use. The system however does highlight that there is a need for further research into modular designs and that the principle of a modular RoV is justified.

Acknowledgements

Thanks to Dr Andrew Maxwell for his Guidance.

References

Christ, RD & Wernli, RL, Sr. (2007). *ROV Manual - A User Guide for Observation-Class Remotely Operated Vehicles*.: Elsevier.

Sinha, P, Stiehl, KR, Huo, ES, Oyebode, OA, Dokov, RP, Chin, SJ, Price, RE & Larson, RW (2007). 'Design of a Modular, Compact, Multi-Role Remotely Operated Vehicle for Sheltered Water Operations', in *Proceedings*, *IEEE*, pp. 1-7.

Shome, SN, Nandy, S, Pal, D, Das, SK, Vadali, SRK, Basu, J & Ghosh, S 2012, 'Development of Modular Shallow Water AUV: Issues & Trial Results', *Journal of The Institution of Engineers (India): Series C*, vol. 93, no. 3, pp. 217-228.

Operational Characteristics of Surge Arresters within High Voltage Substations

Sponsor – Essential Energy

Andrew Close

Bachelor of Engineering (Honours) (Power)

Supervisors: Associate Professor Tony Ahfock, USQ
Mr Luke Clout, Essential Energy
Mr Glen Barnes, Essential Energy

Keywords: Surge Arrester, Lightning, Substation.

1. Introduction

Overvoltages resulting from a lightning strike pose the greatest risk of damage to substation equipment reaching peak values of over 100 times the nominal line voltage within microseconds.

Through the undertaking of this detailed research project, optimum arrester location, connection methods and insulation co-ordination derived from software simulation will be compared to standard design principles utilised by Essential Energy (EE) and verified using equivalent circuit analysis.

2. Background

An investigation was conducted into EE design standards relating to modifications to surge arrester positioning within zone substations. Prior to this project, no detailed analysis of the impact that surge arrester placement has on insulation co-ordination had been completed. The project aims to identify the efficiency of surge arrester operation and the consequential effects repositioning the surge arresters may have.

3. Methodology

Two case studies were identified for detailed analysis:

1. EE Standard 66/11kV Zone Substation
2. Kywong66/11kV Zone Substation

A detailed model was created for each case study using Alternative Transients Program (ATP) and peak voltage surges recorded throughout the substation for a number of different scenarios. Results were validated against theoretical methods to ensure accuracy of the models. A mathematically derived lightning surge was developed for validations, whilst an average lightning surge was calculated using all recorded ground strikes
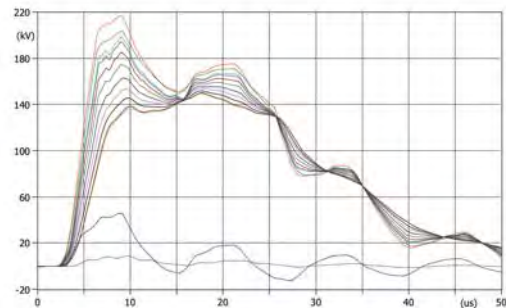
Figure 1 – Substation Equipment Surge Voltages

throughout NSW and utilised for the remaining scenarios.

4. Key Outcomes

Results for both case studies have shown that suitable insulation co-ordination is maintained across all major equipment within the substation.

5. Further Work

Research is continuing to establish suitability of alternative software to ATP for future substation insulation co-ordination studies. Additionally, a comparison between existing period contract surge arresters and alternative models is to be completed.

6. Conclusions

The ATP model provides the designer a tool to make variations to surge arrester positioning within existing designs and current templates whilst ensuring the insulation level of the equipment is not exceeded.

Acknowledgements

A sincere thank you to Associate Professor Tony Ahfock, Mr Luke Clout and Mr Glen Barnes for all their encouragement, support, guidance and time they have each kindly provided me during this project.

References

ABB High Voltage Technologies 1999, Dimensioning, testing and application of metal oxide surge arresters in medium voltage networks.

Hileman, AR 1999, Insulation coordination for power systems, Marcel Dekker, New York.

Hinrichsen, V 2012, Metal-Oxide Surge Arresters in High-Voltage Power Sytems Fundamentals, 3rd, Siemens AG

Maintenance of Timber Bridges

Sponsor –School of Civil Engineering and Surveying

Jethro Cohen

Bachelor of Engineering (Honours) (Civil)

Supervisor: Dr Weena Lokuge, USQ

Keywords: timber bridge, maintenance, structural analysis, level 2 inspection, girder, corbel, sniping.

1. Introduction

There is a significant number of timber bridges still in service in Queensland. The inspection and maintenance of these structures is a costly and time consuming undertaking. In this research, current inspection and maintenance practices will be critically reviewed and improvements will be suggested.

2. Background

There are over 300 timber bridges on QLD state controlled roads. Most of these are in poor condition. They require constant maintenance as the timber components deteriorate over time.

Detailed level 2 inspections are done as part of the Bridge Asset Management System. A significant number of the defects are due to poor practices. These practices, such as excessive sniping of girders and corbels, contribute to many bridges being rated in poor condition. This causes costs to increase due to increased inspection frequencies and rectification works.

The aim of this research is to critically review current practices and attempt to quantify the actual risk of poor maintenance practices, in particular excessive sniping.

3. Methodology

A literature review of current timber bridge inspection and maintenance practices has been undertaken to identify key issues. Inspection data from timber bridges in the Mackay-Whitsunday district has been reviewed to identify the main factors affecting condition states and risk ratings. Finally, some structural analysis has been carried out using finite element modelling in Strand7. This will help validate condition state ratings for individual components. Figure 1 shows a 3D model of an excessively sniped timber girder.
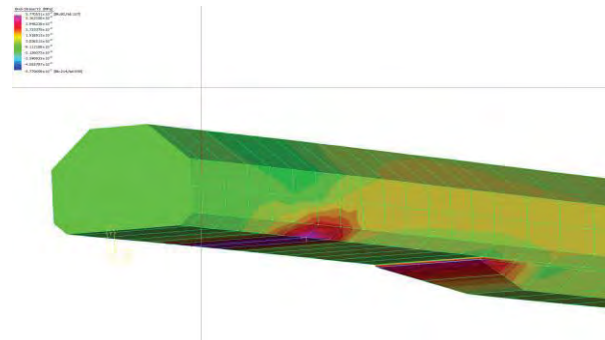
Figure 1 – Strains at snipe of octagonal timber girder

4. Key Outcomes

A review of the current state of the art for timber bridge management was undertaken. Key shortcomings in asset management were identified. Finite Element modelling allows idealised timber components to be analysed under different loading conditions. This has been used to compare the effect of snipe depth on the structural integrity of timber components.

5. Conclusions

As snipe depth increases, stress concentrations form at the snipe resulting in increased risk of splitting. This is more severe in girders than corbels, due to tensile rather than compressive strains. Require further validation through destructive testing of old components.

6. Further Work

Establish a correlation between snipe depth and condition state of timber components. Explain what impact this may have on the overall condition of a timber structure. Show how this could lead to reduced inspection costs in the future.

Acknowledgements

I'd like to thank my supervisor Weena, for her advice and support throughout the year. I'd also like to thank my employer TMR, for providing me access to the necessary resources and the time to do the research.

References

Austroads 2009, 'Part 7: Maintenance and Management of Existing Bridges', in I Hickson (ed.), *Guide to Bridge Technology* Austroads, NSW

BAM, *Timber Bridge Maintenance Manual,* 2005, TMR, Queensland, Australia

Heckroodt, RO 2002, 'Chapter 5 Deterioration of timber', in *Guide to the Deterioration and Failure of Building Materials*, Thomas Telford Cape Town, South Africa, ch 5, pp. 87-105.

Identification of the spectral signature of noxious weed St. John's wort and development of a tracking methodology via remote sensing

Matthew Collins

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Supervisors: Professor Armando Apan, USQ

Keywords: remote sensing, St. John's wort, spectral signature.

1. Introduction

This research project aims to determine the spectral signature of the declared noxious weed St. John's wort (*Hypericum perforatum*) through the application of remote sensing techniques to satellite imagery incorporating known locations. This is intended to enable stakeholders such as Landcare groups and local control authorities to monitor known locations and remotely identify new occurrences for early targeted treatment.

2. Background

The impacts of noxious weeds on both the environment and the economy place a burden on broader society. Techniques for vegetation management using remotely sensed data have been effective in a number of applications. Such applications can provide fast, low cost identification and tracking methodologies to aid management and control organisations.

3. Methodology

The project methodology commences with a literature review of applicable legislation and published works to profile noxious weeds (generally, then with specific respect to St. John's wort) and investigate detection and control mechanisms which utilise remotely sensed data. Following this, identification of the spectral signature of St. John's wort using Landsat imagery and QGIS software is the key task in the overall context of the project. This is to enable mapping of locations for tracking the weed and detection of new occurrences.

4. Key Outcomes

The key outcome is determination of St. John's wort's spectral signature. Upon project completion, findings can be shared with various stakeholders such as local
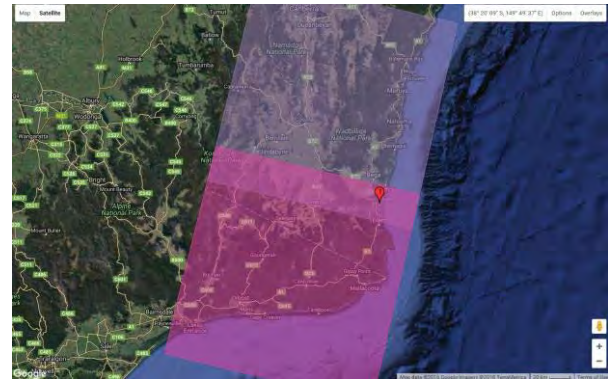
Figure 1 – Study Area (Landsat Path 90 Rows 85 & 86)

control authorities to assist vegetation management programs from detection and tracking perspectives.

5. Further Work

Analysis of results, leading to development of tracking and detection programs, remain at the time of preparing this extended abstract.

6. Conclusions

Ideally, the key message to take away upon completion of this research project is that the methodology implemented can provide an effective means of utilising freely available remotely sensed data to aid a variety of vegetation management applications.

References

Campbell, JB & Wynne, RH 2011, Introduction to remote sensing, 5th edn, Guilford Press, New York.

Naughton, M & Bourke, CA 2007, St John's Wort, Prime facts: profitable and sustainable primary industries, NSW Department of Primary Industries, Orange NSW. viewed 19 March 2016 <http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/193075/St-Johns-wort.pdf>.

Toth, C & Jóźków, G 2016, 'Remote sensing platforms and sensors: A survey', ISPRS Journal of Photogrammetry and Remote Sensing, vol. 115, pp. 22-36.

Underground Check Survey

Sponsor – School of Civil Engineering and Surveying

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Supervisors: Zahra Gharineiat, USQ

Keywords: adjustment, mining, CompNet

Figure 1 – 15L drives at Mount Isa with wall stations

1. Introduction

A check survey involves using high precision surveying techniques to transfer survey control from an area of established checked control to one with either no control, or survey control of low order. High order check surveys will follow up advancing capital development as a means to verify the quality of existing wall stations and provide accurate control to further advance into the mine. A full least squares adjustment will then assess the quality of the network.

2. Background

At Mount Isa Copper Operations (MICO) check surveys are an integral part of insuring wall stations are in the correct position. The aim of this research is to perform a high order control survey and adjust the observations of the traverse using a least squares adjustment. The least squares adjustment will be broken down to analyse positional, survey and relative uncertainties.

3. Methodology

"Survey measurements which are comparatively straight forward on the surface, can assume inordinately difficult proportions in a mine… Furthermore, the extreme environmental conditions underground, coupled with limitations in time and space, make accurate and reliable measurements difficult" (Hodges, Nicholson, & Ketteman, 1984). Due to the nature of the underground mining environment instrument setups directly over survey control marks is not possible.

The traverse consists of backsight and foresight targets on tripods with wall stations. At each instrument setup six sets of angles, face left/face right to backsights, foresights and wall stations will be observed using Leica "Sets of Angles" on a Leica MS50 1" total station.

After the field data is collected the observations will be loaded into CompNet. It takes a traverse network, & applies the least squares adjustment to the data. Station coordinates and statistical information of the network is then generated.
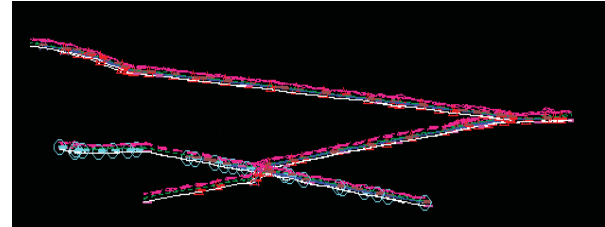
4. Key Outcomes

The research project shows the importance of check surveys in underground mining as a means to verify survey control. The adjustment was graphically and statistically analysed to assess the quality of the survey control being incorporated at MICO. The accuracy of the survey was compared to SP1 v1.7 (Class D).

5. Further Work

Further work to lead from this research project would be to use a gyroscope to verify the accuracy of the bearing transfer at the start of the control network.

6. Conclusions

The key points taken from the research project is that the check survey completed complies with the class D mining standards.

Acknowledgements

References

Hodges, D., Nicholson, T., & Ketteman, M. (1984). Surface and underground automated mine surveys. *Mining Engineer, 143*, 465-470.

Effectiveness of the Wide Centreline Treatment

on Two-Way Rural Roads

Sponsor – School of Civil Engineering and Surveying

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Supervisors: Dr Soma Somasundaraswaran, USQ

Figure 1 – WCLT (DTMR, 2014)

Keywords: Road Safety, Wide Centreline Treatment.

1. Introduction

Road trauma places a significant burden on the community. Reducing fatalities on roads is a national and state priority for transport bodies. The need for road safety improvements is recognised by Queensland's road authority, the Department of Transport and Main Roads (DTMR) through its road safety initiatives. Austroads (2006) states 60% of fatal road crashes in Australia occur on rural roads. This is highly disproportionate to the population distribution.

The Wide Centreline Treatment (WCLT) is one type of road safety treatment aimed at reducing the severity and frequency of head-on and run-off-road type accidents. The intrinsic benefit of a WCLT is in combining the elements of separating opposing traffic streams with audio tactile line marking.

2. Background

In 2011 DTMR implemented the WCLT on sections of the Bruce Highway in south east Queensland that had high frequency occurrences of fatal head-on crashes.

In 2012 research was conducted to determine the effectiveness of the treatment. The limited post implementation crash data available yielded positive crash reduction percentages, reporting an approximate 60% reduction.

Literature surrounding before and after studies suggests multiple years of crash data is required to accurately determine crash reduction percentages. This concept generates the need for this research and it is intended to extend on the current knowledge provided by the preliminary research and the benefit it provides.

3. Methodology

A before and after study was used to determine the effect the treatment has on safety. Reviewing available literature, the Empirical Bayes method was the best suited method for this research.

4. Key Outcomes

This research will quantify the safety benefit the WCLT provides, furthering the knowledge of previous research outcomes.

5. Further Work

Finalise results determining crash reduction percentages. Future analysis can be undertaken with additional crash data or using newer segments of WCLT.

6. Conclusions

It is expected the results of this study will further build on the existing knowledge of the WCLT, its effectiveness of reducing high severity accidents and the role these types of treatments will play in the future of road safety.

Acknowledgements

I would like to thank my supervisor Dr Soma Somasundaraswaran for his support and guidance throughout this research.

References

Austroads, (2016). *Guidance on Median and Centreline Treatments to Reduce Head-on Casualties*. Austroads, Sydney.

ITE-TSC, (2009). *Before-and-After Study Technical Brief*, Institute of Transportation Engineers, Washington, USA.

Effects of On-Site Detention Systems on Urban Drainage Catchments

School of Civil Engineering and Surveying

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Bachelor of Engineering (Civil)

Supervisors: Dr Ian Brodie, USQ

Mr Damian Graham, Burchills Engineering Solutions

Mr Philip Bell, Burchills Engineering Solutions

Keywords: detention, stormwater management, TUFLOW

1. Introduction

Urban development can have a detrimental effect on the natural water cycle, primarily due to the changes in drainage catchment features (Ladson, 2015). These changes result in an increase in rainfall runoff volume and discharge rate, and stormwater management controls are used to try to decrease these impacts.

Stormwater detention is a form of drainage control and can be defined as; storing rainfall runoff for short periods to reduce peak discharge rates, and releasing the stored volume at a controlled rate (Phillips, et al., 2015). In areas where there is limited room for implementation of regional stormwater detention systems On-Site Detention (OSD) can be used as a discharge or flood control technique to mitigate the impact of development or redevelopment on individual sites (Phillips, et al., 2015).

2. Background

This study seeks to build on existing knowledge of catchment wide OSD effects by using a 2 Dimensional flood model (TUFLOW) to assess flow velocity, and other catchment wide effects that occur from implementing OSD solutions.

3. Methodology

An urban drainage catchment within the City of Gold Coast region was selected for the analysis, see Figure 1.

Figure 1 – Subject Catchment – Coomera QLD

A TUFLOW direct rainfall model was constructed to assess the catchment in its existing condition. Areas of the catchment were then selected to be developed, and peak flows within these areas were mitigated by designing OSD systems.

4. Key Outcomes

The study has found that OSD systems can increase flow and velocity within an urban drainage catchment, particularly in events that exceed the design events of the OSD.

5. Further Work

Further work is required on comparing the effects of a regional detention system to OSD systems, additionally, further catchments should be studied.

6. Conclusions

The study has confirmed that it is imperative for a catchment wide study should be completed before OSD systems are implemented

Acknowledgements

References

Ladson, T., 2015. Book 9 - Chapter 2 - Urban Hydrology - Draft. In: *Australian Rainfall and Runoff.* Barton: Engineers Australia.

Phillips, B. C., Van der Sterren, M. & Argue, J., 2015. Book 9 - Chapter 5 - Detention and Retention-Draft. In: *Australian Rainfall and Runoff.* Barton: Engineers Australia.

USING NEURAL NETWORKS TO SOLVE MECHANICS PROBLEMS

Sponsor - School of Mechanical and Electrical Engineering

Deepak Dalal

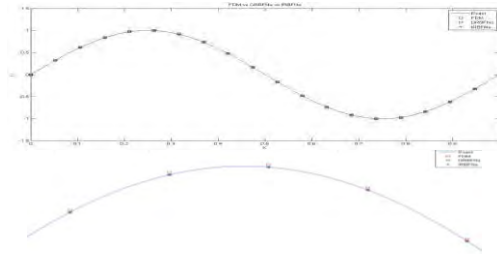Master of Engineering Science (Mechanical)

Supervisors: Dr Nam Mai-Duy, USQ

Keywords: Radial Basis function network, Differential equation, finite difference method.

1. Introduction

For many mechanics problems, their behaviours can be modelled by differential equations (DEs). Generally, exact solutions to differential equations are not available so we have to rely upon numerical methods such as low order methods (e.g. finite difference method (FDM) and finite element method) and high order methods (spectral method and radial basis function networks (RBFNs)). The main object of the project is to develop a symmetric form of integrated RBFs and verify it in one and two dimensional problems.

2. Background

RBFNs have become a powerful tool in numerical analysis. They possess the property of universal approximation. RBF approximations for a function and its derivatives can be constructed through the process of differentiation (direct) and integration (indirect). This project will try to develop a new version of integrated RBF method, where the RBF matrix is symmetric.

3. Methodology

$$f(x) = \sum_{i=1}^{n} w_i g(x)_i$$

The equation above is showing RBF approximation function. we are using multi-quadratic function, $g(x) = \sqrt{(x - c_i)^2 + a_i^2}$. Both direct and indirect approaches use the same function. Only the difference is latter uses the integration of activation function and former uses the differentiation.

Direct and Indirect Symmetric approaches:

Figure 1 – Result Comparison

$$u(x) = \sum_{i=1}^{2} w_i \phi_i(r) + \sum_{i=3}^{n} w_i \frac{d^2 \phi_i}{dx^2}$$

$$u(x) = \sum_{1,n} w_i \phi_i(r) + \sum_{2,n-1} w_i H_2$$

This technique is newly implemented by during this project in indirect RBF approach.

4. Key Outcomes

It has been noted that RBFNs gives higher degree of accuracy than conventional methods. A new scheme already has been successfully implemented in 1D problem.

5. Further Work

A symmetric form of the indirect approach will be implemented.

6. Conclusions

RBF methods are implemented in both direct and indirect approaches. Results obtained are compared with the FDM, showing the RBFNs are more accurate than FDM for a given grid size.

Acknowledgements

I would like to say thanks to my supervisor who is guiding me at every stage of this project and also, thanks to my friend Abishek who helped me in understanding the concept of loops and function in MATLAB.

References

Mai-Duy, N & Tran-Cong 2011, 'Compact local integrated – RBF approximations for second – order elliptic differential problems', *Journal of Computational Physics,* vol. 230, no. --, pp. 4722-4794.

Mai-Duy, N & Tanner, R.I 2007, 'A collocation method based on one- dimensional RBF interpolation scheme for solving PDEs', *international Journal of Numerical Methods for Heat and Fluid Flow,* Vol. 17, No. 2, pp. 165-186.

Automated Docking of a Small Boat using Simulink Modelling

School of Mechanical and Electrical Engineering

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Bachelor of Engineering (Honours) (Instrumentation and Control)

Supervisors: Dr Andrew Maxwell, USQ

Keywords: Fuzzy Logic, MATLAB Simulink, Kinematic and Dynamic Modelling.

1. Introduction

Like self-driving cars automated docking or parking of a boat is an inevitable process currently still in the development stage. Unlike cars, boats are subjected to environmental disturbances such as current, wind and waves. This disturbance can alter the course of the vessel complicating the control within tight locations.

This project has been based on a fully-actuated small boat (20ft Regent Viscount) controlling 3 degrees of freedom (3DOF), within a harbour or marina environment. The system is designed to be operated in manual, semi-auto (learning mode) and auto mode, following predefined waypoints.

2. Background

When attempting to dock a boat, depending on the size of the vessel and weather conditions, multiple crew members may be required to assist the skipper in the process. A closely related study which looks to have evolved into a commercial system, uses physical parameter identification, PI control and gain estimation methods.

This Simulink model uses physical parameter estimation and fuzzy loop control algorithms for decoupled 3DOF actuation of the vessel.

3. Methodology

The Kinematic and Dynamic models are based on previous research studies along with the theories developed by Fossen on marine guidance and control.

Testing was conducted on the vessel to determine the output thrust of the outboard engine and the drag coefficient's due to water and air resistance.
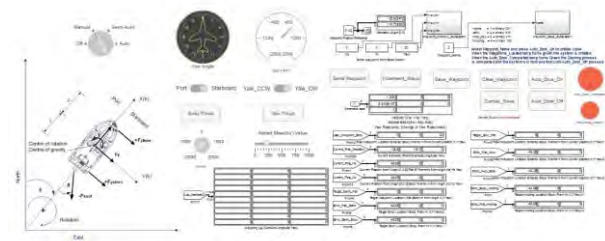
Figure 1 – Simulink Model Dashboard

4. Key Outcomes

Physical parameters have been determined in the surge direction which accurately relates to the vessels dynamics. The Simulink model developed, accurately tracks waypoint targets using fuzzy logic algorithms resulting in an automated docking scenario.

5. Further Work

Environmental disturbance rejection is still to be defined for inclusion into this project. The next stage outside the scope of this dissertation is to build a prototype system for real testing. This will enable the physical parameters for the sway and yaw motions to be determined accurately. Safety factors will also need to be identified to enable collision avoidance and potential system failure.

6. Conclusions

The Simulink model indicates that the fuzzy logic controllers have the ability to effectively control the vessels movements. The system mimics the actual vessel response in the surge direction however physical testing in the sway and yaw direction is estimated (yet to be defined).

Acknowledgements

References

Fossen, TI 2011, 'Handbook of Marine Craft Hydrodynamics and Motion Control', in *Handbook of Marine Craft Hydrodynamics and Motion Control*, John Wiley & Sons, Ltd, pp. 1-595.

Berretta, D, Urbano, N, Formentin, S, Boniolo, I, De Filippi, P & Savaresi, SM 2013, 'Modeling, identification and control of a Boat Parking Assistance system', in *Proceedings of Control Conference (ECC), 2013 European*, pp. 3012-3017.

A Civil Engineering Feasibility Study on a Sustainable Pumped Hydroelectricity Plant at Wivenhoe

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Supervisors: Dr Steven Goh, USQ

Keywords: Renewable energy, feasibility

1. Introduction

With a huge question mark still hovering over the future of energy production this paper aims at giving insight and a feasibility analysis for future sustainable pumped hydro electricity generation. In particular it focuses on the civil feasibility of the a pumped hydro plant in South East Queensland with particular focus pertaining to the conversion of the current pumped hydro plant at Split Yard Creek (Wivenhoe Dam). As a research project this project aims to provide enough of an indication to justify additional development or rule it out completely at the current time.

2. Background

The era of fossil fuelled power generation domination is quickly coming to an end with access to the required resources becoming more and more difficult every day. Therefore it is important to look for potential future alternatives. While the power generation is the goal this project focuses on the underlying civil aspects which largely determine the successfulness of a project. It also takes into account geological, topographical, and foundation requirements for varying forces.

3. Methodology

In order to carry out this project a set of criteria for both stage 1 and 2 were development and implemented. In this way both qualitative and quantitative comparisons could be made between proposed systems and the existing. A large amount of research was also required in this project to ensure that the project was at the forefront of research. Finally a site visit was undertaken to give a better understanding of the overall proposed project and surrounding area as well as giving access to a bank of knowledge from the experience operators.

4. Key Outcomes

Throughout this project so far there have been a number of minor achievements towards the overall goal which include; the successful site visit to the Wivenhoe Power generation plant. By understanding the current infrastructure at Wivenhoe Dam and getting a better understanding of hydroelectric generation plants a number of areas that needed additional literature review. This site visit also helped to give an understanding of how the final conceptual design would fit together. Furthermore the completion of stage 1 puts the project on track to be successful. It has been interesting to note that solar panels are both more expensive and take up require much more space to provide the same energy (often resulting in a negative impact on the surrounding environment), however the one saving grace is the reliability which needs to be weighted heavily in any project. The scoring criteria generated (Figure 1. Stage 1) have been crucial in providing accurate and fair

Figure 1 – Stage 1, Table 1 – 100% Solar

comparisons and thus the methodology planning has been successful.

5. Further Work

The conceptual design (Stage 2) needs to be completed and then validated against the existing system (Stage 3) to finish this project. Unfortunately due to confidentiality and a large workload CS ENERGY refused to accommodate a site visit until December 2016.

6. Conclusions

At the current stage of the project the initial conclusions are that while the project is possible, there is large doubt to the efficiency of the final product and thus it is difficult to justify the huge economical investment. The major outcome of this project is the finding that while the current resources for a large scale pumped hydro plant exist it is difficult to convert to sustainable methods with a lack of consistent and effective renewable resources. This type of project would be better suited to a coastal region closer to the equator with consistent wind levels and high levels of clear days. The most important message to take away from this project is the importance of the civil works in any project and the need for continual research into potential energy alternatives for the future.

Acknowledgements

References

Andrews, R. (2015, October 2). *Energy Matters*. Retrieved from El Hierro Renewable Energy Project – September 2015 Performance Review: http://euanmearns.com/el-hierro-renewable-energy-project-september-2015-performance-review/

Bureau Of Meteorology. (2005). *Australian Government - Bureau of Meterology*. Retrieved from Sunshine: Average Daily Sunshine Hours: http://www.bom.gov.au/watl/sunshine/

Queensland Government Flood Commission . (1984, October). *Wivenhoe Power Station*. Retrieved from Tarong Energy: http://www.floodcommission.qld.gov.au/__data/assets/file/0007/7792/Tarong_Energy_Appendix_11.PDF

Improving Caravan Design by Modelling of Crosswind

Sponsor - School of Mechanical and Electrical Engineering

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(Mechanical Engineering)

Supervisors: Dr Andrew Wandel, USQ

Keywords: Computational Fluid Dynamics, Caravan, Aerodynamics, Drag.

1. Introduction

The project being undertaken involves carrying out research into the aerodynamic performance of a caravan subject to a crosswind. The aim of the study is to perform an analysis through Computational Fluid Dynamics (CFD) of a current design, evaluating the effect that a crosswind airflow has on the generation of drag on the caravan and its effect on the fuel consumption figures for the tow vehicle. Following the initial analysis a parametric study was undertaken to propose changes to the design of the caravan with the aim of reducing drag and improving the handling characteristics of the caravan-tow vehicle combination.

2. Background

Current research into caravan aerodynamics has been primarily concerned with the assessment of the caravan design when subject to a headwind. With this in mind, designers over the last decade have concentrated their efforts on producing caravans that aim to strike a balance between form and function. Crosswind airflow however plays a major part in defining both the aerodynamic performance and stability of the caravan, with a considerable number of caravan rollover incidents attributed to crosswinds.

3. Methodology

In order to evaluate and optimise the design of a caravan to meet the research objectives it was decided that the use of a CFD tool such as ANSYS would be most appropriate given its application in solving fluid flow problems. The project involved creating models of the caravan and undertaking a CFD analysis to obtain baseline data. Please see Figure 1 for an example. Following this a parametric study was conducted to propose design modifications which would be compared
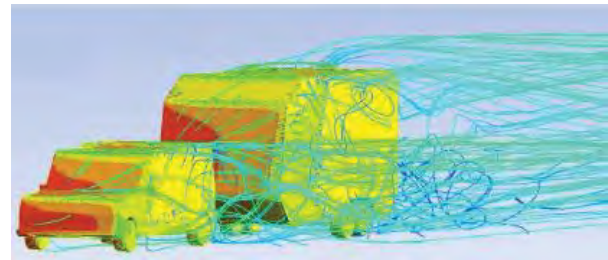

Figure 1 – CFD Fluid Flow - ANSYS

with the original configuration allowing for a detailed discussion of the results regarding the design characteristics of the modified caravan.

4. Key Outcomes

Key outcomes of this study include the proposal of various caravan design features that aim to reduce the adverse effects of aerodynamic drag and side loading attributed to crosswind airflow.

5. Further Work

Further work includes refinement of aerodynamic features to existing caravan design and subsequent CFD testing. If time allows an analysis of the dynamic loads on the caravan will be undertaken with the opportunity to expand into evaluating the effects of transient flow conditions.

6. Conclusions

The final outcome of this study was to ensure that the proposed design modifications contributed to a reduction in drag which in turn reduced the fuel consumption of the tow vehicle. Drag reductions of up to 30% are expected.

Acknowledgements

I would firstly like to express my sincere gratitude to Dr Andrew Wandel, my project supervisor for his guidance and support during this study. To my family who without their support I would not have been able to sustain this long period of study.

References

Briskey, K (2013). Improving Caravan Design by Modelling of Airflow. University of Southern Queensland, Toowoomba, Australia.

Liu, Tu and Yeoh, (2008), Computational Fluid Dynamics: A Practical Approach. (1st ed.). Jordan Hill, Oxford, Elsevier Inc.

Pritchard, P. (2011). Fox and McDonald's Introduction to Fluid Mechanics (8th ed.). Hoboken, John Wiley & Sons.

A Trade-based Approach for Defects Management in Residential Construction

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Bachelor of Construction (Honours)

Supervisors: Dr Vasantha Abeysekera, USQ

Keywords: Defects, Defect management, Risk management

1. Introduction

In developed countries such as Australia, subcontractors do most of the on-site work. According to Pratt (2011) in residential projects almost 80% of work is performed by subcontractors and often most of the on-site work is carried out by the tradies leaving the main builders as the co-ordinator of various trades. This project aims to understand how to manage defects in single and two   storey residential projects in Queensland taking a trade-based approach given that most work is subcontracted.

2. Background

Despite various construction acts, regulations, standards, codes, licensing regimes, other management approaches such as quality management, risk management, defect management building are still handed with defects. However despite subcontractor or trade contractor being the specialists in the specific area, there are yet many problems associated with subcontractors. It is this phenomenon that led to the further investigation in this area. The figure 1 below is further evident that millions of dollars of insurance claims are the cause of defects in residential construction
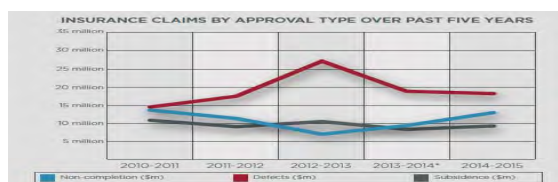

Figure 1: Insurance claims by approval type (Queensland building and construction commission 2015)

3. Methodology

In order to understand the level of performance risk of various trades and strategies to manage them in residential construction sector, questionnaire survey was chosen as a research design. Questionnaire survey was divided into two stages. First stage was conducted to identify the level of performance risk in terms of defects for each trade listed. Second stage survey was to identify the strategies to manage top ten most risky trades identified by the first stage of the survey. Google form was used to create both set of questionnaire and the link to the questionnaire was distributed to the participants electronically along with the information sheet.

4. Key Outcomes

The possible outcome of this project is expected to be the identification of troublesome trades; the project will identify the level of performance risk and strategies for managing troublesome trades. If the knowledge of troublesome trades in residential construction becomes available, then there would most likely be benefits for builders, subcontractor and homeowners. The main benefit would be the knowledge of the troublesome trades themselves. With this knowledge, potential mitigation techniques could be implemented in construction to assist in minimising defects.

5. Further Work

At the current stage, the ethics committee conditionally approves the project. As survey couldn't be commenced until complete approval is obtained, data collection and analysis of the collected data is remanning in the project.

6. Conclusions

As the project is still at the stage of commencing the survey it is difficult to formulate the conclusion. The key message that should be taken away from this project upon completion is the result from the key outcome of the project.

Acknowledgements

References

Pratt, D. (2011). *Estimating for Residential Construction*: Cengage Learning.

Queensland building and Construction Commission. (2015). *Annual Report 2014-2015*. Retrieved from https://www.qbcc.qld.gov.au/sites/default/files/QBCC_Annual_Report_-_1_July_2014_to_30_June_2015.pdf

Assessment of the potential of Hydrogen Fuelled vehicles in Agriculture
Sponsor – School of Civil Engineering and Surveying

Jashandeep Singh Dhaliwal

Master of Engineering Science (Agricultural)

Supervisor: Prof. Guangnan Chen, USQ

Keywords: Tractor, Farm Machinery, Agriculture

1. Introduction

In agriculture field a lot of energy is consumed. Most of this energy comes from non-renewable sources. At present all the tractors available run on petroleum products mainly diesel, kerosene and petrol. A significant research has been done in the past to reduce our dependency on the petroleum products. A number of alternatives like bio diesel, producer gas, and biogas etcetera have been found, however they are unsatisfactory due to a number of problems related to their usage like pollution, lower calorific value, changes required in engine design etc**.**

2. Background

Fuel cell is a device that uses hydrogen as a fuel and converts its chemical energy into other useful form. The basic design of a fuel cell consists of two electrodes placed in an electrolyte. Hydrogen and oxygen passes over each electrode and by means of chemical reaction electricity, water and heat are produced.

Fuel cells have been in use since 150 years. The first they were used as an alternative to the internal combustion engine, in 1860-1880 timeframe. By the 1960s, fuel cells were successfully used in manned spaceflight, and they were continued to be used in aerospace applications. The next wave of fuel cell technologies has been building up since the 1990s, to reduce the pollution caused by petroleum fuels.

3. Methodology

a) Relevant literature about the available technologies for use of hydrogen as a fuel will be collected.

b) The available literature and data of hydrogen fuel usage in vehicles and machinery will be analysed thoroughly.

c) Assessment of the potential of hydrogen fuelled vehicles in agriculture will be done based on this data.

4. Key Outcomes

The methodology mentioned above in the project will focus on the hydrogen fuel usage in vehicles and machinery and relevant literature about available technologies will be collected.

5. Further Work

I am still studying research papers and background information regarding my project. After finishing this, I will start writing introduction and other requirements which will need for successful completion of project.

6. Conclusions

It will depend on my future research what could be the conclusions. It is very hard to say that at this time as I am at the initial stage.

Acknowledgements

References

Biggs, L & Giles, D 2009, Current and future agricultural practices and technologies which affect fuel efficiency, Intelligent Energy Europe for a Sustainable Future, version 1, viewed 2 August 2016, < Biggs, L & Giles, D 2009, Current and future agricultural practices and technologies which affect fuel efficiency, Intelligent Energy Europe for a Sustainable Future >

Constantine, S & Kyle, M 2008, Life Cycle Assessment Gas Emissions from Plug-in Hybrid Vehicles: Implications for Policy, Environment Science Technology, vol. 42, pp. 3170-3176, viewed 28 July 2016, < http://pubs.acs.org/doi/full/10.1021/es702178s>

Analysis of Taylor's Slope Stability Charts Using FLAC/SLOPE and SLOPE/W

School of Civil Engineering and Surveying

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Bachelor of Engineering (Honours)
(Civil)

Supervisor: Dr Jim Shiau

Keywords: Slope Stability, Undrained, Drained

1. Introduction

Slope failures and landslides occurs due to various causes such as; erosion, rainfall, earthquakes, excavations and filling of slopes, increment of pore-water pressure, external loading, geological factors and change in topography etc. The result of slope failure can often be catastrophic, involving the loss of considerable property and many lives. Thus, stability of slope is an extremely important consideration on both the natural slopes and the man-made slopes.

In 1937, Taylor developed two design charts to analyse stability of slopes in homogeneous undrained clays and soils with cohesion and friction. Taylor's stability charts have been widely used for slope stability calculations for many years.

2. Background

In order to predict the stability of slope more precisely and to re-produce Taylor's stability charts more accurately, new advanced computer software needs to be taken into consideration. In this research, two advanced software, namely FLAC/Slope and SLOPE/W have been used to analyse the stability of various slopes and the modified Taylor's stability charts have been produced and compared with the original Taylor's stability charts.

3. Methodology

In this study hundreds of slope stability problems were analysed changing the geometry and the soil parameters and the numerical results obtained were compared with already published solutions. The results were compared among the three methods; Taylors Original Charts, Steward Proposed Charts (2011) and the charts produced using FLAC/Slope and SLOPE/W assessments. New design charts were proposed for the use of practical design.
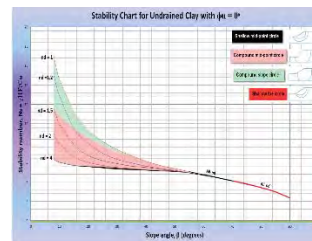
Figure1: Proposed Stability Charts Developed Using FLAC/Slope for $\phi_u=0$.

4. Key Outcomes

In this study, four design charts are presented: two charts for undrained clay ($\phi' = 0$) by using FLAC/Slope and SLOPE/W and two charts for drained (c'- ϕ') soils by using SLOPE/W.

5. Further Work

Taylor's charts are based on the assumptions:
-dimensional limit equilibrium analysis
- Simple homogeneous slopes
- Circular slip surfaces only
Future research should be advanced for non-homogenous and non-circular slips.

6. Conclusion

The proposed charts are somewhat different to the charts developed by Taylor. It may be due to the assumptions and the limitations that have been used when developing the software. The charts for drained soils enable the safety factor of the slope to be computed without any iterative procedure.

7. Acknowledgment

8. References

Baker, R 2003, 'A Second Look at Taylor's Stability Chart', Journal of Geotechnical and Geoenvironmental Engineering, vol. 129, no. 12.

Steward, T, Sivakugan, N, Shukla, SK & Das, BM 2011, 'Taylor's Slope Stability Charts Revisited',International Journal of Geomechanics, vol. 11, no. 4.

Abrasive wear performance of polymer considering different parameters under dry contact conditions

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Supervisors: Dr Belal Yousif, USQ

Associate Professor (Mechanical Engineering)

Keywords: Tribological, polymer composite, grade papers, time, forces.

1. Introduction

This study focuses on the tribological behaviour on polymer composite by applying different grade papers with different time duration at various forces under dry conditions. The important application of minimizing the issues caused by the synthetic fibre is made possible by the development of the Natural fibre polymers.

This paper studies the tribology behaviour of the natural fibre reinforce composite materials and its advantages over the synthetic fibres composite materials.

2. Background

In recent years the natural fibres with plastics is been a significant use. For more than thousand years only natural fibres are used as reinforcing materials. The drawbacks of using synthetic fibres reinforced composites is resolved with the use of natural fibre polymers. The natural fibre polymers are environmental friendly and cheaper. For the tribology applications and for the specific required reinforcing level, the natural fibres with their volatile functionality, being biodegradable, abundant availability and renewability satisfied the requirements. This paper throws light on the everyday use of natural fibres in the form of cotton, jute, glass and coir.

3. Methodology

In this project, I have used all the well-known materials such as, Kinetix H160 medium hardener, Kinetix R246TX Thixotropic epoxy resin, Jute fiber. The main objective of the usage of these materials for this research project is to study the abrasive performance of the surface which is damaged due to conducting the tests by applying various loads with different grade papers under dry contact conditions. The applied loads
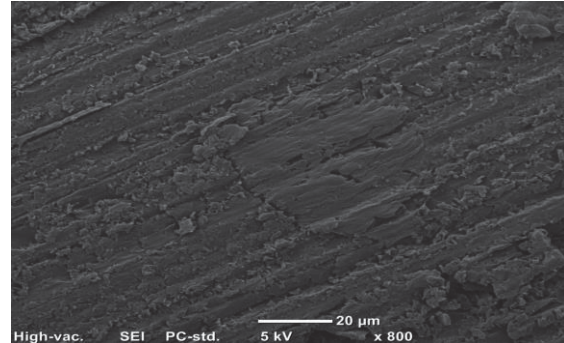

Figure1: SEM images of specimen surface before

in this project are 2.5 N, 5 N, 7.5 N, 10 N. The abrasive grade papers used here are with grades G 400, G600, G1200.

4. Key Outcomes

The outcomes of this work will contribute to the knowledge of the polymer and tribology. Understanding the abrasive wear behaviour of the materials will contribute a lot to the industries.

In addition to this, the tribological behaviour of composite polymers in this study is exposed clearly in dry contact conditions.

5. Further Work

The further work can be procced on the various fibers to analyse the abrasive wear performance of different composition of materials.

6. Conclusions

By comparing the prepared composites (Jute Fiber, Neat Epoxy) it can be concluded that, the jute fibre composite have experienced a very low wear rate than the neat epoxy composite with respect to the abrasive wear performance. The wear rate and frictional force factors are completely depended on the applied loads and duration of time the experiment is conducted. The breakage of fibres is clearly observed through the SEM and optical microscopy to analyse the influence of wear performance among the composite materials.

Acknowledgements

I want to thank all the people who has supported me to complete this research project successfully. At first, I should thank my supervisor, Dr Belal Yousif for his great support, guidance, patience and motivation throughout my project. His knowledge and experience helped me in each and every stage of my project and writing of this thesis.

References

Dwivedi, U & Chand, N 2008, 'Influence of wood flour loading on tribological behavior of epoxy composites', *Polymer Composites*, vol. 29, no. 11, pp. 1189-92..

Overcoming Asymmetrical Communication Delays in Line Current Differential Protection Circuits

Sponsor: School of Mechanical and Electrical Engineering

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Bachelor of Engineering
(Honours) (Electrical and Electronic)

Supervisors: Dr Narottam Das, USQ

Mr Geoffrey Bartleman,
AusNet Services

Keywords: Asymmetry, Current differential, Communication delay.

1.   Introduction

The development of communications networks in power systems and the increased use of line current differential protection have led to occurrences of asymmetrical communication delays causing protection relay misoperation. This project identifies the causes of delay asymmetry and proposes ways to overcome it.

2.   Background

AusNet Services has several line current differential protection circuits in service with relatively high probability of asymmetrical communication delays. The company is not yet prepared to use GPS synchronisation to compensate for the asymmetry, and little development work had been carried out to find alternate solutions.

3.   Methodology

After researching AusNet Services' and similar communications networks and equipment, a model was created to predict the latency and potential asymmetry across all of the company's critical E1 bearers. The responses of current differential relays to communications asymmetry were calculated and tested, then used to identify the protection circuits at risk of misoperation. The Avara DB4 family of E1 branching cards were tested for their bi-directional switching performance, which, if it performs as advertised, would greatly reduce the risk of protection misoperation due to communications asymmetry. Figure 1 shows one of the test configurations used.
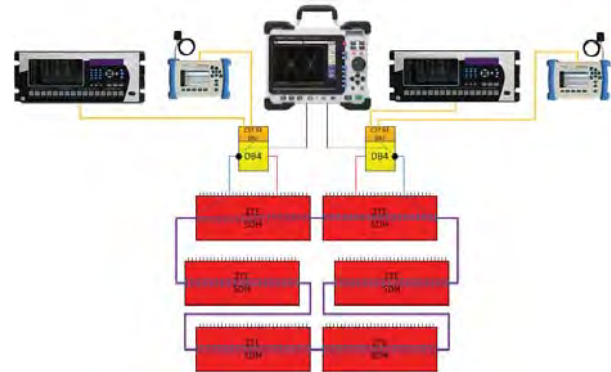

Figure 1 – Relay Asymmetry Response Test Setup

4.   Key Outcomes

The delay model created was able to predict delays to within 6% of the measured times. The L90 relay model could predict relay asymmetry responses to within 5% of those observed. Several current differential circuits were identified at high risk of misoperation. The DB4 testing revealed a fault in their switching performance, which is being rectified by a pending upgrade.

5.   Further Work

Further delay testing will result in a refined model with a higher degree of accuracy.

6.   Conclusions

The delay and relay response models created will quickly and easily assess the suitability of current differential communication circuit designs. The findings of this project will lead to improved bidirectional switching performance of Avara DB4 cards that will eliminate the risk of false trips due to delay asymmetry.

Acknowledgements

References

Brunello, G, Voloh, I, Hall, I & Fitch, J 2004, 'Current differential relaying - coping with communications channel asymmetry', in Developments in Power System Protection, 2004. Eighth IEE International Conference on Developments in Power System Protection, pp. 821-4, Vol. 2.

IEEE 2015, 'IEEE Guide for Application of Digital Line Current Differential Relays Using Digital Communication', IEEE Std C37.243-2015, pp. 1-72.

Species Distribution Modelling of the Glossy Black Cockatoo in Queensland's Condamine Region

School of Civil Engineering and Surveying

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Supervisor: Professor Amando Apan, USQ

Keywords: Geographic Information System, Maxent, Species Distribution Modelling, Cockatoo

1. Introduction

This project undertakes species distribution modelling of the Glossy Black Cockatoo (*Calyptorhynchus lathami*). Species distribution modelling is a GIS application that has been used in a number of different studies (Booth, 2014). In this instance it will be used to predict and map the habitat suitability of areas across the Condamine River catchment in Queensland for the subject species and thus provide information valuable for developing conservation strategies.

2. Methodology

The maximum entropy (Maxent) modelling software program was utilised in species distribution modelling (Phillips, Anderson & Schapire, 2006). The data for the project has been sourced from a variety of spatial data custodians and then processed through the ArcGIS software to achieve the required data format for analysis. Two main types of datasets were required: the samples (sightings) data of the species, and the environmental variables that provide information to derive the prediction. These variables include; land use, DEM, slope, aspect, regional ecosystems, roads and drainage data.

3. Key Outcomes

The modelling has produced a satisfactory and valuable set of results. The main output is a species distribution map (seen in the figure), in which every area is assigned specific habitat suitability values for the cockatoo in the area. Another important result is the contribution made by each variable to the final model. In this project land use (46.2%) and elevation (34.9%) were the most important variables in the model, while aspect (1.3%) was the most inconsequential.
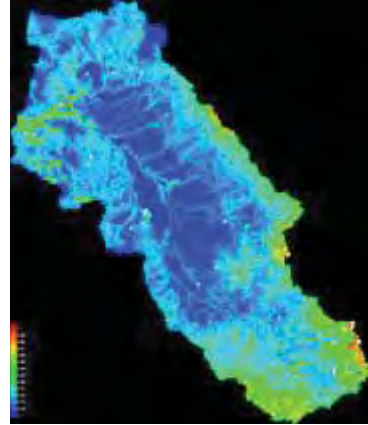

Figure 1 Species Distribution Map of the Glossy Black Cockatoo

4. Further Work

Conducting this research has opened up avenues for further work such as expanding the scope to alternate species or different areas. Doing so would further assist in preventing the demise of an endangered species. Doing further research into the specific characteristics of the identified areas of high suitability would also be enlightening.

5. Conclusions

The project has been successful in indentifying suitable habitat for the Glossy Black Cockatoo. The information obtained from this study could be useful in future conservation efforts for this species.

Acknowledgements

I would like to thank Professor Armando Apan for all his valuable assistance and guidance throughout the undertaking of this project and also to my family for their support and encouragement through this project and all my years at university.

References

Booth, T.H., Nix, H.A., Busby, J.R., Hutchinson, M.F. (2014). Bioclim: the first species distribution modelling package, its early applications and relevance to most current MaxEnt studies. *Diversity and Distributions, 20*(1), 1-9.

Phillips, S.J., Anderson, R.P., & Schapire, R.E. (2006). Maximum entropy modelling of species geographic distributions. *Ecological Modelling, 190*(3-4), 231-259.

Internet of Things for a small business
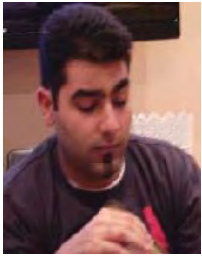
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Supervisor: Mr Mark Phythian, USQ Lecturer
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Keywords: IoT - IT - Raspberry PI – IP- Google Firebase – remote access – geo-fencing.

1. Introduction

The concept of Internet of things is all about connected devices in all possible domains such as healthcare, smart homes, smart transport, and so on. It is a network of sensors, servers and all possible low resource devices that share information among the devices to serve the demand of a business and an individual's day to day activities. This project concentrates on selecting a specific use case scenario with implementing the concept of IoT to develop a simplified computer system that serves that use case. The current use case would be a bike rental company with the intent to develop a functionality that provides tracking distance and sending feedback data to the business for analysis.

2. Background

With the emerging acceptance of technology and IT based services, the concept of IoT is notably easily applicable in the current infrastructure of any process to provide better use of data exchange and information flow of the current process. This project would aim to answer the question of "Does implementing an IoT based system provide benefits for a small   business?"
In the sense that for a small business, you would have many factors of resisting technology or requiring small scaled aiding tools that aid business process and provides better use of the collected data and so on.

3. Methodology

An approach to provide some practical implementations of the mentioned concept is to provide a small scaled system demonstration of the technology and its use case for such a small scaled business scenario. In order to address the question, a design of the overall system based on a computer/software project solution is currently employed to provide feasible outcomes. Setting up a Raspberry PI 3 device with GPS sensing capabilities, establishing a method of connecting that device to the user terminal (Using Ethernet,

Wi-Fi) and displaying that data in a useful interface for the user to interact with are the key components of the current developed system. The device is to be used in our use case as a mounted device on the bike and it would record its location and upload it to a cloud-based service (Google Firebase) and accessing it from a PC terminal using an interface.

4. Key Outcomes

The hardware is successfully acquired with the relevant sensors and components, the software is in an ongoing process of development and refinement to better reflect the design to demonstrate the concept of IoT in providing a system that suits as a business decision adding tools.

The cloud-based database (Open sourced google service) is established successfully and it receives information and stores it accordingly for later use in the PC interface.

Connection to the device is enabled via remote access from the PC terminal using the device's IP, several other tested methods are included (direct connections).

5. Further Work

Establishing a clear functionality with focussing on applying further programming work and establishing the end a working system or segmented systems for demonstration purposes that could show the collection of the data from the device, the transfer of that data over the cloud-based internet database and its later use in a local computer program (business side).

Dissertation writing and incorporating the IoT element that was established in the demonstration code is a necessary work for the future.

6. Conclusions

In conclusion, the project provides a demonstration of the concept of Internet of Things through the process of developing a software/computer system that shows the use of the technology. Through using several mainstreamed technologies and IT approaches coupled with our IoT concept, the project demonstrates the data flow of information to suit a specific intent of a computer system through an easy to use system and with low-cost implementation means.

Acknowledgements

References

Qin, H., Li, H., & Zhao, X., (2010), Development status of domestic and foreign smart city. Global Presence, 9, 50-52.

Atzori, L., Iera, A., & Morabito, G., (2010), The internet of things: A survey. Computer networks, 54(15), 2787-2805.

Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I., (2012), Internet of things: Vision, applications and research challenges. Ad Hoc Networks, 10(7), 1497-1516.

Finite element modelling of a new type of sustainable hybrid sandwich panel under bending

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Supervisors: Associate Professor Yan Zhuge, USQ

Keywords: FEM, Hybrid Structures, sandwich panel, flexural test, NFRP

1. Introduction

An innovative method in mass construction, recommends adding an intermediate layer of Natural Fibre Reinforced Polymer (NFRP) to the conventional Structural Insulated Panels (SIP) in order to increase the strength of the panel under structural loading. A finite element model is developed in Strand7 software to provide a faster method to analyse the behaviour of NFRPs under bending in a lower cost.

2. Background

Modular panelised construction using SIP reinforced by NFRP is able to reduce construction duration and labour cost. Analysing SIP in Strand7 enables the industry to understand the behaviour of the panel and optimise the performance.

3. Methodology

Major phases of the project are summarised as:
1. Model foam core using 3D brick element(Hexa8)
2. Model top and bottom skin layers in SIP by 4 node isotropic rectangular plate elements (Quad4)
3. Model NFRP layer by 4 node orthotropic rectangular plate elements.
4. Apply the boundary condition and load and validate results with the experimental data
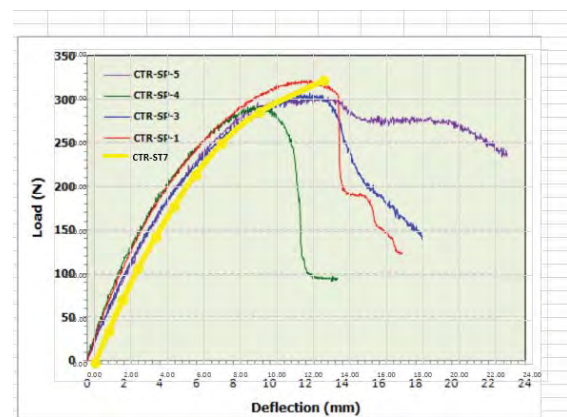

Figure 1 – Comparison of Finite Element (FE) Analysis results with experimental outcomes

4. Key Outcomes

Data acquired from Finite Element Modelling indicate that adding intermediate layer of NFRP increases the flexural capacity of panels. However, the behaviour of the panel is highly affected by delamination of epoxy between the core and faces which makes it challenging to be modelled in software.

5. Further Work

It is understood that the behaviour of panels, near the failure point, is affected by epoxy delamination between faces and core. Modelling the epoxy in Strand7 and introducing epoxy specifications to the model, is recommended to produce even closer results to the experimental data.

Acknowledgements

References

Abang Abdullah Abang, A, Mohammad, P & Yen Lei, V 2013, 'Structural Insulated Panels: Past, Present, and Future', Journal of Engineering, vol. 3, no. 1, pp. 2-8.

Fajrin, J, Zhuge, Y, Bullen, F & Wang, H 2013a, 'Hybrid sandwich panel with natural fibre composite intermediate layer: Manufacturing process and significance analysis'.

Fajrin, J, Zhuge, Y, Bullen, F & Wang, H 2013b, 'Significance analysis of flexural behaviour of hybrid sandwich panels'.

Design of a Portable Bushfire Attenuation Fence

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Supervisors: Dr Ahmad Sharifian, USQ

Keywords: Bushfire, Firebrand Attack, Wire Mesh

Figure 1 - Simulated Firebrand Attack

1. Introduction

Bushfires are large scale fire events that occur frequently in Australia and other parts of the world. Due to the substantial financial and humanitarian costs associated with bushfire events, there is significant interest in developing better defensive measures. Previous research conducted at USQ has indicated that fine aperture wire mesh screens have potential in impeding bushfire progress. This project focuses on the design of a low cost, lightweight and portable wire mesh fence as the next step towards conducting a full scale test of the wire mesh bushfire defence concept.

2. Background

Research has shown that the major cause of fire spread and building ignition during bushfire events is a phenomenon known as 'ember attack'. Embers created by the bushfire are carried by wind and convective currents and deposited against fuel beds, leading to spot fires. By creating a physical barrier between the fire and the defensive region, the transmission and accumulation of a large number of the embers produced can be achieved. Australian Standards for building in bushfire prone regions mandate the use of wire mesh over windows and other openings for this reason, however, no large scale tests have been performed as a method of impeding or containing bushfires.

3. Methodology

In order to achieve the goal of developing a preliminary design of a bushfire attenuation fence, a literature review into the bushfire environment was conducted to determine the required design conditions. These included maximum temperature, required fence height and required mesh size. Design specifications were developed, as was a criterion to assess the final design. Much of the design work was carried out using the ANSYS Mechanical Package, allowing Finite Element Analysis to be carried out at varying temperatures.

4. Key Outcomes

Key outcomes of this project so far have been: initially demonstrating the feasibility of a temporary, portable structure of this size; determining the required design specifications; evaluation of the optimum height and spacing of the upright supports and design of a dismountable post system capable of being erected and secured in a variety of conditions with minimal machinery.

5. Further Work

Further work yet to be completed on the project include the design of the mesh installation arrangement, and evaluation of the final design against the specified criteria. Beyond the scope of this particular project much work still remains and includes: evaluation of exact thermal conditions the system is subjected to, temporary ground anchoring methods and investigation into the use of lightweight composite materials.

6. Conclusions

The primary conclusion of this project is to aid in the furthering of the wire mesh bushfire defence concept by providing a low cost, portable design for large scale fire testing.

Acknowledgements

References

Sharifian, A. and Hashempour, J. 2015, *The combined effects of woven wire screens and buffer zone in mitigating risks associated with firebrand showers*, University of Southern Queensland, Toowoomba

Light Fidelity (Li-Fi) Video Streaming Prototype with Raspberry Pi

Sponsor – School of Mechanical and Electrical Engineering

Paul Fergusson

Bachelor of Engineering (Honours)

(Electrical & Electronic)

Supervisor: Assoc/Prof Alexander Kist, USQ

Keywords: Raspberry Pi, Light Fidelity, Visual Light Communication.

1. Introduction

With the Radio Frequency (RF) Band nearing complete allocation for wireless communication, the Visible Light Band lies under-utilised. This band has 10,000 times the size of the RF Band and can transmit data at speeds limited only by current electronics.

Light Fidelity (Li-Fi) technology, where visible light waves are modulated to carry the information, is ready for integration with the domestic environment and this research project utilises Raspberry Pi (RPi) micro-controller to transmit data using only light.

2. Background

Visible Light Communication (VLC) is a developing technology that has a place as a secure, high-speed, line of sight communication. A knowledge gap exists where a low cost micro-controller has been configured with consumer components and software, is used to establish a prototype for VLC.

3. Methodology

A transmitter (TX) and receiver (RX) module form the Li-Fi system, with RPi units utilised for coding, file management and data handling. The communication takes place between an addressable LED (APA102) and a photodiode (S5973), with a total cost <$100. Figure 1 shows the layout and components of the prototype.

Python coding provides the simple manipulation of file data, such that is can be sent to the LED for modulation. The RX module decodes the modulated signal and restores the original content. A MobaXTerm application allows interfacing with the RPi's and reduces peripheral costs (keyboard, screens etc).
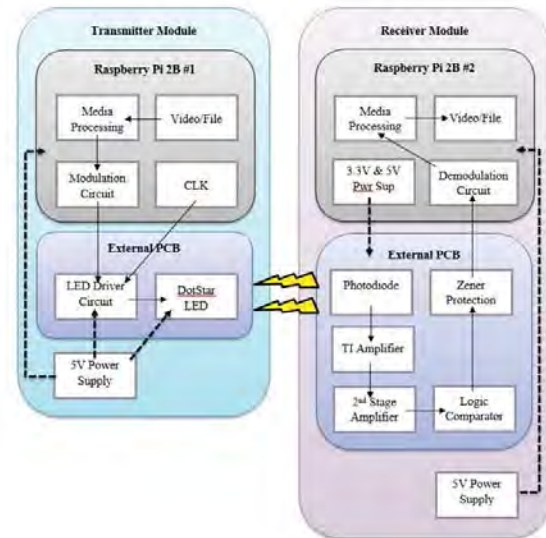

Figure 1 - Li-Fi System Diagram

4. Key Outcomes

The prototype system can transmit and receive modulated data from text and image files with high quality, low loss reproduction. The RX and TX modules were created using accessible and low cost components, with a large amount of research ready to be enhanced.

5. Further Work

Due to the complexity of video files, real-time streaming was not able to be achieved. Further work includes exploring Raspberry Pi Zero's, real-time audio streaming, alternative LED's and alternative coding methods to build on this research.

6. Conclusions

A suitable foundation has been established for future students to enhance the research conducted as part of this project. Li-Fi technology is now very accessible for students and through further research, real-time video streaming is a realistic goal.

Reference

Pathak, P, Feng, X, Hu, P & Mohapatra, P 2015, 'Visible Light Communication, Networking and Sensing: A Survey, Potential and Challenges', in Communications Surveys & Tutorials, IEEE , vol.PP, no.99, pp.1-1.

Study of blast effects on structures

School of Civil Engineering and Surveying

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Supervisors: Dr Habib Alehossein, USQ

Figure 1 – Shock wave pressure time history from a blast

Keywords: Blast Loading, Structures, Finite Element Analysis.

1. Introduction

Majority of structures are rarely designed to resist the effects of blasts loading. Blast loading has become more prevalent due to the occurrence of industrial accidents in recent years and steady escalation of terrorist's attacks increasing the threat to structural safety. Therefore, the importance of resilient structural design becomes the first layer of defence against blast effects. This study is focussed on understanding the nature of blast effects on structures and methods for analysing structures under blast load conditions.

2. Background

Design guidance for blast loading has started to emerge and slowly evolved into the civil sector. Blast design today has gained more attention as a design factor for the safety of life where due diligence in design is required not only for government or military buildings, but for other high risk buildings including banks, transport hubs, public facilities, hospitals and industrial plants.

3. Methodology

During this study a literature review of recent blast incidents, blast loading phenomena, relevant design documents was undertaken to gain a comprehensive understanding of blast effects and the need for blast resilience in design. Refer to Figure 1 for an example of the blast pressure vs time curve for detonation response. In order to understand the blast effects a credible blast loading is developed and applied to a 3D Finite Element Analysis (FEA) model. The model is to be simulated by means of blast loading cases using nonlinear transient dynamic analysis.
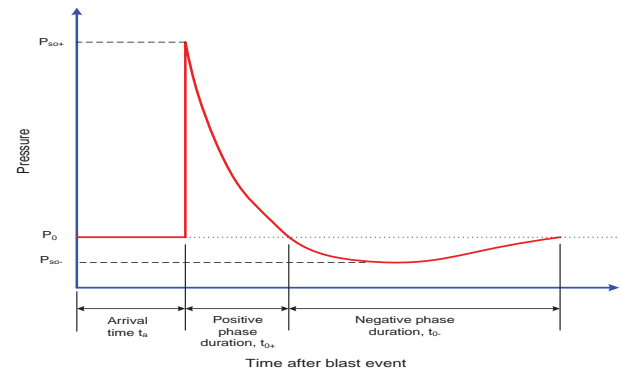
4. Key Outcomes

Throughout the study relevant standards that deal specifically with blast loading have been identified and applied to define credible blast threats using empirical methods. Blast load cases have been applied using FEA methods for determining stresses in structures. The outcomes of which have produced high localised stresses at blast front likely to cause failure of exposed structural elements. Other results include large bending stresses at rotational joints and large shear stresses at restraints followed by whipping due to inertia effects.

5. Further Work

Where time permits, further simulations using an optimised structural model for improved blast resilience will be made and make recommendations on practical methods to reduce blast effects.

6. Conclusions

Limitations of empirical blast determinations is the analysis is limited to smaller structures due to the rapid pressure decay with distance. Larger structures require analytical approaches using Computational Fluid Dynamics (CFD) software or equivalent to determine blast loading time history such as ProSAIR (CFD only) or ANSYS (coupled structural and CFD).

Acknowledgements

References

Cormine, D., Mays, G., & Smith, P. (2009). *Blast effects on buildings*. London: Thomas Telford.

Dusenberry, D. (2010). *Handbook for Blast resistant desgin of buidlings*. New Jersey: Wiley.

Department of Defense. (2014). *Unified Facilities Criteria 3-340-02 Change 2 Structures to Resisit the Effects of Accidental Explosions. DoD* (Approved or Public Release).

Future Public Transport Options for Toowoomba for the Next Twenty Years.

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Supervisors: Prof. Ron Ayers, USQ

Keywords: Public Transport, Toowoomba

1. Introduction

All around the world, growing cities are experiencing the harsh reality of insufficient public transport facilities. This problem needs to be addressed to ensure that measures can be taken and solutions swiftly implemented before the problem escalates. Current public transport networks need to be critiqued and addressed so that future public transport options can be determined. This project will identify the major factors controlling the current development and use of public transport within the Toowoomba area.

2. Background

Worldwide, by 2024 there is expected to be 7.4 billion people, therefore, making the need for mobility within cities even more essential (Worldometers, 2016). In the larger cities, this is particularly vital where there is already limited carparks in the city centre, increased driving times and limited roadways, creating congestion within city centres. Planning and designing of bus routes need to be careful thought out to ensure that the residents needs are met and suitable routes are obtained.

3. Methodology

Six cities that have similar population to Toowoomba's expected future population will be identified. An analysis of their public transport systems will take place and a form filled out.

Identify the strategies/technologies which have not been used in Toowoomba

4. Key Outcomes

This analysis of cities that have a high public transport usage has suggest key strategies and technologies that could be used to increase the public transport usage within Toowoomba.

Figure 1 – Toowoomba's Current Public transport system (Queensland Government, 2016)

These are;

- Free usage for High school students and seniors.
- Electronic cards.
- Park and ride facilities.
- Multiple interchanges
- Route coverage.

5. Further Work

Further work could be undertaken to show the effects of implementing the identified strategies and technologies into Toowoomba's public transport system.

6. Conclusions

This thesis has provided insight into strategies and technologies that could be implemented to improve public transport usage for towns with a similar population as Toowoomba's expected population in twenty years' time. If these strategies and technologies are implemented than Toowoomba's public transport system usage may increase and therefore ensuring adequate mobility in Toowoomba is achieved.

Acknowledgements

References

Queensland Government. (2016). *Toowoomba Bus Service*. (Online) Available at: https://www.qld.gov.au/transport/public/transport/timetables/qconnect/toowoomba/

Worldometers. (2016). *Real world time statistics*. [Online] Available at: http://www.worldometers.info/

Non-Invasive Methods for Testing the Integrity of Bulkheads and/or Deckheads During a Fire

Sponsor – Naval Technical Bureau, Department of Defence

Michael Gall

Bachelor of Engineering
(Honours) (Mechanical)

Supervisors: Prof. John Billingsley, USQ

Mr Ian Raymond, Naval
Technical Bureau

Keywords: Non-Invasive Testing, Integrity, Fire.

1. Introduction

This project aims to investigate and evaluate a possible non-invasive test method to evaluate the integrity of bulkheads and/or deckheads during a fire.

2. Background

There is currently no accurate method for determining the integrity of a bulkhead and/or deckhead during a fire on-board a ship. When a ship is constructed from materials such as Aluminium, Glass Fibre Reinforced Plastic (GFRP) and Carbon Fibre Reinforced Plastic (CFRP), due to their comparatively low temperature resistance this can be a significant structural integrity risk. Aluminium loses 50% of its original strength at approximately 200°C (Beatrice Faggiano, 2004). This means that a fire at temperatures below 200°C can have a catastrophic effect on the structural integrity of a ship.

3. Methodology

A literature review was conducted, following it was determined that air-coupled ultrasonics was the most suitable non-invasive test method. Optimisation of the air-coupled ultrasonic test method was conducted for use in a non-laboratory environment. Aluminium, GFRP and CFRP plates were then heated to 200°C using a Liquid Petroleum Gas (LPG) bottle and burner to simulate fire conditions. The materials underwent air-coupled ultrasonic testing at 10°C temperature increments. The test results were then evaluated in relation to the suitability of the chosen non-invasive test method, impact of temperature on results, material properties and structural integrity issues, suitability of

Figure 1 – CFRP Air-Coupled Ultrasonic Test Under Fire

the results to be used as a baseline response at a set temperature and limitations of this non-invasive test method.

4. Key Outcomes

The key outcomes of this project thus far are:

- The development of an air-coupled ultrasonic test method suitable for use in a non-laboratory environment.
- Initial results show the ultrasonic wave response progressively changes due to thermal loading as the plates are impacted by the fire.

5. Further Work

Beyond the scope of this project, further work will include:

- Optimisation of the non-invasive test method response and feedback for end user functionality.
- Re-design of the non-invasive test method to be fully portable and suitable for a fire hazardous environment.

6. Conclusions

Initial results show the suitability of an air-coupled ultrasonics to test for testing the integrity of bulkheads and/or deckheads during a fire. Further analysis is to be undertaken to evaluate the ultrasonic response to material behaviour under fire.

Acknowledgements

References

Beatrice Faggiano, Gianfranco De Matteis, R. L. . F. M. M. (2004), 'Behaviour of aluminium alloy structure under fire', Journal of Civil Engineering and Management.

Effects of an Ageing Population on Road Intersection Functionality

Sponsor – Harrison Infrastructure Group

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Mr Tony Gallagher (Harrison Infrastructure Group)

Keywords: Gap Acceptance, Elderly Drivers, Traffic Engineering

1. Introduction

This project aims to explore the effects of an ageing population on road intersection functionality. This will be done by a gap acceptance analysis focusing on critical gap and follow-up headway for various intersections. It is important to define these concepts as critical gap is the minimum time taken to complete a manoeuvre such as a right-hand turn within the flow of traffic. Furthermore follow-up headway is the time taken for the proceeding car to complete the same manoeuvre within the same gap.

This gap acceptance analysis will be completed for round-abouts, sign-controlled and signalised interesections using a field study and the computer program SIDRA. The subject of this project is the elderly driver which has been defined as people above the age of 60.

2. Background

AUSTROADS and SIDRA have their default values for critical gap and follow-up headway which are used in the industry. With the population ageing it is important to address whether or not these values need to be adjusted.

3. Methodology

The guidebook for SIDRA Intersection 6 contains a method for field observation for gap acceptance analysis. The method is applied by recording the number of vehicles which enter a gap and the associated duration of the gap. Time and number of
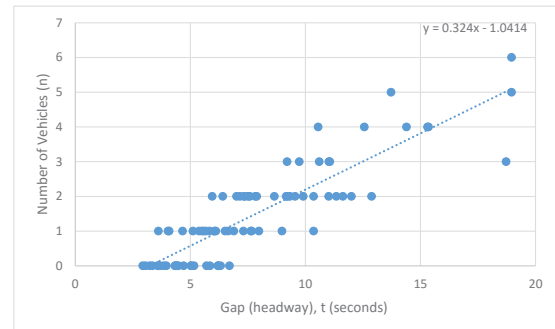

Figure 1 – Gap Acceptance field study for Ruthven and Spring Street (Signalised intersection).

vehicles are plotted to make a linear regression which gives an equation to calculate critical gap and follow-up headway. This method is completed for various types of intersections. Figure 1 displays the outcome of this process.

4. Key Outcomes

The key outcomes from this field study are to test the hypothesis that an ageing population will affect intersection functionality. It is anticipated that an elderly driver requires a longer gap and resultant follow up headway.

5. Further Work

The next stage of this project is to complete the field study for multiple intersections for further possible proof that an ageing population is affecting intersection functionality.

6. Conclusions

This project will prove whether or not an ageing population is affecting intersection functionality. If proved the AUSTROADS standards along with the SIDRA defaults may need to be modified for an ageing population.

Acknowledgements

I would like to acknowledge the support from my supervisor Ron Ayers (USQ) for all the guidance throughout this project. Also I appreciate the sponsorship from the Harrison Infrastructure Group (HIG) and the guidance of Tony Gallagher (HIG).

References

SIDRA SOLUTIONS (2014). Quick Guide to SIDRA Intersection 6. Greythorn, Victoria: Akcelik & Associates Pty Ltd.

A Mechanical Design of Axial flux Permanent Magnet no Clogging Torque

Sponsor - School of Mechanical and Electrical Engineering

Name:Dineshkumar Ganesan

Master of Engineering Science (Mechanical)

Supervisors: Mr Andreas Helwig Lecture, USQ

Keywords: Permanent magnet, flux machine, rotor stator

Introduction

The Electromagnet has become significant uses in many of the fields. Particularly Axial flux permanent magnet is used for the producing electricity in the wind mills and many other applications. This project is mainly design of AFPM where clogging torques is totally avoid to generate power and also used in 3D printing machines

1. Background

The background explains about the design of axial flux permanent magnet and also no clogging torque. The topology of AFPM are investigated and used for various purpose. The design concept of AFPM reducing clogging torque are existed, where it providing the different ways to reduce clogging torque in AFPM machine.

2. Methodology

The methodology of the research project is carries the design, analysis, construction and testing. The software CREO 3.0 is going to use to create the design and it is analysed through finite element analysis. The results will be compared with the augmented calculations

3. Key Outcomes

The outcome of the research project is expected to be greater achievement of developing the axial flux permanent magnet no clogging torque. The test should be conducted to get proper results by using the design.

4. Further Work

The design task is in progress, to attain a proper results and to achieve the accuracy still have to work for it. The once the design is completed the prototype will be developed for the further process.

5. Conclusions

The Axial flux permanent magnet no clogging torques will be achieved and generating of power will easily when the project is successfully completed

Acknowledgements

References

Aydin, M, Zhu, Z. Q & Lipo, T.A.(2007)" Minization of cogging torque in Axial-Flux Permanent Magnet Machines: Design concept" *IEEE Trans*. *Ind. App.*, vol.43, no 9, pp.3615-3621

J. D. L. Ree &N. Boules, (1989)"Torque production in permanent-magnet synchronous motors," *IEEE Trans. Ind. Appl.*, vol. 25, no. 1, pp.107–112,

Visualisation of a 3D Cadastre using Terrestrial Laser Scanning

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(Surveying)

Supervisor: Dr Zhenyu Zhang, USQ

Keywords: 3D Cadastre, Visualisation, Terrestrial Laser Scanning

Figure 1 – Terrestrial Laser Scanning and resulting Point Cloud

1. Introduction

Society is increasingly undergoing densification of its urban environments, resulting in the cadastre extending into 3D space, and subsequently becoming increasingly complex and more difficult to conceptualise land rights restrictions and responsibilities. Visualisation of 3D cadastres and interpretation is not often clear, with archaic 2D mediums used widely to do so. This research project aims to consider visualisation of a 3D cadastre through the use of a terrestrial laser scanner given its capabilities in providing highly accurate and rich datasets. The key objective is to provide a medium in which end users can easily and interactively see the intangible 3D cadastre.

2. Background

Land rights and ownership is transitioning to 3D spaces situated above or below ground, within structures and amongst multiple land uses. Research and investigation were conducted on the use of terrestrial laser scanners to visualise 3D cadastres

3. Methodology

To visualise a 3D cadastre using terrestrial laser scanning, a site was first selected where a 3D Cadastre in effect exists in the form of a basement car-park. A laser scan of the car park was conducted along with a field survey to geo-reference the data. Once the scanned data was collected, a synthesised point cloud was created from the collected scans and the features of the car park were extracted using Leica Cyclone software.

AutoCAD was then used to incorporate the cadastral information from the registered plan into the extracted features to visualise the 3D cadastre within the scanned data. Finally a 3D PDF of the data was generated in order to enable end users relatively easily visualise the 3D cadastre of the subject site using freely available PDF viewers.

4. Key Outcomes

The key goals of this dissertation were to visualise an intangible and complex 3D cadastre using a terrestrial laser scanner. This was achieved through the generation of a 3D PDF, which enabled effective and clear visualisation of a 3D cadastre.

5. Further Work

Further work could include integration of this method of visualisation of 3D cadastres with GIS datasets such as Land Administration Domain Models (LADM) and Digital Cadastral Databases.

6. Conclusions

The terrestrial laser scanner is an effective tool in being able to visualise a 3D cadastre. The resulting dataset has provided a medium that is dynamic, interactive and informative concerning land rights, restrictions and responsibilities.

Acknowledgements

References

Pouliot, J., & Vasser, M. (2014). Terrestrial LiDAR Capabilities for 3D Data Acquisition (Indoor and Outdoor) in the Context of Cadastral Modelling: A Comparative Analysis for Apartment Units. *4th International Workshop on 3D cadastres, 4*(1), 99-107.

Shojaei, D., Kalantari, M., Bishop, I. D., Rajabifard, A., & Aien, A. (2013). Visualization requirements for 3D cadastral systems. *Computers, Environment and Urban Systems, 41*, 39-54.

Use of Chemical Additives in Foam Bitumen Stabilisation

Sponsor – School of Civil Engineering and Surveying

Jonathan Gilmour

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Andreas Nataatmadja, USQ

Figure 1: Insitu foamed bitumen stabilisation (Kendall, Baker, Evans, & Ramanujam, 2016)

Keywords: Supplementary binders, sodium silicate, foam bitumen.

1. Introduction

This project is to determine if waterglass (sodium silicate) can be used as an alternative to lime as a supplementary binder in foam bitumen stabilisation.

2. Background

Foamed bitumen stabilization "is a viable, cost-effective, environmentally sensitive method to rehabilitate a roadway or street which has significantly deteriorated from wear, or which was not originally constructed with a proper structural section". (Techtransfer.berkeley.edu, 2015) Foamed bitumen is often used in conjunction with a supplementary binder. Within Australia that binder is usually lime. Sodium silicate is used in soil stabilization and to improve adhesion in cement mixes. The research was conducted to find out whether waterglass can be used as an alternative to lime as a supplementary binder in foam bitumen blends.

3. Methodology

The development and testing of foam bitumen samples was carried out in the USQ labourites. This includes all preparation, mixing, curing and testing.

4. Key Outcomes

The required outcome of this research project is to identify the amount of waterglass that can be substituted for lime as a supplementary binder in foam bitumen mixes, whilst maintaining characteristics displayed by current bitumen stabilisation in the Australian Standards. The use of waterglass as a supplementary binder has potential economic and environmental benefits.

5. Further Work

All research and analysis of the sodium silicate supplementary binder has not been completed. Further research and analysis into the physical properties exerted by sodium silicate stabilized aggregate is yet to be completed.

6. Conclusions

Alternative binders that modify bitumen have the potential to help save the world's natural resources and reduce energy consumption while maintaining and at times even improving performance. Sodium silicate is a readily available, non-organic product that could potentially be used as an alternative supplementary binder in foam bitumen blends.

Acknowledgements

References

Huan, Y., Jitsangiam, P., & Nikraz, H. (2011). Effects of Active Filler Selection on Foamed Bitumen Mixture in Western Australia. *AMM*, *90-93*, 457-465. http://dx.doi.org/10.4028/www.scientific.net/amm.90-93.457

Kendall, M., Baker, B., Evans, P., & Ramanujam, J. (2016). *Foamed Bitumen Stabilisation*. *AustStab*. Retrieved 16 June 2016, from http://www.auststab.com.au/pdf/tp26.pdf

Raffaelli, D. (2004). *Foamed Asphalt Base Stabilization*. *Technology Transfer Program*. Retrieved 18 June 2016, from http://www.techtransfer.berkeley.edu/sites/default/files/technical-topics/2004techtopics.pdf

Remotely Operated Tele-present Robotics

School of Mechanical and Electrical Engineering

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Bachelor of Engineering
(Mechatronics)

Supervisors: Dr Tobias Low, USQ

Keywords: Robotics, VR Headsets & Control Methods

1. Introduction

This research project investigates depth perception vision and alternative control methods to determine if user interaction and operation of remotely controlled robotics can be improved through the addition of these features. The project scope includes the design, construction and operation of such a device termed as a "remotely operated telepresent robot".

A study to investigate whether there are any benefits to incorporating these features into current tele-operated robotics has been conducted. The study compares the factors of accuracy, speed, learning curve and ease of use of the telepresent features against more traditional control methods such as joysticks and buttons.

2. Background

The Oculus Rift Development Kit 2.0 is a low cost device originally developed to for the electronic entertainment industry which allows users to experience virtual reality. Being newly developed technology, the device is relatively untested in other fields of applications and shows great potential in the field of robotics where remotely operated robots are frequently used in hazardous environments in place of humans to prevent injury or death.

3. Methodology

The project consists of 6 main phases. The key aspects of these phases involve:

1) Reviewing and utilising existing literature
2) Incorporating the Oculus Rift virtual reality headset (**Figure 1**) in tandem with digital video cameras to achieve stereoscopic vision

Figure 1 – Oculus Rift Development Kit 2.0

3) The construction of a wearable apparatus to allow a robotic arm to mimic the movement of a human arm
4) Construction of a mobile platform
5) Amalgamation of all aspects of research and constructed components for experimental testing
6) The write-up phase

4. Expected Outcomes

Expected outcomes include; the development of a new remotely operated telepresent robot, detailed information on whether the Oculus Rift DK2 can provide an advantage over traditional camera-screen combinations for users, detailed information on whether a wearable control apparatus can provide an advantage over joystick and buttons for users and how easy this technology can be adapted for use in robotics.

5. Further Work

Currently further testing of the constructed hardware is to be undergone to gather conclusive evidence of any benefits related to adapting this technology to the field of tele-operated robotics.

6. Conclusions

Currently, conclusive evidence is unavailable with further testing still required. Please see the completed dissertation after 13th October 2016 for final conclusions.

Acknowledgements

I would like to acknowledge Dr Tobias Low for the valuable advice, guidance and feedback through he course of the project.

References

Oculus, 2015, Oculus USA, Irvine, California, viewed 20 October 2015,
< https://www.oculus.com/en-us/rift/>

Best practice management of industrial process control alarm floods

Sponsor – School of Mechanical and Electrical Engineering

Ross Guy

Bachelor of Engineering (Instrumentation and Control)

Supervisors: Mrs Catherine Hills, USQ

Figure 1 – Alarm flood - exceeding 10 alarms in 10 minutes

1. Introduction

The term "big data" describes gathering, processing and storing large amounts information for use. Modern control systems utilise data interface tools to increase the effectiveness between human, machine and process. Designed with the ability to extract and analyse data, limit downtime by self-diagnosing problems in the form of an alarms, redesign via software changes all contribute towards continuously improving the apparatus and process one strives to control. This ability if not managed can introduce other problems such as information overload. This project studies best practice to avoid, better manage or address alarm system information overloads known as "Alarm Floods".

2. Background

Major industrial incident investigations associate alarm floods as a contributing factor leading to or during an incident or abnormal event. Alarm floods overwhelm the operator with audio and visual alarms, often causing the operator to abandon the alarm system that is designed to aid the operator rectify a situation. In 1991, the ASM Consortium estimated abnormal situations cost the US petrochemical industry $10-20 billion per year (EEMUA, 2013). An area of research in this field is automatic alarm load shedding algorithms which limit alarm frequency rates however, is yet to be proven practical and safe (EEMUA, 2013).

3. Methodology

The research methodology employed in this project includes qualitative or quantitative research of current industry process control alarm management systems, human factors, standards and industry best practice publications. Alarm data was extracted and analysed to dete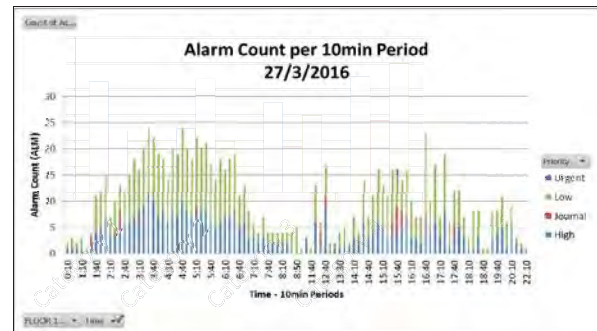rmine the systems performance against best practice benchmarks. High alarm frequency periods alarm load shedding methods were also considered.

4. Key Outcomes

Timely targeted analysis of alarm system data identifies poor performance areas to aid integrated accountability while working towards reliable alarm systems.

5. Further Work

Further develop standardised methods of analysing alarm data using available tools to increase alarm system performance, awareness and accountability.

6. Conclusions

The implementation of alarm system performance metrics measuring a range of Key Performance Indicators (KPI) assists operators present the state of an alarm management system to targeted influential audience, vital to effectively and efficiently address alarm management issues within suitable timeframes.

Acknowledgements

References

ANSI/ ISA, 2009, 18.2 - Management of Alarm Systems for the Process Industries, published by the International Society of Automation (ISA), Research Triangle Park, North Carolina 27709

EEMUA, 2013, Alarm systems - A guide to design, management and procurement, publication 191, edition 3, published by the Engineering Equipment and Materials Users' Association (EEMUA), London

Reduction of Fertiliser Losses in Agriculture

School of Civil Engineering and Surveying

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Bachelor of Engineering (Honours) (Environmental)

Supervisors: Assoc Prof Thomas Banhazi, USQ

Dr Les Bowtell, USQ

Keywords: Fertiliser, Soil, Biochar

1. Introduction
This project involves investigating the effectiveness of biochar in reducing fertiliser losses in agriculture. Reducing, or even eliminating these losses is expected to have considerable economic and environmental benefits. The project focused on a key problem area, specifically, the leaching of nitrogen fertilisers from sugar cane crops. By adding biochar to the soil in a simulated sugar cane environment, this investigation endeavours to determine its effectiveness in an industry where fertiliser losses do occur.

2. Background
Pollution from fertilisers is a global issue, with around half the fertilisers applied to some popular crops being washed away. These lost nutrients pollute water courses, causing algal blooms, as well as other negative environmental impacts such as soil acidification and groundwater pollution. As expected, these environmental effects in turn have negative economic implications as well, providing further motivation to reduce fertiliser runoff in agriculture.

3. Methodology
It was decided to conduct soil column tests, designed to simulate spring rainfall on a sugarcane crop after fertiliser had been applied. Rates of biochar application were decided according to a recent field trial, while fertiliser doses followed the industry standard for the soil used.

4. Key Outcomes
While tests are ongoing, it is expected that this investigation will determine the effectiveness of biochar in reducing nitrogen losses in the sugar cane industry under both standard and increased fertiliser loads. The difference in performance between banded and incorporated biochar application should also become apparent.

5. Further Work
This is a broad area of study, and there is an opportunity for further work, as this investigation (quite appropriately) is only a preliminary study. Future areas of study might include (1) the ability of biochar to retain phosphorous and potassium fertiliser, (2) the effect of different soil types, and ultimately, (3) the optimal amounts of biochar and fertiliser to apply to a given crop. Some further study into (4) application methods may also be possible, while the (5) performance of different types of biochar might need investigation. Creating (6) biochar-fertiliser composites could also provide further benefits. Economics of biochar production (7) is possibly the most important area of future study as biochars need to be produced cost effectively to ensure wider adoption of this technology.

6. Conclusions
This investigation aims to demonstrate that biochar is a possible means of reducing fertiliser losses in the sugar cane industry, as well as determining how well field trials scale to simpler (and cheaper) lab experiments.

Acknowledgements

References
Lehmann, J & Joseph, S 2009, *Biochar for Environmental Management: Science and Technology*, Taylor & Francis, Abingdon, United Kingdom.

Morley, G 2015, *Assessing the impact of biochar in the Herbert cane industry*, Sugar Research Australia, Indooroopilly, viewed 26 July 2016, <http://elibrary.sugarresearch.com.au/handle/11079/14654;jsessionid=8AAF0B6F24F076F87A873BAA2273ACE6?show=full >.

Acoustic shark repellent

University of southern Queensland

Student Name

Yousef A Haidar

Bachelors of Engineering (Honours) (Mechanical)

Supervisors: Mr Ray Malpress, USQ

Keywords: Acoustic shark repellent

1. Introduction

Almost 70 years of researches on developing shark repellents to decrease the number of shark bycatch and prevent shark attacks on humans has led to only a few reliable, affordable and effective solutions. This study aims to explore the possibility of enhancing acoustic shark repellent device capabilities.

2. Background

Because of dangerous conditions related to the safety of humans at sea, technologies emerged to avoid shark attacks. The basic idea is not to harm the sea creatures and affect the aquatic eco systems the devise works in a way by which shark attacks can be prevented. This prevention can be achieved through a certain sound frequency emitted in the acoustic shark repellent device causing a shark to pull back or force it to keep a safe distance from its target.

3. Methodology

Following is the main tasks needed to be achieved in order to successfully meet the main objective. Exploring the information in the literature to determine the significance of the repellent performance using a statistical approach. Using information obtained from literature review; establish what aspects of repellent performance have been proven to be effective. Exploring materials that can be used for the acoustic shark repellent with the goal of enhancing performance in water. Simulate performance of combinations on repellent modifications using computer software.

4. Key Outcomes

Key outcomes in completing the tasks are as follows. Accumulating information on shark's acoustic sensory preceptors and specifying the range over which artificially generation acoustic signals can influence shark behaviour. Determining an appropriate distance an acoustic shark repellent device can be effective. Thirdly, identify an effective material to increase the reliability of the frequency generated by the acoustic shark repellent. Finally, we are able to purpose an effective frequency to repel multiple types of shark species.
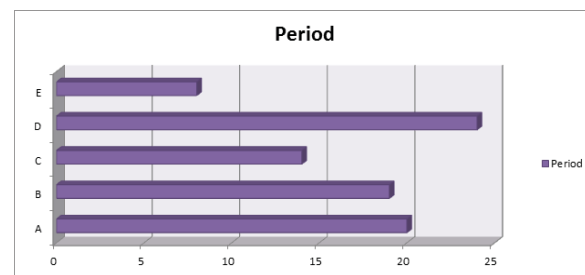

Figure 1 Period of day's bar chart

5. Further Work

Simulating performance of combinations on repellent modifications using computer software task is yet to be achieved. There is one aspect in the project that I will not be able to address .I wanted to analyse two commercially purchase acoustic devices however acoustic devices are currently not available for purchase in the market .when the acoustic shark repellent is available in the market I would like to continue conducting the project analysis and tests.

6. Conclusions

We are able to explore the characteristics in terms of frequency, distance, material etc. In which acoustic shark repellents can be enhanced in order for the device to operate in different set of conditions that can consistently repel sharks

Acknowledgements

I would like to thank my supervisor Ray Malpress .Ray supported me throughout the project even when I made mistakes he did not give up on me and guided me in the correct path though out the project.

References

Hart NS & Collin SP 2015, 'Sharks senses and shark

repellents', *Integrative Zoology,* vol. 10, pp. 38–64.

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Image Processing for Crown Rot Detecting in Wheat

The National Centre for Engineering in Agriculture-University of Southern Queensland

Rawaz Hama Ali

Master of Engineering Science (Agricultural)

Supervisors: Dr Cheryl McCarthy NCEA

Dr.Cassy Percy Centre for Crop Health CCH

Keywords: Image Processing, Crown rot, ImageJ

1. Introduction

Crown Rot is a fungus disease caused by Fusarium Pseudograminearum. It affects the wheat crown area and browns them. This disease reduces the wheat yield by 10% yearly. Current method to identify and scoring this disease is using naked eye which is not accurate and time consuming. Using image processing technique will accelerate identification process, time and labour saver.

2. Background

Diseases are the main cause of harm that threaten wheat. These diseases need a cautious diagnosis in order to protect the wheat yield from heavy losses The most widely method of the disease detection is visual scoring. The problem with this method of detection is that it is not only time consuming, but not accurate as well as it is relied on the inspector's judgement. Therefore, new methods are required to reduce time to identify and scoring crown rot in the wheat crown area.

3. Methodology

Infected tiller for this project comes from the Centre of Crop Health at the University of Southern Queensland from the harvested Crown rot infected wheat plant. Each infected tiller will be photographed in a bright environment. Different acquisition methods were used such as point and shot camera, hyperspectral line scanner, and an infrared camera. CVIPtools, ImageJ, Image Studio lite, and Image Net software processed the results that will be interpreted based on the degree of
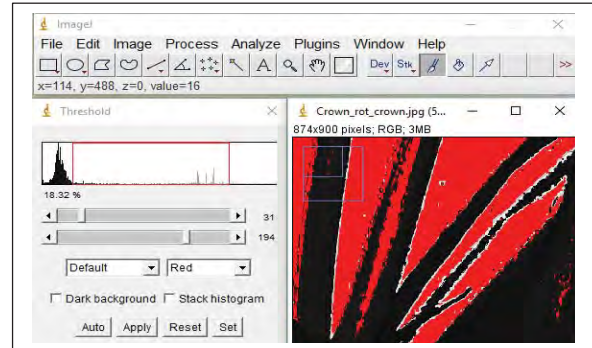

Figure 1 – Crown rot Identification using ImageJ severity from 0-5, in which 0 means a healthy tiller, and 5 means severe infection.

4. Key Outcomes

This research will develop a new method for Centre of Crop Health -USQ to detect Crown rot disease which is lead to breed a variety which is more resistance to Crown rot disease.

5. Further Work

Further work required to assess outcome and finding error rate.by using False acceptance ratio (FAR), False rejection ratio (FRR) and Recognition ratio (RR). Processing of identifying different varieties of Crown rot infected wheats.

6. Conclusions

Identifying and scoring Crown rot Disease with Visually is not accurate, time consuming. Using image processing technique will accelerate the process and more accurate. This project can be used as a replacement of current Crown rot detection and scoring method.

Acknowledgements

I would like to thank my supervisor Dr. Cheryl McCarthy for her support and guidance, Dr.Cassy Piercy for her support and providing diseased samples and explanation on current scoring method.

References

Burgess, L, Wearing, A & Toussoun, T 1975, Surveys of Fusaria associated with crown rot of wheat in eastern Australia, Aust. *J. Agric. Res.*, vol. 26 no.5 p.791.

Camargo, A & Smith, J 2009, An image-processing based algorithm to automatically identify plant disease visual symptoms, *Biosystems Engineering*, vol.102, no.1 pp.9-21.

Real world 3D accuracy achievable of Australian Standard 5488- 2013 Classification of Subsurface Utility Information using electromagnetic field detection

Sponsor – School of Civil Engineering and Surveying

Samuel Hathaway

Bachelor of Spatial Science (Honours) (Surveying)
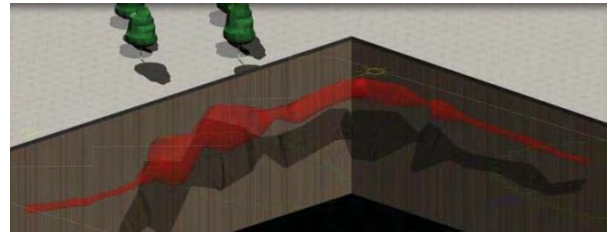
Supervisor: Dr Albert Chong, USQ

Figure 1 – Underground utility line - confidence

Keywords: **Subsurface Utility Detection, AS 5488, Utility Mapping**

1. Introduction

The aim of this project is to evaluate the Real world 3D accuracy achievable of Australian Standard 5488-2013 Classification of Subsurface Utility Information using electromagnetic field detection methods.

This report is not designed to improve the methods of electromagnetic detection. The aim of the report is to evaluate statistically the results that can be obtained using electromagnetic detection techniques available to the ordinary surveyor.

2. Background

Surveyors are often measuring what's on the surface of the land and creating a plan for designers to use to help them design future developments on. Yet hundreds of kilometres of underground services - pipes and cables that carry vital services such as water, electricity, communications and gas are buried throughout and that number is increasing every year. For a surveyor who typically works around 5 millimetres to be able the measure utilities to the required quality it should be quite simple, the only weak link being what is the real accuracy that can be obtained from the electromagnetic field detector.

3. Methodology

A field measurement programme was designed to collect appropriate data. This programme included the independent measurements of the same utility line using the different equipment. The data collected was then critically evaluated using the results obtained from exposing each underground utility.

4. Key Outcomes

The key outcomes of the project will be to see the reliability of the results both absolutely and relatively between each of the equipment evaluated.

5. Further Work

With time permitting it would be good to try and test newer detection equipment which has a GPS unit built in and compare it to the results collected.

6. Conclusions

A surveyor who could produce a plan showing the full picture above and below a subject land would be a very valuable tool, But also an understanding of the quality of data that is obtained is essential for it's real world use/limitations.

Acknowledgements

I would like to thank my colleagues at Landmark Surveys for their encouragement, support, equipment and software. And also my supervisor Dr Albert Chong for his guidance.

References

Dial Before You Dig, 2016. *Home - DBYD Locator*. [online] Available at: <http://www.dbydlocator.com/>

Li, S., Cai, H. and Kamat, V., 2015. Uncertainty-aware geospatial system for mapping and visualizing underground utilities. *Automation in Construction*, 53, pp.105-119.

Lew, Anspach, Scott, Slack, 2000, Cost Savings on Highway Projects Utilizing Subsurface Utility Engineering, Purdue University

Using Engineering Cementitious Composites as an adhesive for near-surface mounted FRP bars strengthening concrete/masonry structures

School of Civil Engineering and Surveying
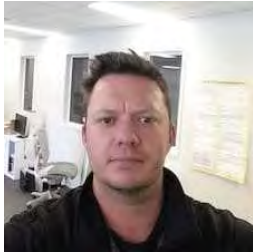
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Bachelor of Engineering (Civil)

Supervisors:
Associate Professor
Yan Zhuge, USQ

Keywords: Engineered Cementitious Composites, Structural Reinforcement,

Figure 1 – Near Surface Mounted Reinforcement System

1. Introduction

The aim of this project was to determine if engineered cementitious composites (ECC) could be successfully implemented as groove filling material as it has higher tensile strength and excellent ductility compared to typical cementitious grout, and is cheaper than epoxy alternatives.

2. Background

Internationally, the cost of maintenance and rehabilitation of infrastructure is growing, and has reached roughly 50% of total construction expenditure in many countries. The near-surface mounted (NSM) FRP method has attracted increasing attention worldwide as one of the most promising techniques for structural strengthening and as an effective alternative to the externally bonded FRP method. Typical adhesives include cementitious mortar and epoxy however engineered cementitious composites offer greater ductility compared to cementitious grout and lower cost compared to epoxy.

3. Methodology

Understanding the bond slip behaviour between the substrate, adhesive and reinforcing is critical in assessing the suitability of adhesive for use in a near surface mounted system. In order to determine the suitability of ECC as an adhesive, an experimental program using a direct shear test was conducted comparing a typical cementitious mortar adhesive and an engineered cementitious composite adhesive.

4. Key Outcomes

The preliminary round of testing produced results that demonstrated strain hardening in the samples that used an ECC binder. However the results still demonstrated brit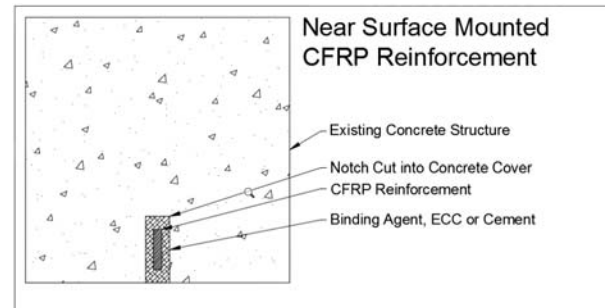tle failure once samples were loaded to plastic deformation. It is presumed this is a result of a fast loading rate hence a second round of testing is to be completed.

5. Further Work

The ECC mix design used in this project was too wet to be used in overhead or vertical applications. There is potential future work to develop more workable mix designs to improve workability of the ECC in soffit applications.

6. Conclusions

The results of the experimental testing indicate that the material characteristics of ECC make it a suitable adhesive for use in a near surface mounted system. While not as strong as epoxy adhesives the ECC adhesive are capable of sufficient bond to ensure the reinforcing is fully utilised.

Acknowledgements

References

De Lorenzis, L. and J.G. Teng, *Near-surface mounted FRP reinforcement: An emerging technique for strengthening structures.* Composites Part B: Engineering, 2007. **38**(2): p. 119-143.

Li, V.C. and T. Kanda, *Innovations Forum: Engineered cementitious composites for structural applications.* Journal of Materials in Civil Engineering 1998. **10**(2): p. 66-69

Investigation into flexural characteristics of cold formed steel filled with rubberised concrete

School of Civil Engineering and Surveying

Brendon Heath

Bachelor of Engineering (Honours)(Civil)

Supervisor: Assoc. Prof. Yan Zhuge, USQ

Keywords: Crumb Rubber Concrete (CRC), Cold Formed Steel, Compressive strength, Flexural Strength.

1. Introduction

This study investigates the optimal use of crumb rubber as partial replacement for natural sand aggregate in concrete. The effect of various treatment methods for crumb rubber and local sourced materials has been examined. Although adding rubber to concrete is known to have negative effects on compressive strength, rubber treatment methods may be a viable option for reversing the reduction in strength. Furthermore, the use of local aggregates contributes to the literature and helps gain insight into whether there is a locational factor for CRC strength.

2. Background

The disposal of waste tyres is a series threat and raises many environmental issues. The use of recycled crumb rubber as a substitute for fine aggregate will help the construction industry preserve the environment while reducing the stress on natural resources.

3. Methodology

Stage 1: Determination of CRC mix design for use in composite concrete slab. Fifteen cylindrical specimens and fifteen prism specimens with varying crumb rubber content (0% to 20% replacement of fine aggregate) and various rubber treatment methods were created. The specimens were tested for compression and four point bending to determine the strength characteristics. Preliminary results for compression are shown in Figure 1.

Stage 2: Shear-bond connection test. Two composite slabs (0.3m x 0.1m x 1m) will be tested. Both specimens were created using Bondek permanent formwork. One specimens was created using the optimised design mix from stage one and the other specimen was created using ordinary concrete as a
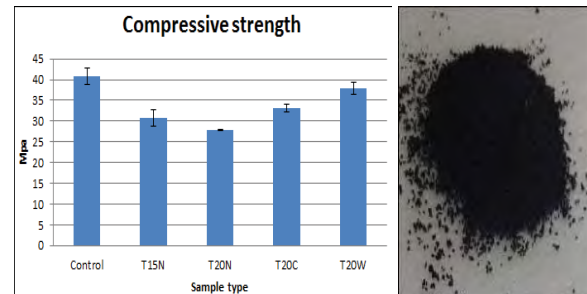

Figure 1 – Compressive strength of various concrete specimens and a sample of crumb rubber

control panel. The results from both samples will be compared to determine the effect of crumb rubber.

4. Key Outcomes

Testing on the first stage CRC specimens found CRC treated by water soaking is 13% stronger than CRC treated with sodium hydroxide treatment and 27% stronger than no treatment. The method of water soaking is a far simpler rubber treatment method making it much easier to implement on an industrial scale.

5. Further Work

Testing of stage 2 specimens is still to be conducted. Once this is accomplished, a detailed analysis of the data can be completed.

6. Conclusions

Results from stage 1 testing indicated that even with 20% water treated crumb rubber, there is no significant loss of compressive strength.

Acknowledgements

References

Yousff, O., ElGawady, M., Mills, J., & Xing, M. (2014). An experimental investigation of crumb rubber concrete confined by fibre reinforced polymer tubes, *Construction and Building Materials*, *53*, 522-532.

Mohammadi, I., Khabbaz, H. (2015). Shrinkage performance of crumb rubber concrete (CRC) prepared by water-soaking treatment ethod for rigid pavements, *Cement and Concrete Composites*, *62* 106-116.

Automatic Circuit Recloser (ACR) Communications Using P25 RMU (Radio Modem Unit)

Sponsor – School of Mechanical and Electrical Engineering

Hung Hoang

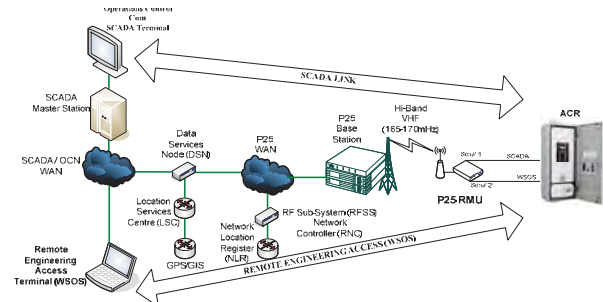Bachelor of Engineering (Electrical and Electronics)

Supervisor: Mrs Catherine Hills, USQ

Figure 1 - ACR Communications Using P25 RMU (Radio Modem Unit)

Keywords: Research, Configure and Investigate.

1. Introduction

The current Ergon Energy telecommunications in the field for remote smart grid operations to its Automatic Circuit Reclosers (ACRs) uses public carriers such as Telstra mobile data services and Immarsat BGN network (Satellite).

The operational cost of using Immarsat BGN network is very costly ($8 per Megabyte) so there is financial incentive to investigate the use of the P25 Radio Modem Unit (RMU) to provide communications to ACR using existing the Ergon Energy P25 Radio Network.

2. Background

This project aims to assess the capabilities of the P25 devices in the context of Ergon Energy's operational requirements through both research and practical experimentation. The results will be used to identify and quantify (where possible) potential issues and make recommendations about any implementation.

3. Methodology

The main aim is to use P25 RMUs over the Ergon Energy P25 Radio Network for communications to ACRs by benchmarking against the existing NextG modems in use. Communications must be implemented for two serial ports on the ACR, one for SCADA and the other for engineering configuration access as shown in Figure 1.

4. Key Outcomes

The data and packet formats of the P25 communications protocol for both the DNP3 and engineering access connections have been documented. The operational requirements of the ACR SCADA and Remote Engineering connections have been identified. Following this a testbed was established and used to evaluate performance across a range of parameters. These were compared to the identified requirements.

5. Further Work

The results and recommendations will be documented in a format useful for Ergon Energy as a decision making tool.

6. Conclusions

The P25 RMU testbed assessed performance against the benchmarks established for the existing NextG modem application used on ACR. The P25 RMU worked with limitations which are to be outlined in the report on findings and hence recommendations to further improve the performance.

Acknowledgements

The author sincere appreciations are offer to: Glenn Firth for conceiving the project topic, project supervisor Catherine Hills, Trevor Gilliland with SCADA master station configuration, Greg Borger and Ian McNalty for provision of P25 operation information, James Lowes for authorising access to P25 BSC for operational testings, my wife and children for their support and patience throughout the project.

References

Hung Hoang, Research Project 2016. *Automatic Circuit Recloser (ACR) Using P25 RMU (Radio Modem Unit).*

Managing Our Assets – Stormwater and Wastewater Pipeline Condition Assessment for the Grey District

Sponsor – Grey District Council

Elena Hofman Bachelor of Engineering (Honours) (Civil)

Supervisors: Associate Prof David Thorpe, USQ

Keywords: Water, condition assessment, asset management

1. Introduction

The aim of my project is to undertake a condition assessment of 400km of stormwater and wastewater pipelines within the Grey District, New Zealand. This will be used by the Grey District Council (GDC) to improve current asset management practices, assist planning of physical works and to justify financial expenditure.

2. Background

Many pipelines are aged beyond, or near to, their expected design lives. There are many different pipe materials, diameters and ages including stone/brick arch pipelines from the early 1900's, plus there are pipelines subject to significant loading from buildings, highways and railway lines. GDC is under increasing pressure to optimise the useful life of these pipelines and manage their expenditure appropriately.

3. Methodology

A methodological approach was required due to funding constraints and to take into account the wide number and complexity of factors affecting overall pipe network condition. Assets were first allocated a criticality score based on the consequence of failure. The matrix shown in Figure 1 was then used to prioritise CCTV inspections. The CCTV inspections resulted in structural and service condition grades for each pipeline, which along with information from contractors and Council Engineers, were used to help decide the overall pipe condition.

		Pipe Criticality Score								
		7	8	9	10	11	12	13	14	15
		Low			Medium			High		
Remaining life (yrs)	30+	5	5	5	4	4	4	3	3	3
	10-30	4	4	4	3	3	3	2	2	2
	0-10	3	3	3	2	2	2	1	1	1
	<0	2	2	2	1	1	1	1	1	1

Figure 1 – CCTV Prioritisation Matrix

4. Key Outcomes

The pipelines are in varying condition, with some being excellent and others requiring urgent repair. Determining the expected remaining life of the pipes is difficult and needs careful consideration in each case.

5. Further Work

Once the data has been collected from the CCTV investigations, I will analyse the pipe condition and extrapolate the information to all assets where suitable. If time allows I hope to complete a forward works programme for future maintenance and renewals.

6. Conclusions

The key achievement is that GDC will, for the first time, have up-to-date information on the condition of their stormwater and wastewater pipelines. They will be able to proactively manage these assets, which will optimise the useful life of the pipes and lead to more sustainable infrastructure funding.

Acknowledgements

References

Institute of Professional Engineers Australia (2015) *International Infrastructure Management Manual*. (5th ed.). Australia.

New Zealand Water and Wastes Association (2006) *New Zealand Pipe Inspection Manual (3rd ed).* Wellington.

Development of Multi-Sensor Wireless Link for Non-Critical Gas Systems

School and Mechanical and Electrical Engineering/Gas Detection Australia Pty Ltd
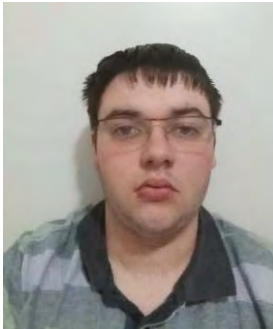
James Hogg

Bachelor of Engineering (Honours) (Electrical and Electronics) and Bachelor of Science (Mathematics)
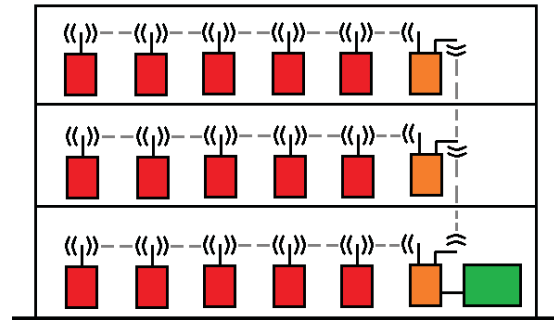
Figure 1 - Demonstration of multi-floor network structure.

Supervisors: Mr Mark Phythian, USQ

Mr James Boucher & Mr Chris Kelly, Gas Detection Australia

Keywords: LoRa, Wireless, Networking, Sensors

1. Introduction
The industry standard 4-20mA current system for transmitting sensor information is widely used in many building systems. However, with physical infrastructure required for this system, installing in existing structures can cause many difficulties. To alleviate this issue, a wireless solution is required to reduce infrastructure modifications. The aim of this project is to design and test a wireless interface board to communicate over distances up to a kilometre within a building environment, to act as an extension of the 4-20mA system. A secondary aim of the project is to develop an energy efficient proprietary protocol for secure data transmission between devices.

2. Background
Gas Detection Australia (GDA) design and manufacture gas detection products that typically use the 4-20mA current standard for communicating sensor information. However, in some situations, a wired solution is not appropriate, so a wireless solution is needed. There are already many such products on the market, but as GDA wishes to use a secure data transmission, a new design is required.

3. Methodology
A literature review was conducted to see how other companies had constructed their own devices. During this process, a performance criteria was created with the assistance of GDA for creating a prototype system. The prototype system required both the hardware and software to be designed, with the hardware being most important, due to the nature of radio frequency communications.

4. Key Outcomes
The key outcomes of this project are the evaluation of a wireless system for transmission of information pertaining to GDA equipment and sensors, and the development of a energy optimised communication protocol. At the time of writing, the proof of concept has been completed, and testing will begin shortly. Testing should be complete by the residential school week.

5. Further Work
Testing should be completed by now, with the preliminary results available in my presentation. The communication protocol should be in the process of being tested, with the final write-up of the project underway.

6. Conclusions
The key conclusion is that the device does work as intended, and will fulfil the performance criteria specificied.

Acknowledgements

References
Sornin, N et al. (2015). LoRaWAN Specification v1.0 : LoRa Alliance.

An Investigation into Surveying Graduate Capabilities, Job Readiness, and the Aim of Universities

School of Civil Engineering and Surveying

Carl Hotz

Bachelor of Spatial Science (Honours) (Surveying)

Supervisor: Dr Marita Basson, USQ

Keywords: Surveying Graduate Capabilities.

1. Introduction

As the mining industry in Australia continues to slow, the government are beginning to increasingly rely on infrastructure projects to maintain economic growth and provide employment. Surveyors play a key role in the operation of these projects, and with the forecast shortage of surveyors predicted in the BIS Shrapnel (2013) report set to peak in 2019, it leaves little time to find a solution. The current shortage of surveyors in Australia is evident at all levels of qualification (BIS Shrapnel 2013). With the peak of the shortage less than four years away, it is argued that a strategy needs to be implemented as soon as possible to lessen the severity, as it has the potential to be detrimental to proposed major infrastructure projects (Consulting Surveyors National 2013). Currently, to become a fully qualified surveyor in Queensland it takes four years of fulltime study, plus approximately two years to become registered, plus approximately two additional years to obtain a surveying endorsement, for example a cadastral, engineering or mining endorsement. This leaves the total minimum time required to become fully qualified at approximately eight years. At the time of the completion of this report there will be two years until the predicted shortage peaks. The aim of this report is to focus on surveying graduate capabilities, their job readiness and the aim of the universities as an institution. Similar studies in various disciplines have shown that university degree curriculum for these disciplines do not adequately prepare the student for what is expected from them in the workplace. As there has been no review of the surveying degree curriculum for quite some time now is the ideal time to complete one.

2. Methodology

The methodology selected for this project was a hybrid of the Define Your Discipline (DYD) approach (Dowling & Hadgraft 2013). Slight modifications were made to the DYD process to tailor the process to this project.

3. Key Outcomes

The aim of this project was to:

1. Establish the need for improved job readiness skills in surveying graduates.

2. Establish the current benchmarks for surveying graduate capabilities.

3. Establish the expected capabilities of graduates after their first 3 to 5 years of employment.

4. Prepare a draft Graduate Capability Framework.

5. Consult stakeholder groups and authenticate the draft Graduate Capability Framework.

4. Further Work

Tasks remaining are:

1. Prepare a draft Graduate Capability Framework.

2. Consult stakeholder groups and authenticate the draft Graduate Capability Framework.

5. Conclusions

The only conclusion that can be drawn at this point in time is that some authors agree that university degrees need to do more in terms of preparing students for the workforce.

Acknowledgements

References

BIS Shrapnel 2013, Determining the Future Demand, Supply and Skills Gap for Surveying and Geospatial Professionals, Consulting Surveyors National,

Dowling, D & Hadgraft, R, The DYD Stakeholder Consultation Process, 2013, OfL Teaching,

Eraut, M 1994, Developing Professional Knowledge and Competence, Falmer Press, https://books.google.com.au/books?id=8bqz-dZo7TcC>

Effect of Distributed Photovoltaic Embedded Generation on the Electricity Distribution Network

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Bachelor of Engineering

(Honours)

(Electrical and Electronic)

Supervisors: Assoc Prof Tony Ahfock, USQ

Dr Les Bowtell, USQ

Keywords: Photovoltaic, Distributed Embedded Generation, Feeder Load, Electricity Distribution

1. Introduction

Over the past seven years there has been an exponential increase in the capacity of private embedded generation (EG), mainly in the form of photovoltaic (PV) arrays, with Australia now having the highest penetration rates of rooftop PV in the world. This has the potential to cause problems within the traditional, 'top-down' uni-directional power flow electricity distribution network, particularly with regards to voltage rise, voltage regulation, reverse power flow, increase in available fault current and load predictions.

2. Background

With global focus on climate change, it is predicted that the installation of renewables will continue to thrive meaning the effects on the traditional electricity distribution network will become much more apparent. This project aims to investigate the effects of current and future levels of distributed privately owned EG on the electricity distribution network.

3. Methodology

Using empirical data from NSW electricity network operator Ausgrid, this project seeks to analyse the effects of the current level of penetration of EG on the electricity distribution network with regards to voltage rise, voltage regulation, increase in available fault current and reverse power flow, and how these may impact the ability to accurately complete load predictions. Through theoretical modelling, it then proposes to investigate the ongoing effects to the network if the predicted increase in private EG continues, and analyse the problems that may occur. Figure 1 demonstrates the decrease in daytime load on a particular high voltage feeder from 2009 to 2015.
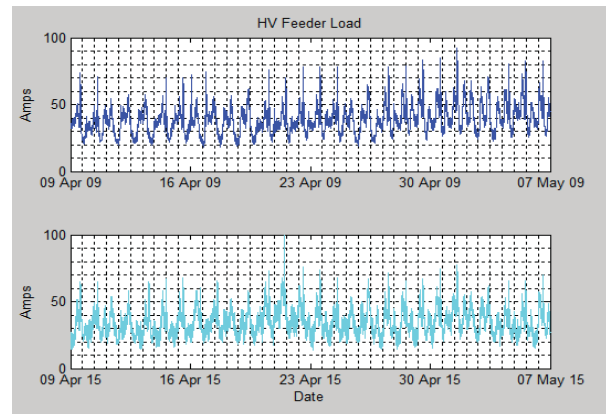

Figure 1: HV Feeder Load Change from 2009 to 2015

4. Key Outcomes

Results of gathering the actual network data, as well as data logging of individual installations showed a direct correlation between a high voltage feeder and individual PV EG installations. It was also proven that the daytime loading on the feeders has decreased over the last seven years, coinciding with increased renewable energy incentives. Theoretical modelling of feeders has been proven using empirical data, and these models have then been used to analyse the effects of increasing the level of distributed EG up to and beyond the predicted penetration levels.

5. Further Work

Further modelling on specific configuration of feeder to analyse the effect EG installed in certain areas has on prospective fault current, and suggesting possible solutions to the problems identified.

6. Conclusions

The current level of distributed EG has had significant loading effects on the electricity distribution network and in certain cases has caused voltage rise on the high voltage network. Modelling has shown that with future increases in distributed EG, these effects will continue to increase.

Acknowledgements

References

Bayliss, C. R. & Hardy, B. J. (2012). *Transmission and distribution electrical engineering*,Oxford, Newnes.

Jenkins, N. (2000). *Embedded generation,* London, Institution of Electrical Engineers.

A Study of Installed Water Sensitive Urban Design Structures in the South West of Western Australia

Sponsor – Calibre Consulting

Dean Huizinga

Master of Engineering Science (Environmental)

Supervisors:

Dr Ian Brodie, USQ

Mr Brendan Oversby, Calibre Consulting

Keywords: WSUD, runoff, LGA

1. Introduction

Urban development increases water runoff and reduces infiltration into groundwater from rain interception through to the receiving water body. Increased connection of impervious surfaces allows the increased discharge of heavy metals and nutrients to sensitive water bodies and environments. Populations on the Swan Coastal plain, Western Australia, rely on groundwater sources. Waterways in the study area already have elevated nutrient levels.

Water sensitive urban design (WSUD) holistically values stormwater run-off as a resource, in contrast to traditional 'pit and pipe' systems which are used to protect against flooding, viewing stormwater as a waste product. The research will focus on bio-retention systems, a conveyance structural design element primarily to improve water quality, in and around urban areas of the Leschenault catchment.

2. Background

WSUD is seen to be important on the Swan Coastal Plain, but its adoption is tenuous and success varied. Some work has been done to understand the barriers to adoption. Many factors combine to give Local Government Authorities (LGAs) different perceptions of WSUD. Expanding urban development means that LGAs require clear guidelines on the factors that deliver the various performance aspects required. Few studies focus on secondary benefits of WSUD and even fewer review assets at post-investment stage. Studies into wetland aesthetics and regional vegetation help to inform this work. The government department has recently developed a nutrient model specifically for this region because current models cannot readily handle the unique hydrogeology.

This project is important in determining how key factors affect performance requirements of bio-retention systems and how that can inform their design, construction and maintenance.

3. Methodology

In coordination with LGAs, 122 representative WSUD sites were selected, inspected and the data collated into a database. Data were categorised to represent factors and indicators. A
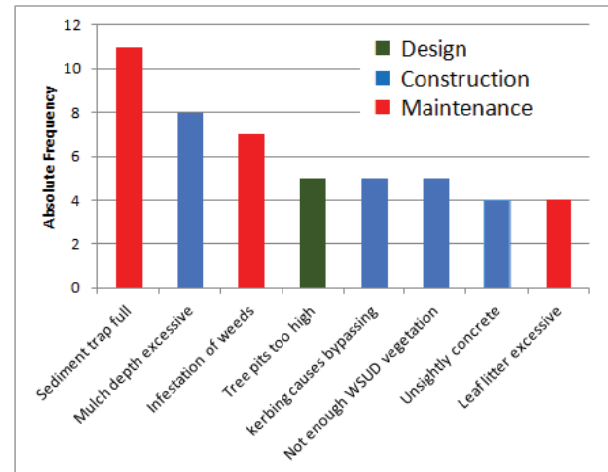

Figure 1 Pareto Analysis of Problems

numerical relationship is being determined and the correlation verified from other unused data. As time permits, hydraulic conductivity performance may be verified by some selected studies.

4. Key Outcomes

Pareto analysis of 72 problems in 23 problem categories shows that maintenance and construction factors account for the chief problems with bio-retention systems and that design problems feature less prominently (Figure 1).

5. Further Work

Numerical analysis of key success factors is planned to derive a matrix of logical links to performance requirements. Qualitative review of significant links may reveal causes. Further work on inlet effectiveness and ponding subsidence may verify a link to hydraulic performance.

6. Conclusions

Post-investment reviews in bio-retention systems can reveal more guidance to LGAs on effective WSUD than mere application of best practise adoption design guidelines.

Acknowledgements

I would like to thank: Brendan Oversby for his assistance in vegetation identification. Also thanks to LGAs: Bunbury, Donnybrook-Balingup, Dardanup & Harvey for their input. Also thanks to Bunnings Australind and Adco Constructions for access to their site and drawings.

References

Department of Water and Swan River Trust (2007). 'Structural Controls', in *Stormwater Management Manual for Western Australia*, Department of Water and Swan River Trust, Perth, Western Australia.

Dobbie, M. F. (2013). 'Public aesthetic preferences to inform sustainable wetland management in Victoria, Australia', *Landscape and Urban Planning*, vol. 120, pp. 178-89.

3D Data Capturing and Metadata Transfer

School of Civil Engineering and Surveying

Christopher Hunt

Bachelor of Spatial Science (Surveying)

Supervisors: Dr Albert Kon-Fook Chong, USQ

Mr Paul Stivano, Aurecon Australasia Pty Ltd

Keywords: Utilities, 3D, codelists and GIS

1. Introduction

The development of software and hardware within the engineering field has been rapidly changing at a fast pace. Consequentially, this has introduced further skills to be incorporated into the engineering spectrum. The objectives of this study is to explore the way greater efficiencies can be made with capturing service utilities whilst optimising the latest ground based surveying technologies.

2. Background

It has been identified that there are inefficiencies with data exporting and importing into various software programs. This is mainly due to the fact that multiple software platforms are used within the engineering field. The aim is to identify three typical software platforms that are used in most businesses and develop mapfiles that will allow the extraction of all the survey data captured that includes specific attribute data and three dimensional rendered blocks (Please see Figure 1). The process will introduce the ability to import the densified data into a Computer Aided Drawing (CAD) and Geographical Information System (GIS).

3. Methodology

The developed codelist is based on NSW RMS and AS 5488-2013 coding. The strong emphasis on developing the codelist for the controller and readable mapfiles for 12D Model instigates the ability to attach attribute data to surveyed points. This includes utility owner, utility status, utility material, utility size, utility configuration and utility location method. The design of the exportation process from 12D Model to GIS will allow the program to filter through the data in multiple ways
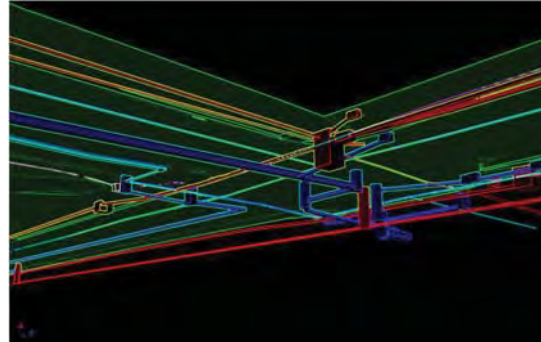

Figure 1 – 3D model of utility data captured with the created codelist, visualised within 12d Model software

that includes the attribute data to become a part of this process. The export will also allow for the 3D rendered pipelines and pits to be imported into CAD and GIS.

4. Key Outcomes

The project has highlighted the measures needed to create specific codelists, but has introduced complexities with allowing the identified software platforms to talk to each other. Expert consultations with software representatives have been essential in formulating the design of the systems created.

5. Further Work

The items still waiting to be consulted is turning the attribute data from points to strings within 12D Model so that the data is readable within a GIS software.

6. Conclusions

Dynamic systems introduced in this project have the ability to improve efficiencies within a multi-faceted engineering team, to improve project management, project delivery, visualisation and data extraction.

Acknowledgements

I would like to give great thanks to the support given by Dr. Albert Kon-Fook Chong from USQ with helping keep my research on the right path. I would also like to Paul Stivano from Aurecon Australasia Pty Ltd for giving his vested interest in furthering the developments that our survey department has made.

References

Standards Australia. (2013). *AS54882013: Classification of Subsurface Utility Information (SUI).* Sydney: Committee IT-036.

Board of Surveying and Spatial Information (BOSSI). (2016). *Guide for Professional Conduct V1.3.* Bathurst: Land and Property Information.

Sewer Infiltration - Analysis, Impacts and Mitigation for a Growing City

Rory Hutchinson

Bachelor of Engineering (Honours)
(Civil)

Supervisors: Dr Ian Brodie, USQ

Keywords: Infiltration, Sewerage, Rainfall

1. Introduction

Rain derived infiltration and inflow (RDII) is the act extraneous water entering a sewer system through a variety of means and sources during/after a rainfall event.

There are many drivers in managing and reducing RDII within a network as it impacts on a sewerage networks maintenance, operations and capital investment whilst in turn reduces the capacity of a sewer system.

This project focuses on identifying and analysing RDII within the Albury sewer reticulation system and its associated impacts.

2. Background

With drought conditions lifting within Albury City Council (ACC) in recent years there has been an increased demand to undertake a study into RDII within the sewer network and identify that catchments that seeing increased flows in peak rainfall events.
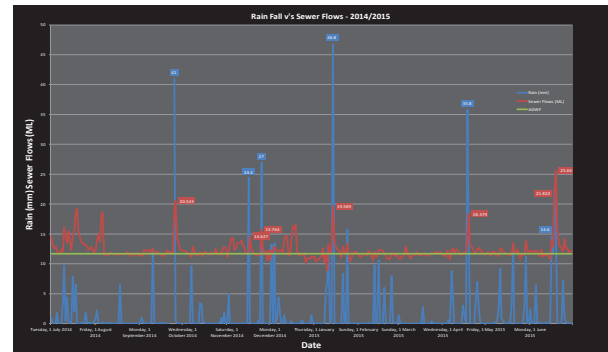
By indentifying RDII within the network there is increased ability to focus on rehabilitation, in turn, reducing the costs of sewer operations and capital expenditure, the frequency of sewer overflows, environmental pollution, public health risks and furthermore helping meet regulatory requirements.

3. Methodology

This study investigates wastewater flow and volume data using sewer pump station SCADA systems and rain data using pluviometers in identify sub-catchments that are seeing higher flows.

4. Key Outcomes

Detailed analysis of SCADA and rainfall data has identified the existence of RDII in 46 wastewater sub-catchments with varying degrees of infiltration and volumes. The hydrographs of inflows into pump wells has been documented from selected sub-catchments that have been identified high infiltration rates.

5. Further Work

Further work is required to investigate the sub-catchments identified with high RDII multiplication factors and investigating the financial impacts they have on ACC.

6. Conclusions

The study has determined so far that extensive RDII is present within each sewer sub-catchments within the Albury LGA. Infiltration is also occurring within newly constructed subdivisions and cumulatively affecting the overall maintenance, operations and capital renewal of sewer infrastructure for the city.

Acknowledgements

References

Zhang, Z. (2007). Estimating Rain Derived Inflow and Infiltration for Rainfalls of Varying Characteristics. *Journal of Hydraulic Engineering, 133*(1), 98-105.

WSSA (2013). Management of Wastewater System Infiltration and Inflow Good Practice Guideline Background and Theory, Volume 1, 3-22

Investigate grinding Biomass into nanoparticles using conventional methods and separate using centrifuge technique

School of Mechanical and Electrical Engineering

Mohamed Fawaz Iqbal

Master of Engineering science (Mechanical)

Supervisors: Dr Ihsan Hamawand, USQ

Suzette Eberhard, USQ

Keywords: biomass, grinding, ball milling, bagasse, SEM, centrifuge, ethanol extraction.

1. Introduction

Due to large scale of manufacturing and advanced technical enterprises the rising deficit of traditional fossil fuels lead to severe energy and environmental situation. To reduce the dependence on fossil fuels an extensive effort has been focused to develop sustainable and green energy resource (D.Yue, 2014).The biofuel (ethanol) is produced from grinding biomass to Nano-particles by traditional grinding method. The ethanol production can be enhanced by pre-treating the bagasse with chemical or mechanical methods such as ball milling, and which results in the breakdown of the complex structure of the lignin. A ball grinder has been manufactured for this purpose. The Nano-particle resulted from grinded lingocellulosic material (bagasse) will be separated from the bulk materials using solvents and centrifuge techniques.

2. Background

The ethanol is a colourless volatile flammable liquid that is the intoxicating agent in liquors and also used as a solvent in fuel. The main aim of the project is to convert bagasse into Nano particles to obtain more ethanol from the lingocellulosic biomass (sugarcane bagasse).converting biomass into Nano-particle is a challenging task due to chemical and structural factor of cellulose, hemi cellulose and lignin.

3. Methodology

The pre-treatment process used for this project is ball milling with some solvents/chemical treatment. The
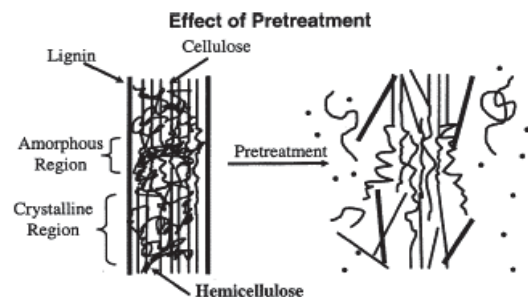

Figure 1 - Sample Diagram

ball grinder has been manufactured for this Nano grinding. The bagasse is grinded using ball grinder for particle size reduction up to Nano-meters. The Nano particles are separated using sieve or centrifuge technique. SEM will be used to quantify and qualify the produced Nano-particles. After the results, the ethanol production from the bagasse can be calculated.

4. Key Outcomes

The preliminary experiments needs to be conducted to compare the result with the Nano grinding and other existing methods.

5. Further Work

Presently, Literature review will be carried out to investigate methods and equipment's available for grinding biomass to Nano-Particles. This research may decide to choose a best equipment for grinding.

6. Conclusions

The anticipated outcomes will be comparing the ethanol production percentage and suitable method for producing more ethanol from the bagasse will be discussed.

Acknowledgements

References

Moseir, N., Wyman, c. and Dale, B., 2016. Features of promising technologies for pretreatment of lignocellulosic biomass. *Bioresource Technology*, 1(2), pp.1-14.

1.D. Yue, F. You and S.W. Snyder, *Computerized. Chem. Eng.*, 66, 36 (2014).

Development of a sustainable footpath material utilising Recycled Road Profile, Natural Soils and PolyCom Stabilising Aid

School of Civil Engineering and Surveying
Ipswich City Council

Scott Jackson

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr. Buddhi Wahalathantri
Assoc. Prof. Yan Zhuge

Keywords: recycled materials,
sustainability,
footpaths and pavement

1. Introduction

Recycling and sustainability is a key element that needs to be addressed in modern day construction, to ensure the preservation of resources for future generations. This project aims to investigate the feasibility of using a material that is 99.998% -100% recycled, and is also suitable for use for pedestrian thoroughfare. Literature indicates that recycled road profile alone does not provide required stability to use as a construction material. This research investigates the stability of recycled road profile when they mixed with different percentages of natural soil available in local area and PolyCom Stabilising Agent.

2. Background

The Ipswich City Council currently removes road profile and stores it for future use that is unknown. Footpaths in the region are commonly constructed using virgin N20 – N25 concrete, and as shown through numerous studies, the production and utility of concrete is harmful to the environment, through the production of carbon emissions. Successful application will yield a sustainable material that is cheaper than traditional reinforced concrete, and may be an alternative for concrete in rural areas and national parks, as well as providing footpaths in emergency situations.

3. Methodology

Laboratory testing of four commonly available soils in Ipswich and road profile with and without PolyCom (PC) occurred. Modified Proctor Compaction tests were conducted to determine the OMC and Max Dry Density, and modified dry CBR tests were undertaken to determine the Optimum Road Profile proportions for each soil. Different mix proportions of the four common soils of the Ipswich region and road profile were tested (mixes of 0%, 25%, 50%, 75% and 100% of natural soil). The optimal mix proportion for each soil was tested with and without PolyCom in California Bearing Ratio (CBR), Unconfined Compressive Strength (UCS) and Slip Resistance (SR) tests.

4. Key Outcomes

Testing indicates that Road Profile benefits from the addition of soil, but the percentage of soil required to achieve optimum stability varies between soils. Samples demonstrate improved stabilisation compared to samples of 100% Road Profile, and improved strength compared to 100% soil samples.

Material	Optimal Road Profile %	CBR (No PC)	CBR (With PC)	UCS (With PC)	SR Class (With PC)
Sodosols	25%	12%	12%	0.866 MPa	P5
Chromosols	25%	80%	45%	1.971 MPa	P5
Dermosols	50%	70%	70%	3.104 MPa	P5
Kandosols	25%	45%	16%	1.805 MPa	P5

5. Further Work

There is a broad range of laboratory testing and field testing that can occur. Due to time and equipment constraints, it was only possible to conduct dry modified CBR tests, instead of soaked CBR tests to determine the optimal road profile proportions, which may change under wet conditions.

6. Conclusions

A 100% recycled footpath material is a new alternative that may become possible in the near future. Though the road profile, soil and PolyCom mixtures may not yet provide the strength required when tested in laboratory conditions, the CBR values acquired are high and very promising, and further research will be beneficial.

Acknowledgements

References

Arulrajah, A., Horpibulsuk, S., Hoy, M. (2016). Strength development of Recycled Asphalt Pavement – Fly ash geopolymer as a road construction material, Construction and Building Materials, Vol. 117, Retrieved from http://www.sciencedirect.com/science/article/pii/S0950061816306924.

Arulrajah, A., Disfani, M., Horpibulsuk, S., Prongmanee, N., Suksiripattanapong, C. (2014)., Physical properties and shear strength responses of recycled construction and demolition materials in unbound pavement base/subbase applications, Construction and Building Materials, Vol. 58, Retrieved from http://www.sciencedirect.com/science/article/pii/S0950061814001809.

Evaluation of the use of safety barriers on roundabouts

School of Civil Engineering and Surveying

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Bachelor of Engineering (Civil)

Supervisors: Trevor Drysdale, USQ

*Keywords:*Roundabout, Safety, Barrier

1. Introduction

Remedial works on roundabouts arising from a high occurrence of off carriageway crashes are often treated by providing safety barriers to minimise the severity of crashes. This crash type is generally more prevalent on high speed roundabouts and involves a single vehicle. With changes to design principles and standards relating to the design of roundabouts, deficiencies can be noted that may be treated by alternative solutions. This research project aims to ascertain whether the lower cost treatment of a safety barrier to minimise the severity provides a suitable safety benefit over improvements to roundabout deficiencies.

2. Background

Roundabouts are common intersection treatments that have been implemented countless times across roads nationwide. Over time the design standards and principles that have been used to implement these intersections has changed to provide safer and more efficient intersections. As standards have changed, this leaves a legacy of roundabouts that have undesirable geometry that can be related to increases in crash rates.

It is common to treat off carriageway crashes with the use of safety barriers, as is often the case with roundabouts that feature high off carriageway crashes.

3. Methodology

The methodology applied to this project involved a literate review of roundabout design standards to identify differences and potential legacy issues throughout roundabouts in NSW. A number of roundabouts that feature safety barriers as measures to treat crashes will then be evaluated for deficiencies. Crash statistics will be used to analyse the performance of the barriers and see if crashes in the roundabouts can be correlated to any trends in deficiencies.

4. Key Outcomes

The outcomes from this project are to better understand the contributing factors on roundabouts that feature a high crash rate and to determine a set of recommendations that should be considered when developing a suitable engineering treatment to reduce the occurrences a severity of these crashes.

5. Further Work

Further work is required on impact angle of hazards adjacent to roundabouts. Due to the radial nature of roundabouts severity of crashes can be greatly increased and it is not clear how this affects clear zones and safety barrier effectiveness.

6. Conclusions

At this stage of the project it is becoming apparent that appropriate entry geometry is the most critical component of a roundabout. This governs the speed at which vehicles operate within the intersection. While safety barriers serve a purpose to reduce the severity of off carriageway crashes the treatment of approach geometry could have a reduction in all crash types.

Acknowledgements

References

Austroads Ltd. (2015),*Guide to Road Design Part 4B-Roundabouts*

Austroads Ltd. (2010),*Guide to Road Design Part 6-Roadside Design, Safety and Barriers*

Robinson, B.W. (2000), *Roundabouts: an informational guide,* U.S.Dept. of Transportation, Federal Highway Administration

The effect of materials and conditions on reflectorless electronic distance measurements from a total station

School of Civil Engineering and Surveying

Jeff James

Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Ms Zahra Gharineiat

Keywords: Reflectorless, EDM, Total Station.

Figure 1 – Housing Bracket

1. Introduction

All surveyors should know the errors associated with electronic distance measurements. When using EDM a prism constant is applied to adjust the effect of the prism. When using reflectorless EDM this constant is unknown. Factors such as material, colour, external conditions and angles can affect the reading. The exact number is unknown and with endless scenarios this paper will only have the opportunity to look at some common elements to provide the surveyor with some useful knowledge.

2. Background

This information is important to surveyors as more and more surveying instruments are using the REDM technology to capture data. With the technology clients are becoming aware of the data that can be captured and as a result reflectorless measurements are a normal part of everyday surveying. An understanding of the errors associated will allow the surveyor to make the best judgement on how to survey the required location.

3. Methodology

In order to achieve results, quantitative data had to be obtained. As a result of the information required a lot of data is required for analysis. A key part to producing reliable data was a housing bracket designed to hold the targets in the same location each time. Figure 1 shows the housing bracket in operation.

4. Key Outcomes

The outcomes of this research has provided valuable knowledge of the characteristics of common materials and conditions and how they affect the REDM. It provides knowledge of the potential expected error and allows judgement to be made in real time with the use of quick reference guides.

5. Further Work

In order to gather a greater range of knowledge more testing is required. With advancements in technology, new lasers will become available which can have the potential to change results. Different distances, different materials and different conditions can also provide a greater knowledge base for the surveyor to use. With forever changing composites and technology the potential for testing is almost unlimited.

6. Conclusions

The knowledge that has been achieved from this research has already been of aid during my work tasks and as a result, a more accurate and reliable survey was achieved. I feel the knowledge obtained from this research will be of high value to all surveyors and should form part of a surveyor's knowledge for everyday use.

Acknowledgements

I would like to thank everyone involved in making this research possible, particular Ms Zahra Gharineiat for her advice throughout the process. Importantly I would also like to that my partner Christine for understanding how much time and effort was required to complete the project and achieve outcomes. Lambrou & Pantazis (2010) and Reda & Bedada (2012) were key pieces of research used in structuring the research.

References

Lambrou, E., & Pantazis, G. (2010). Evaluation of the credibility of reflectorless distance measurement. *Journal of Surveying Engineering, 136*(4), 165-171.

Reda, A., & Bedada, B. (2012). Accuracy analysis and Calibration of Total Station based on the Reflectorless Distance Measurement. Stockholm: Royal Institues of Technology.

Extraction of ECGs for Twin Pregnancies

Sponsor – School of Mechanical and Electrical Engineering

Jarkko Jarvinen

Bachelor of Engineering (Honours)
(Electrical & Electronics)

Supervisor: Assoc Prof John Leis, USQ

Figure 1: Extracted NI-fECG signal

Keywords: fetal ECG, fECG, signal extraction, BSS

1. Introduction

This research project focuses on exploring methods for non-invasive fetal ECG (NI-fECG) signal extraction for singleton and multiple pregnancies. One of the main goals of this project is to implement and test the most promising NI-fECG extraction methods in MATLAB™. Furthermore, ECG data storage formats are also investigated and data access functions are tested in MATLAB.

2. Background

Cardiovascular abnormality is one of the most common birth defects and heart related defects are one of the most common causes of neonatal and infant deaths in Australia. Heart defects can originate from the early stages of the pregnancy, with timely detection, the treatment can be started early and a potential fatal outcome can be avoided. Furthermore, multiple pregnancies carry inherently higher health risks for the fetuses and a higher risk of other complications during the pregnancy.

One of the biggest issues the NI-fECG extraction method needs to overcome is poor Signal-to-Noise (SNR) ratio of the NI-fECG signal. Typical NI-fECG signal is corrupted by multiple noise sources (i.e. maternal ECG, fetus movement, 50Hz noise, baseline wonder etc.).

3. Methodology

Secondary research was carried out to investigate the different NI-fECG extraction methods. In addition, online biomedical signal databases were also researched to obtain suitable test signals for testing the ECG data access functions in MATLAB. The online biomedical sig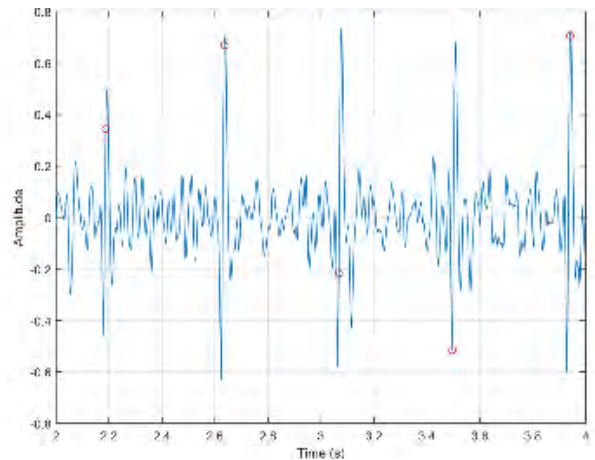nal databases were searched for a suitable NI-fECG test signal which could be used for testing the NI-fECG signal extraction methods.

4. Key Outcomes

To date, the main ECG data storage format access functions have been successfully tested in MATLAB. In addition, testing of the NI-fECG extraction algorithms has commenced. Figure 1 shows extracted NI-fECG signal using Blind Source Separation (BSS) method; Independent Component Analysis (ICA) algorithm to be exact.

5. Further Work

Further work will include testing the remaining NI-fECG extraction methods. The results also need to be critically evaluated to understand overall performance of the NI-fECG extraction methods. The current test signal is a synthetic signal and if time and resources permit, some testing will be done on "real world signals".

6. Conclusions

The first analysis of the results from the early testing of the NI-fECG extraction methods are promising. Furthermore, the review of available literature suggests that the NI-fECG has potential to be a mainstream method for fetal heart cardiac activity monitoring.

Acknowledgements

I would like to sincerely thank my supervisor John Leis for all his support and assistance during the project. I would also like to thank my wife Megan for all the proofreading she has done, not only during this project, but also during my studies in general.

References

Hill, M. (2016), `Embryology Australian Statistics', https://embryology.med.unsw.edu.au/embryology/ index.php/Australian_Statistics

Terrestrial Laser Scanner for 3D Modelling of USQ Toowoomba Campus

Sponsor – School of Civil Engineering and Surveying

Antonio Jelacic

Bachelor of Spatial Science (Honours) (Surveying)

Supervisor: Dr Xiaoye Liu, USQ

Keywords: TLS, laser scanning, point cloud, modelling

1. Introduction

3D models as replicas of the real world are becoming essential for urban applications such as: mapping, facilities management, engineering, emergency services, tourism, i.e. The resulting 3D model is a data-rich, object-oriented and parametric digital representation of the building from which data appropriate to various user needs can be extracted and analysed for effective decision-making.

The scanner can digitize all the 3D information concerned with a real world object such as buildings, trees and terrain down to millimetre detail therefore, very accurate 3D representations of built environment can be produced.

2. Background

TLS technology enables digital documentation of buildings, enables creation of educational resources within the built environment as well as the reconstruction of the built environment. Documentation can be used as a part of USQ's building management process, in planning the new facilities or refurbishment of the existing ones, or in promotional activities.

3. Methodology

Faro laser scanner was used for collection of the data and fifteen scanning positions were designed to enclose the subject area. Figure 1 shows combined data of four separate scans. Also, artificial sphere targets were used, as part of registration process of the scans. Processing of the data included combining all the scans into a single aligned coordinate system, filtering the data from errors and preparing the data for export into the CAD environment where all the modelling took place.

Figure 1 – Combined data of four separate scans

4. Key Outcomes

Highly detailed 3D model of the "Quad" area and surrounding buildings with spatial certainty. 3D model of the "Quad" area and surrounding buildings that is incorporated in Google Earth. Virtual fly-through of the photorealistic 3D model of the "Quad" area.

5. Further Work

If time permits it would be beneficial to expand the scanned area to inside of the buildings and create complete 3D model of the buildings by combining outer and inner building scans

6. Conclusions

Results of the project will provide information and experience, and if proven successful, it will create base for further expansion of 3D campus project.

References

Armenakis, C & Sohn, G 2009, 'iCampus: Modelling of York University Campus', paper presented at *American Society for Photogrammetry and Remote Sensing Annual Conference, ASPRS 2009, Baltimore, USA*.

Arayici, Y 2007, 'An approach for real world data modelling with the 3D terrestrial laser scanner for built environment', *Automation in Construction*, vol. 16, no. 6, pp. 816-29.

Mahdjoubi, L, Moobela, C & Laing, R 2013, 'Providing real-estate services through the integration of 3D laser scanning and building information modelling', *Computers in Industry*, vol. 64, no. 9, pp. 1272-81.

Temporal Deformation Study of Guyed Masts in Variable Ground Conditions

University of Southern Queensland, Toowoomba – ENG4903 Professional Practice 2

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Bachelor of Spatial Science
(Honours) (Surveying)

Supervisor: Mr Shane Simmons (Senior Lecturer in Surveying), USQ

Keywords: Guyed telecommunication masts, deformation monitoring, weather conditions.

1. Introduction

In engineering terms a mast is supported by guys or stays, and a tower is a self-supporting structure. The focus of this project is on guyed masts to determine if there is any shift in the position of the mast anchors or verticality in terms of their design, construction, purpose, environment and soil conditions.

2. Background

Guyed telecommunications masts are subject to a number of direct and indirect pressures. Some of these being wind, soil types, moisture, UV exposure and development impacts such as vibration and excavation. These impacts, especially movement can be detected through survey monitoring techniques. The potential movement of the guy anchors and any shift in verticality of the masts is the focus of this research. The effects of weather and landscape are the key influencing factors that will contribute to the results of this monitoring survey.

3. Methodology

This project sets out to detect possible movement by repeated monitoring. The monitoring involves an initial control traverse being placed outside the vulnerable site area, levelling the concrete anchors at different stages and a verticality check on the mast at the take-off points (guy wire connections at intervals along the mast height).
The expected outcomes of the project include:
- Compare results over a period of time between sites.
- Identification of the soil type and land use.
- Identification of the constructed materials.
- Determine the effects on the masts stability.

4. Key Outcomes

The aim of the project was to see if weather conditions and geology affect the stability of guyed masts and to what degree the movement becomes a design issue. The following key objectives were reported on:
- Determine any shift in the 'X', 'Y' & 'Z' axis and verticality of the mast.
- Determine the effects of soil conditions and movement of the concrete footings.

Figure 2 – Guy wire concrete anchor (Johnson 2016).

Figure 1 – Guy Wire Take off points (Johnson 2016)

- Compare the structural stability of all four masts based on the above results.
- Determine if the weather has any impact on the ground types which affect the footings. These objectives provided direction for the report and ensured that definitive results would be produced. The results section concluded that that there was negligible movement generated by the ground conditions.

5. Further Work

Future research could include the use of a laser scanner and reflective targets for monitoring compared to digital levelling and reflectorless total station measurement.

6. Conclusions

Deformation monitoring of large structures is essential for the safety of the public, property owners and the people maintaining them. This report has provided useful information for industry professionals regarding the engineering of the structures and the equipment used to monitor them.

References

Ulrik Stottrup-Andersen 'Masts and Towers' Market Director, Head of Department RAMBOLL Bredevej 2. Publish date not found, cited 2016.

<www.inti.gob.ar/cirsoc/pdf/antenas/Mobile_Communications_Masts_Towers.pdf>

Shorten Cole, A.J., 'A Comprehensive study of Footing on c-ø Soil Slopes – Numerical and Physical Modelling.' University of Southern Queensland, Dissertation Major Civil 2009.

Numerical study on the abrasive wear of fiber/polymer composites

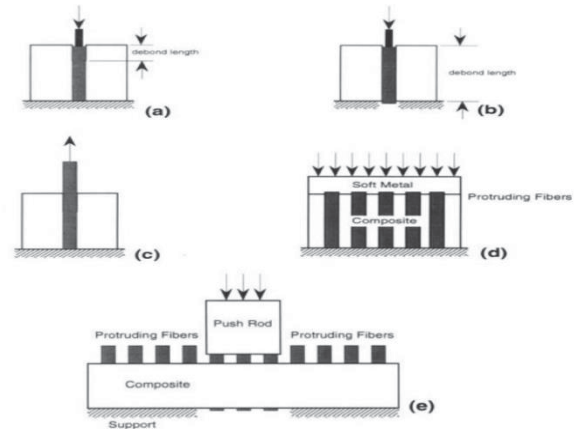## University of Southern Queensland

Bader Jomaah

Bachelor of Engineering (Honours) (Mechanical)

Supervisors: Dr Belal Yousif, USQ

Keywords: Abrasive wear behaviour

1. Introduction

Most composites have solid, hardened fibres in a matrix which is weaker and less firm. The goal is normally to make a segment which is solid and firm, frequently with a low thickness. Business material normally has glass or carbon fibres in networks taking into account thermosetting polymers, for example, epoxy or polyester pitches. There are further classes of composite in which the network is a metal or a fired. Generally, these are still in a formative stage, with issues of high assembling costs yet to be overcome. Moreover, in these composites the purposes behind including the strands (or, now and again, particles) are regularly somewhat mind boggling; for instance, changes might be looked for in jerk, wear, break sturdiness, warm security, and so on.

2. Background

The passion of utilizing common strands as fortification for composites happened due to the expanding mindfulness among architects and engineers on the positive parts of the item. Moreover, there is an expansion in worldwide rivalry for lightweight parts. Ordinary fibre use in industry advances a manageable material improvement through usage of renewable assets. The essential objective is to substitute manufactured strands like glass and mineral based. The main objective of this study is to exchange the materials in use with best possible alternative.

3. Methodology

In this project Ansys software will be used to simulate the abrasive wear behaviour of kenaf/epoxy composites. Develop numerical model for fibre composites and analyse the friction coefficient and material removal of fibre/polymer composites during abrasive loading conditions.

4. Key Outcomes

The outcome is thought to be the behaviour of kenaf/epoxy composites under different conditions of abrasive wear and with respect to several physical properties and orientation of structure.

5. Further Work

This is an initial stage of the simulation and there are many factors need to be considered in the development of the model. In addition, the structure of the composites (fibre orientation, fibre length and fibre content) is the key in determining the characteristics of the composites and this need an attention in the future work.

6. Conclusions

To sum up, the main result of this project to learn how to work with different software like ANSYS and be familiar with how to determine the characteristics and behaviours of various composites types. No matter how many software you work with, it will always enhance your knowledge and skills.

Acknowledgements

I would like to thank my supervisor Dr.Belal Yousif for his support and help throughout the project. I also would like to thank all my colleges who were always for me.

References

Bull, J. W. (1996). Numerical Analysis and Modelling of Composite Materials. Chapman and Hall

N. V. David, S. K. (n.d.). Elastic and dynamic response characteristics of Kenaf/Polypropylene composites. The technical Journal of Science and Technology, 186-225.

T.W.Clyne, D. a. (1996). An Introduction to composite materials. Cambridge University Press.

COMBUSTION OF WASTE COOKING OIL AND ETHANOL BLENDED WITH DIESEL FUEL

Sponsor - School of Mechanical and Electrical Engineering

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Master of Engineering Science (Mechanical)

Supervisors: Dr Saddam H.Al-lwayzy, USQ

Figure 1 - Fuel prepared for experiment

Keywords: Bio- fuel,Diesel, Ethanol

1. Introduction

Debates on renewable over non-renewable sources of energy dates back to couple of decades now. Diesel and petrol still run all our vehicles and machineries. It is time that an alternative renewable fuel replaces these conventional fuels. These alternate fuels can have better fuel properties than crude petroleum. In this project, waste cooking oil and ethanol with 5% water are blended with diesel to study its fuel properties, engine performance and emission characteristics. The engine is also run with the conventional diesel alone and their characteristics studied. These values and put into study and compared.

2. Background

Previous studies performed on biodiesel made with pure ethanol or biodiesel made with waste cooking oil and diesel gave results showing better fuel properties compared to the conventional diesel fuel. One of the main factor that the industry faced is the cost in purification of ethanol. Hence, in this project 5% water of 10% ethanol of the total bio-diesel is added and experiments conducted.

3. Methodology

This experiment was carried out by performing the fuel preparation. The bio- diesel with required amounts of waste cooking oil and alcohol(5%water) was prepared. 1:1:8 is the mixture ratio with large parts of diesel. This fuel is run on a Hatz Diesel 4M41 engine. It is run on four different speeds at maximum load to get the engine performance. A total of three trials were carried out to get the most accurate values. A gas analyser was used to measure the emission properties of the fuel. The same test was done on diesel fuel under the same

circumstances. These values will be further studied and compared.

4. Key Outcomes

The power output, torque and fuel consumption of the engine are the factors that I have considered to measure the engine performance. Emission factors such as NO_x, CO, CO_2 were noted down as well.

5. Further Work

Since the experiment was successfully carried out and all the desired values noted, now the crucial part of the experiment is the data analysis. A comparative study has to be performed to reach the project conclusion.

6. Conclusions

Since the experiment has not reached its final stages, at this point we cannot have a conclusion.

Acknowledgements

References

Mangesh G. Kulkarni (2006). Waste Cooking Oil- An Economic Source for Biodiesel: A Review 45(9),pp. 2901-2913

Demirbas, A (2008) Relationships derived from physical properties of vegetable oil and bio-diesel fuels.87(8-9) pp. 1743- 1748.

Assessing the risk of failure of deteriorated timber bridges
School of Civil Engineering and Surveying

Tyrone Jowett

Bachelor of Engineering (Honours) (Civil)

Supervisors: Weena Lokuge, USQ

Keywords: Timber Bridges, Maintenance, Inspection Reports, Modelling Deterioration,

1. Introduction

Throughout Australia, the early construction of bridges, was mainly constructed out of timber. To continue to allow these bridges to function and be safely utilised, regular maintenance and inspections are essential in order to uphold a high level of service. To determine the frequency of maintenance intervals, the trending deterioration patterns must first be identified. This report uses level 1 and 2 bridge inspection reports sourced through government departments to identify and predict, and model these **deterioration** patterns within the bridge members.

2. Background

It is expected that all timber bridge elements will decay over the period of their lifespan, however identifying and predicting trending patterns and rates in which the elements become problematic is the key to addressing the risk of failure. This project will identify patterns and predict rates of deterioration in the timber elements providing opportunities for refinement in the maintenance requirements for timber bridge assets.

3. Methodology

The methodology used for this research project involves a thorough background research and literature review into timber bridges. The data obtained for the Department of Transport Main Roads based on level 1 and 2 inspection reports an analysis can be made on the findings. The contents that are predominately found in a level 1 inspection report consists of information that shows the damaged components and the identification and description of the damage. Following that the level 2 report go into greater depth that indicate the extremity and severity of the damaged components. This information will then be gathered and compiled to compare and predict of there is trending information to indicate if there are patterns to shown there is deterioration in specific timber bridge elements.

4. Key Outcomes

Once the final results have been reviewed, a conclusion can be ascertained as to whether there are components of the timber structure that show trending patterns of decay. This would then show the particular elements of the bridge which deteriorate quicker than others requiring regular more frequent inspection and repairs.

5. Further Work

As there is still some current and ongoing data collection and entry at the point of writing, the majority of the modelling is yet to be finalised before the results are to be reported on.

6. Conclusions

Conclusions from the project will contain a detailed list of timber bridge elements the show heightened risk of failure, whether that is due to under sizing or deterioration of the members. If the results obtained are seen to be consistent and reliable recommendations could be made to asset management sectors

Acknowledgements

References

Agrawal, K. and Kawaguchi, A. (2009). *BRIDGE ELEMENT DETERIORATION RATES.* New York: Transportation Infrastructure Research Consortium.

Crews, K. S. (2004). *Testing and assessment procedures to facilitate the management of timber bridge assets.* Centre for built infrastructure research,

Lake, N. & Seskis, J. (2013). *Bridge Management Using Performance Models.* Sydney: © Austroads Ltd.

A NEW APPROACH IN MODELLING MACHINABILITY OF FIBRE POLYMER COMPOSITES USING ARTIFICIAL NEURON NETWORKS

Sponsor – School of Mechanical and Electrical Engineering

Sri Bindhu Kancharakuntla

Masters of Engineering Science (Mechanical)

Supervisors: **Dr YOUSIF BELAL**

Faculty of Engineering and Surveying,

University of Southern Queensland.

Keywords: Artificial Neural Networks (ANN), Machinability parameters, trained neural networks.

1. Introduction

In the present research project work, artificial neural networks (ANN) model will be developed using MATLAB to predict machinability of Fibre Polymer Composites.

2. Background

Artificial Neural Networks (ANN) is an advanced application for predicting the machinability properties. During the training of the model, ANN modifies itself to set up a pattern between inputs and outputs through the hidden layers. The ANN model requires a series of inputs and output data instead of any mathematical formula. ANN models can be used for the engineering applications when there is a huge data base is available to predict non linear and complex connections between input and output variable data base which cannot be solved by mathematical equations.

3. Methodology

A large volume of experimental data from the previous USQ student are taken in to account to predict Hole Accuracy, Delamination, Torque, Thrust Force, Specific Cutting Pressure and Machining Power (outputs) as related to the conditions of the neat epoxy, glass/epoxy and date/epoxy. The data base files are imported to mat lab files and the ANN models are developed. The

ANN model is trained by using specific transfer function through repetition process and the results are verified by comparing the ANN outputs to experimental data.
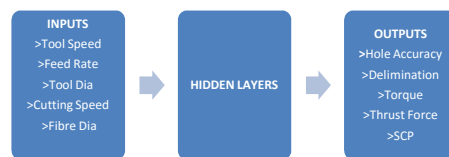

Figure 1 Artificial Neural Network Model

4. Key Outcomes

The key outcomes of this experimental work are to evaluate the machinability of the glass composites by using ANN technology without considering the complex calculations and experimental procedures. The behaviour of the composite materials can be evaluated accurately before the fabrication of the composite which saves time and effort. The experimental data are converted from graphs to manual excel data, the data base files are imported to Matlab and the ANN models are developed and training of the ANN networks are in process.

5. Further Work

By following the methodology the tasks remaining are the training of ANN networks in Matlab and verification of the results by comparing the ANN outputs to the experimental data.

6. Conclusions

The main purpose of the present work is to evaluate the machinability of glass composites considering different operating parameters and to promote wide consideration of the use of the artificial neural network approach (ANN) in Fibre Polymer Composites.

Acknowledgements

References

Malinov, Sha, Guo, Material Science and Engineering A, 283, 2000, 1, Application of artificial neural network in materials research.

Z.Zhang, K.Friedrich, Artificial neural networks applied to polymer composites: a review

T Nasir, B F Yousif, S McWilliam, N D Salih, L T Hui, an artificial neural networj for prediction of the friction coefficient of multi-layer polymeric composites in three different orientations.

Analyse and optimise Centrifugal fan

Sponsor –Downfield Engineering

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Masters of Engineering Science (Mechanical)

Supervisors: Dr Guangnan Chen, USQ
Dr Ruth Mossad, USQ
Mr Victor Stiller , Downfield
Engineering

*Keywords:* Centrifugal Fan, Fan Curve, CFD, Fluid Mechanics

1. Introduction

The aim of this research project is to analyse the characteristic fan curve with computational fluid dynamic. The pressure – volume curve of a fan is usually termed as the characteristic fan curve (Eck, 1973). Characteristic fan curve are calculated in ideal condition by the manufacturers. The selection of critical parameters is very essential while determining the performance of the fan (Yahya, 2005). The performance of the centrifugal fan varies with the work environment.

Autodesk Inventor will be used to create 3D model of a fan. CFD analysis using ANSYS Fluent will be used to verify the fan curve. Different parameters are then selected and will be optimised to get better efficiency of the fan assembly. CFD analysis will be used to calculate the outcome.

2. Background

Grain aeration is a popular method offering harvest flexibility, increased marketing opportunities and better control of grain quality. This technique is very old and there are no aeration specific fan design and selection charts for the selection of right equipment. Because of lack of new works, it appears that most of the equipment are inefficient. This project aims to optimise existing fan design and create a basic selection fan curve for grain aeration industry.

Figure: Typical Aeration & Centrifugal fan F370 for analysis.
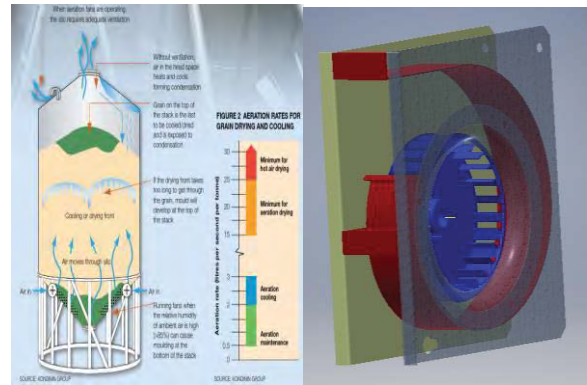
3. Methodology

Desktop review was conducted to find out the current practice on grain aeration industry for the fan design and selection. A suitable fan F370 was selected for the investigation and CFD was used to analyse the efficiency and improvement of current design.

4. Key Outcomes

To achieve most efficient centrifugal fan for grain aeration and creation of fan curve for easier fan selection.

5. Further Work

Further work is required on simulation on ANSYS to finalise the fan housing. More tests will be carried out on the motor selection, blade width & manufacturing technique.

6. Conclusions

The initial analysis suggests that there are considerable rooms for improvements in the current fan design and efficiency.

Acknowledgements

References

Eck, B. (1973). *Fans : design and operation of centrifugal, axial-flow, and cross-flow fans*. Oxford: Pergamon Press.

Yahya, S. M. (2005). *Turbines Compressors and Fans*: Tata McGraw-Hill.

Carbon Nano tube reinforced polymer composite material

Student Name <u>Sainath Kasarla</u>

Degree – Masters of Engineering Science (Mechanical)

Supervisors: Dr. Canh Dung Tran, USQ
Keywords: Carbon Nano tubes, Fibre glass composite, epoxy resin.

1. Introduction

The concern of this research project is to study the relationship between Carbon Nano Tube (CNTs) structures and properties in combination with composite material including mechanical behaviour.

Taking materials carbon Nano tube in the form of (multi walled), epoxy resin and aligning them into 200*200mm panel. Following certain tests compressive strength and impact testing the results will be analysed. Structural and other behaviour of materials will be analysed by microscopic observation.

2. Background

Carbon Nano tubes have been extensively used from every nook and corner of the globe. Due to its expensive nature it's been slowly degrading. It is necessary to find an alternative material which has the same properties within economical range.

Specific area of research will be study and analyse behaviour of composite material when in contact with carbon Nano tube.

3. Methodology

To know the outcome of material behaviour combining of materials carbon Nano multi walled with epoxy resin treating them with compressive and tensile strength. This results will allow us to analyse strength, flexural and other properties of materials.

4. Key Outcomes

Major key outcome deals with microscopic structural elements of carbon Nano tube aligned with glass fibre /composite. With this, other mechanical properties of material are directly proportional to their materialistic nature.
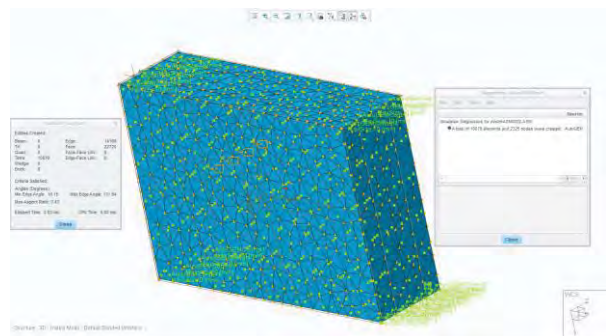
5. Further Work

Figure 1 - Sample Modelling

Further experimental procedures will be carried on large scale and outcome will be conferenced. If time permits a steady prolonged research on carbon Nano tubes aligned with composite fibres will be carried out.

6. Conclusions

The research project will allow to determine the material behaviour and structural properties of CNT based polymer composite. Mainly after the tests, mechanical parameters dealing with strength, flexural and compression will vary according to CNT alignment and handling.

Acknowledgements

I would like to thank my supervisor Dr. Canh Dung Tran for helping me throughout the project. Healthy subject was built after completion of this project on CNT based polymer composite fibres. I would also thank university of southern Queensland for giving me this opportunity of conducting research of my interest. C-D Tran, S.Lucas (2011), C-D Tran, W.Humphries (2009).

References

Tran C D, et al, "Manufacturing polymer/ Carbon Nanotube Composite Using A Novel Direct Process, - Pubmed- NCBI". *Ncbi.nlm.nih.gov.*N.P., 2016.web.28 Mar.2016.
"Improving The Tensile Strength Of Carbon Nanotube Spun Yarns Using A Modified Spinning Process". *Sciencedirect.com.* N.P., 2016. 5 Apr . 2016

Behaviour of concrete with oil contamination and reinforced with fibres.

Sponsor – School of Civil Engineering and Surveying

Job King

Bachelor Engineering of (Honours) (Civil)
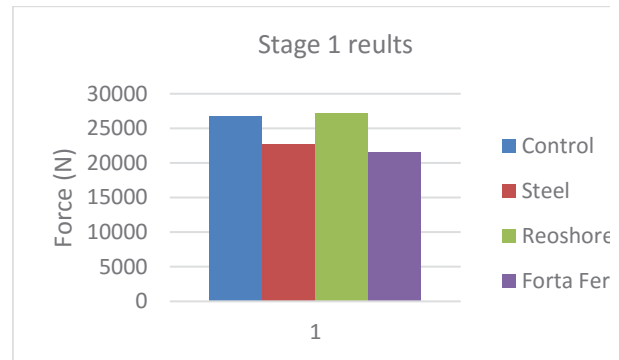
Supervisors: Dr Allan Manalo, USQ

Figure 1 - Sample Diagram

Keywords: Fibres, Concrete, Crude oil

1. Introduction

Due to modern societies reliance on fossil fuels increases in pollution of the environment have been observed. Since there is such a high demand for oil based products there are ever increasing environmental issues arising from this. Many industrial process produce pollutions that can potentially find their way into local water systems (both surface and sub surface) these pollutants may eventually settle into the natural soil and sands thus increasing the spread of contaminants. Regardless of how oil contaminants are transferred this will lead to the pollution of the natural environment and as such will jeopardise the potential effective applications of commonly used materials in civil engineering works

2. Background

Since concrete is one of the most used materials in construction the use of sand in the creation of concrete is essential. Oil contaminated sands have been used to create concrete however the oil has caused significant decrease in the strength characteristics of the mix. Therefore their use in practice have been limited to low bearing applications. There are numerous methods used to treat contaminated soils for efficient use in civil and construction works, however, most of these are deemed unsuitable for large and extended projects. The introduction of fibres is offered as a solution to modify and enhance the mechanical properties and behaviour of oil impacted concrete.

3. Methodology

A two stage testing program was employed. Stage 1 investigated the effects of 6% (by weight of sand) oil contaminated samples with 0.1% of reinforcing fibres. Specimens contained either Steel, Forta Ferro or Reoshore 45 fibres. Samples were tested under compressive and flexural loadings to determine which the best performing fibre was. Stage 2 explored the best performing fibre with varying dosage rates. These dosage rates were 0.1, 0.2, 0.3 and 0.4 percent of specimen volume.

4. Key Outcomes

Some key findings of the study are as follows:

- Reoshore45 was found to be the best performing fibre

- Figure 1 displays the averaged results of stage 1.

5. Further Work

Further work includes testing and analysis of the stage 2 specimens.

6. Conclusions

Testing not completed

Acknowledgements

References

Oluremi, J & Osuolale, O 2014, 'Oil Contaminated Soil as Potential Applicable Material in Civil Engineering Construction', Journal of Environment and Earth Science, vol 4, no. 10, pp. 2224-3216

An investigation into the potential benefit/value of Ipswich CBD residential revitalisation

Matthew King

Bachelor of Construction (Honours) (Management)

Figure 1- Residential revitalisation would benefit Ipswich CBD

Supervisors: Paul Tilley

Keywords: Ipswich, Residential, Revitalisation

1. Introduction

CBD revitalisation strategies are now considered common practice in many major cities nationally and internationally. Revitalisation is usually a government funded incentive aimed to reverse the decline of economic decay and restore the importance of the traditional commercial area of a city centre. There isn't however, any precedent of the effect that residential revitalisation may potentially have on restoring CBD functionality. Therefore, the focus of this dissertation will be on the relationship between sustainable CBD's and residential revitalisation.

2. Background

Common CBD revitalisation techniques often include, maintaining high density levels, emphasizing the importance of historic preservation, being sure not to suburbanise the CBD by creating strict design control measures and highlight the importance of street and consumer activity by creating a pedestrian friendly urban environment.

This raises the question; "Can residential revitalisation in decaying city centres be just as beneficial/valuable as large government funded revitalisation projects"? "Will small scale residential revitalisation be an effective strategy in contributing to CBD sustainability"?

3. Methodology

The research has been broken down into three phases. Phase 1, asks Ipswich community members a series of questions to determine if Ipswich is suitable for residential revitalisation. Phase 2 Identifies and grades 10 properties in Ipswich CBD, and comments on their current benefit/value and future development potential. Phase 3, surveys Ipswich construction contractors about their personal experience with development in Ipswich CBD and why residential redevelopment is not yet commonly applied.
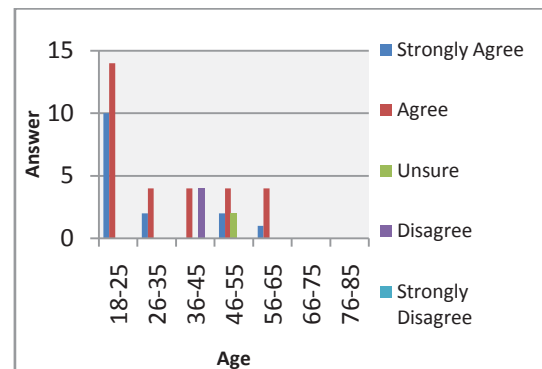
4. Key Outcomes

The Ipswich community survey indicated there is strong demand for residential revitalisation within Ipswich CBD, however, there are a number of factors that must be addressed before Ipswich would capable of accommodating in increase in population density. These issues included, employment opportunities, infrastructure/transport , and a lack of open spaces.

5. Further Work

In order to truly distinguish the amount of benefit/value residential revitalisation would provide Ipswich CBD, ongoing testing on various new developments would be required, which cannot be achieved inside the scope of this project.

6. Conclusions

The literature proves revitalisation is essential for a CBD's future. The research proved that there is demand for residential development and that there are sites suitable for development. The contactor survey identified potential issues with urban investment/planning policy which hinder the potential for further urban development.

Acknowledgements

References

- Pallagst, 2008, 'Shrinking cities: *Planning changes from an international perspective'*, Kent State University's Cleveland Urban Design Collaborative, Kent State University.

- Robertson, 2004, *'The main street approach to downtown development: an examination of the four-point program'*, Journal of Architectural and Planning Research, vol. 21, no. 1

Soil Stabilisation in Road Pavements

School of Civil Engineering and Surveying

Jarred Kohler Bachelor of

Engineering (Honours) (Civil)

Supervisor: Dr Andreas Nataatmadji, USQ

Figure 1 – Expected Outcomes

Keywords: Road, Stabilisation, Lime

1. Introduction

If roads are not adequately designed to deal with ever increasing traffic volumes and traffic loadings, we continually end up with roads failing to maintain an acceptable standard.

This is where soil stabilisation becomes a major factor when designing and/or rehabilitating roads due to its ability to add many performance attributes which ultimately lead to a longer service life.

2. Background

The process of soil stabilisation is designed to improve the characteristics of a particular material by adding a stabilisation binder to meet an engineered purpose in its operating, geological and climatic environment.

The broad aims of stabilisation for new road pavements and rehabilitation of existing pavements are:

Correct any mechanical deficiencies i.e. Particle size distribution and/or plasticity, increase the strength or bearing capacity, reduce the permeability or moisture sensitivity, provide cost effective pavement configurations, improve the wearing characteristics of unsealed pavements, improve the strength of subgrades, improve the compaction of unbound granular materials.

3. Methodology

The methodology has been largely focused around testing of materials to gain an understanding of the different compressive strengths achieved using various percentages of lime. Tests which have been conducted have followed Australian Standards and RMS test methods and included methods which tested for the lime saturation point and compressive strength values.
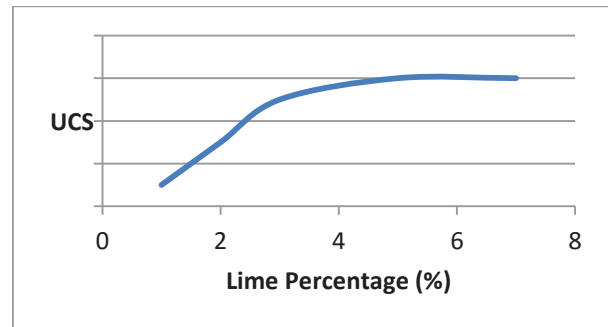
Data analysis will follow the testing phase which will bring all raw data together and essentially transform it into some meaningful data to discover any relationships or repeated patterns

4. Key Outcomes

It is predicted that the strength of a soil will plateau and possibly decrease once the lime saturation point is reached. Furthermore, it is expected that the results will assist in determining when a pavement is likely to crack due to excessive lime.

5. Further Work

Completion of the testing and data analysis are still remaining for the project. At this stage all aspects of the project aims and objectives will be addressed.

6. Conclusions

As the project is still ongoing, definitive conclusions and recommendations cannot be made yet.

Acknowledgements

First and foremost I would like to acknowledge and thank the assistance to which my supervisor Dr Andreas Nataamadji has given throughout this project so far.

Importantly, I would like to recognise Mr Toby Roelandts, Laboratory officer at Roads and Maritime Services, Port Macquarie. He has provided extensive knowledge and support throughout the preparation and testing stages of this project. Finally I would also like to thank Boral who have supplied materials for this project.

References

Matthews, Scott (n.d) Control of Reflective Cracking. Cement & Concrete Australia. (AUSTAB)

INFLUENCE OF DIFFERENT ADDITIVES ON THE LUBRICITY OF WASTE COOKING OIL

Phanindra Kommineni

Master of Engineering Science (Mechanical)

Supervisors: Assoc/Prof Belal Yousif, USQ

Keywords: Lubricants, Additives, Waste cooking Oil

1. Introduction

This project focuses on the viscosity of waste cooking oil by adding different types of additives in different temperatures and unlike quantity of additives in the waste cooking oil for the measurement of the viscosity of oil.

This paper studies the comparison of the viscosity of waste cooking oil and viscosity of oil when additives added to it.

2. Background

Though Crude/ fossil oil & vegetable oil are cited to occur naturally, they are reluctant to share similar chemical properties and their methods of usage. The viscosity of the oils depends up on the chemical properties in it. The study shows that the use of waste cooking oil in the place of petroleum by products could be a possible future solution for the sustainability of the planet and to provide a relief period for the fossil fuel to replenish the reserves as currently the global population is consuming faster than nature is capable of replenishing .The viscosity of the oil changes when the lubricants or different types additives added to it.So this project throws an light on the viscosity and nature of the waste cooking oil when additives added yto.it.

3. Methodology

In this project, the commercial waste cooking oil is collected and initially measured its dynamic viscosity values at various temperatures with a variation in the speed of spindle in the Tribology machine. Then the additives are added to study the influence of them on dynamic viscosity such that the waste cooking oil could be used as an alternative solution to the lubrication industry challenges focusing on reducing the consumption of fossil oils as a lubricant. In the raw state, WCO was unable to meet expectations of the lubricant industry in terms of dynamic viscosity so the characteristics are improved using additives. In this study our additive of such sort is Graphite. So, after the readings were recorded in its raw state, the graphite is added at different compositions namely 2mg, 5mg, 10mg and 20 mg respectively. The speed at which the readings are recorded are 20RPM, 50RPM and 100RPM. As the oil is so thick the spindle can't rotate at that so that temperatures so the spindle speeds are adjusted according to the temperatures

4. Key Outcomes

The outcomes of this project will give an idea about the chemical properties and the viscosity changes of the waste cooking oil when the additives are added to it.

In addition to it the viscosity comparison normal waste cooking oil and the waste cooking oil with additives are shown in it.

5. Further Work

The further work can be proceeded is the other chemicals were added to the waste cooking oil. The chemical properties and the viscosity changes in the oil will be analysed.

6. Conclusions

The main goal of this project is to study the influence of graphite on viscosity of the waste cooking oil at various temperatures. The results revealed that recommended additives incorporation into waste cooking oil results in its prospective use as a lubricant in various engineering applications.

Acknowledgements

I would like to thank all the members who supported me to complete the project successfully. Firstly, I would like to thank my supervisor Dr belal yousif for his great support, guidance and motivation throughout this project. His guidance in each and every step helped in writing thesis if the project.

References

Anastopoulos, G, Lois, E, Stournas S, Zannikos F, Serdari, A,(1999).

Management of Engineering Assets: Best Management Practices for Management of Road infrastructure

Sponsor - School of Civil Engineering and Surveying

Student Name: Peter Garang Kooch

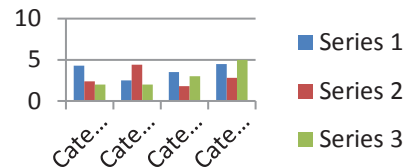**Degree:** Master of Engineering Science (Civil)

Figure 1 - Sample Diagram

Supervisors: Assoc/Prof David Thorpe from USQ

Keywords: Asset Management, Engineering Asset management, Best Management Practices and Road Infrastructure.

1. Introduction

Management of roads is a complex process due to its many challenges/issues. Key issues/challenges faced in management of road infrastructure included; management of road conditions (skid resistance, structural integrity, and others), lack of road funding and poor financial management, management of climate changes and extreme weather conditions, and others.

2. Background

Management of road is challenging task and hence require adopting of best management tools to overcome the challenges.

It is to identify issues/challenges experienced by road authorities in management road infrastructure.

3. Methodology

This research project use qualitative analysis of secondary data/information (use of available information to understand the matter). It considered the use of the desktop research approach throughout.

4. Key Outcomes

This research will add to the limited current research on challenges/issues facing road providers in management of road infrastructure.

5. Further Work

Further work deem necessary is deep investigation of the matter by conducting or carryout field collection of primary data instead of using desk top information.

6. Conclusions

Some of the challenges/issues are not manageable or resolvable by adopting of any of the management tools.

One best management practice can resolves or addresses multiple road infrastructure challenges or issues.

Advance research in the road infrastructure best would improves management of road.

Acknowledgements

References

Agarwal, P.K, & Das, A., 2012 Comprehensive pavement maintenance strategies for road networks through optimal allocation of resources", 2012, *Transportation Planning and Technology,* vol. 35, no. 3, pp. 317-339, viewed 12 June 2015, <http://www.tandfonline.com/doi/pdf/10.1080/03081060.2012.671044/>.

American Society of Civil Engineers 2010 "Effect of Aggregate and Asphalt on Pavement Skid Resistance Evolution" 2010, in American Society of Civil Engineers (ASCE), Reston, Virginia, USA, pp. 8-18, <http://ascelibrary.org.ezproxy.usq.edu.au/doi/pdf/10.1061/41104%28377%292/>.

Clevenger, A.P., Grift, v.d., E.A, Jaeger, J.A.G. & Ree, v., R 2011, "Effects of Roads and Traffic on Wildlife Populations and Landscape Function Road Ecology is Moving toward Larger Scales", *Ecology and Society,* vol. 16, no. 1, pp. 48. Viewed 12 July 2015, <http://olam.ed.asu.edu/epaa/>.
http://www.ecologyandsociety.org/vol16/iss1/art48/

Project Title: Improving the design and modelling of Nickel Iron pocket plat battery

Sponsor –School of Mechanical and Electrical Engineering

Student Name: Sankar Kudumula

Master of Engineering Science
(Electric and Electronics)

Supervisors: Mr. Andreas Helwig

Keywords: Pocket plate, battery, longevity.

1.0 Introduction
This Project progress report provides background and outline design and ongoing development of a Nickel iron pocket plate battery to produce a lower maintenance requirements and improved performance. Various methods are being investigated to build two new versions for a Nickel Iron battery, one of that includes gelled electrolyte including a new porous membrane separator for rapid wetting and allow high chemical and thermal stability.
From this another design with carbon fibre is possible where to the positive electrode to form a half dipole inbuilt capacitor can be added to potentially improve the batteries response time to large and rapid load increases. The ability of these designs is to predict reality is demonstrated by testing and analysing the results that are compared to the performance of a standard wet type battery, proves an overall improvement in the performance characteristics under variety of operating conditions

2.0 Background
The nickel iron battery has seen only two significant developments since its inception. The Edison pocket plate version was the first commercial development, and contained one flat pocket plate electrode and a round cylindrical second electrode. These batteries were very robust, but suffered from high internal resistance of the battery due both to the electrolyte gap between plates, but also high self-discharge due to hydrogen formation on the iron (Fe) electrode. Piccard (US) in the 1970's during the first electric vehicle (EV) push, further developed the Edison pocket plat design by now using two flat opposite polarity electrodes to reduce electrode electrolyte plate gap, and also added sulphides to the negative plate to reduce self-gassing / self-discharge

3.0 Methodology
In this paper, we will apply following three methodologies in order to improve the design and testing of NICKEL-IRON pocket plate battery. They are described in great details in the following section:

1.   Initial testing will involve ESR testing of an existing 10Ah battery- a standard wet type as well as charge/discharge characteristics. Charge acceptance and gassing during charging.

2.   Design/construct the gelled battery with new microporous battery separate material to replace existing battery separator and reducing the distance between the negative and positive plates. After this ESR testing will be done and standard testing like charge/discharge characteristics. Charge acceptance and gassing during charging will be performed.
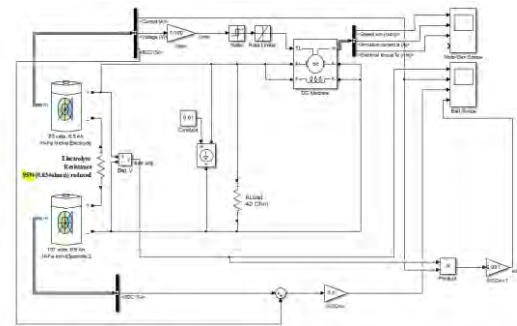
3. Design a battery with carbon fiber construct added to the positive electrode. And again all tests will be performed.

4.The resistance of a battery provides valuable information about its performance as it detects hidden trouble spots.

4.0 Key Outcomes
The use of modern day technology enables the compact packing of electrodes within the battery. This can increase the overall battery efficiency significantly. These compact batteries are more robust, proof to mechanical stress and deep discharge cycles even over repeated use. The lesser the electrolyte gap, the theoretical model has predicted the more discharge efficiency is being achieved. Reduced electrolyte gap also results in lesser battery internal losses. The effect of a capacitor with battery shows that it is a better option when compared to the other cases. However, a reduction in 95 percent of the electrolyte gap produces much better results.

5.0 Conclusions
It is estimated that petroleum based fuels will last only next 30 to 40 years. With more support from governments, big industries are now investing in renewable energy technologies. One issue with renewable energy sources is their dependency on natural sources which are fluctuation with weather and time. Hence, the generated power must be stored. There is no better option other than a battery to store bulk power. Hence, low maintenance and high-performance batteries are going to play a key role in renewable technologies.
The nickel-iron battery is such an option to store the bulk power. These batteries can last over 40 years [40]. Unlike lead acid batteries, nickel-iron batteries are quite safe for the home environment.

5.0 Acknowledgements
I would like to thank Dr Andreas Helwig and Dr Tony Ahfock. on guiding me throughout my project tenure .my supervisor initiated my research since my proposal and supported for my progress of preliminary results, specifically with the research modelling and designing of the battery in Simulink.

References

1.Battery Operating characteristics manual. copyright 2007 Be Utility Free, Inc.

2. ChangHong NF-S series Nickel-Iron batteries for solar PV application manual, Sichuan changhong battery co., LTD.

Compression & Flexural Testing Of Syntactic Foams Made Of Ceramic Hollow Microspheres & Vinyl Ester Resin

Sponsor – School of Mechanical and Electrical Engineering

Student Name: Abhinav Pranav Raj Kumar.

Masters of Engineering Science (Mechanical)

Supervisors: Dr Mainul Islam, USQ

Keywords: Ceramic Micro balloons, Syntactic Foams Compression, Flexural Behaviour.

1. Introduction

This project involves the critical evaluation of the available materials which are Ceramic hollow microspheres & vinyl ester resins in terms of compression & flexural behaviour. These test procedures are conducted in order to evaluate the effectiveness of the material for marine practices & any further modification is suggested. The final result will conclude the best composite material after further analysing the test results on the material.

2. Background

Increasing performance demands in the present applications, paves way for the indispensable requirement for new materials. Syntactic foams are composite materials that are manufactured by filling a polymer matrix with hollow glass or hollow ceramic microspheres & suitable lightweight structured materials (Hohe et al, 2012). In reference to the stronger & lighter materials syntactic foams are mostly opted for many mechanical as well as structural practices.

3. Methodology

Ceramic micro balloons with different weight percentages of 2.0, 4.0, 6.0, 8.0, 10.0 wt. % of the type SL75 will be used in this experiment. Vinyl ester resin is used as the matrix material along with an amine based MEKP as the hardener. Measured quantities of the micro balloons are mixed along with vinyl ester until a slurry of uniform viscosity is obtained. The mixture is then shifted to PVC moulds & then subjected to compression & flexural testing after they are post cured at 80^0C for 4hrs in the oven.
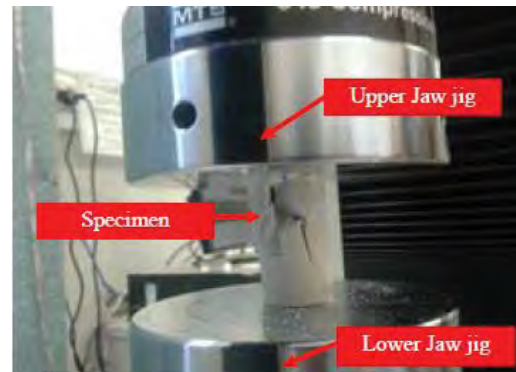

Fig 1: Specimen in progress for compression test

4. Key Outcomes

The outcomes in this particular experimental study will comprehensively contribute to knowledge of syntactic foams made of ceramic hollow microspheres with vinyl ester as a matrix material as well as its potential application in the marine industry, for reduced density applications.Analysing mechanical properties especially compressive & flexural performance of the syntactic foams will contribute a lot to the marine industries.

5. Further Work

The experiment is yet to be performed, to get further results & detailed performance of the syntactic foams made of ceramic hollow microspheres & vinyl ester resin.

6. Conclusions

Though many experiments have included glass microspheres in the syntactic foams this particular experiment will employ ceramic hollow microspheres. As a result the syntactic foams will exhibit outstanding properties such as low weight, continuous thermal stability & low thermal conductivity while enhancing the workability of syntactic foams.

Acknowledgements

References

>Hohe, J., Hardenacke, V., Fascio, V., Girard, Y., 2012. *Numerical and experimental design of graded cellular sandwich cores for multi-functional aerospace applications. Materials & Design*, 39, pp.20-3
>Anon, 2016. *ICMIEE 2014: International Conference on Mechanical, Industrial and Energy Engineering*. Www2.kuet.ac.bd. Available at: <http://www2.kuet.ac.bd/icmiee2014/> [Accessed 14 Aug. 2016].

Visualisation Techniques to Increase Public Clarity in an Urban Setting

School of Civil Engineering and Surveying

Kate Lack

Bachelor of Spatial Science
(Honours)
(Surveying)

Supervisors: Dr Marita Basson , USQ

Dr Xiaoye Liu, USQ

Keywords: visualisation techniques, urban planning, development applications

1. Introduction

Cities are rapidly growing, leading to complex built environments. This makes it difficult for developers to communicate issues surrounding the built environment in a simple, understandable way to other stakeholders. It is crucial for all stakeholders involved in the development process to understand the effects of the proposed changes before they are set in concrete (Pullar and Tidey 2001).

Public participation is the process used to incorporate the public's opinions in the decision making phase. It can result in beneficial information which helps verify and possibly improve the design. However, as the public struggle to understand and conceptualise the two-dimensional plans traditionally used for visualisation in a three-dimensional space, the public participation phase can be frustrating for all involved.

2. Background

To alleviate frustration, three-dimensional visualisation techniques can be employed, although they rarely are with the outcomes unknown. A case study of a controversial development in Toowoomba City will be used to determine if there is a need for better modelling in terms of development applications and how effective that modelling would be.

3. Methodology

The research will consist of a case study. Due to the nature of case studies, no theories have been determined as it will not be clear until the data and context have been analysed as to what theories are most suitable. Two three-dimensional models of the case study area will be created and analysed to determine if they are easier to understand than traditional two-dimensional plans.

4. Key Outcomes

The first key outcome will be an understanding of the current techniques available, the extent to which they have been applied in a real-world scenario and how often they are employed in the development application assessment process. Accompanying this will also be an understanding of how people conceptualise two-dimensional drawings in a three-dimensional space and the difficulties associated with that. Both of these are required to understand the applicability of visualisation techniques and how effective it could be.

The second key outcome is determining if three-dimensional models would make it easier for the public to understand what is being proposed.

5. Further Work

Further work includes the completion of the two models and analysing the models.

6. Conclusions

It is expected that this project will reveal the effectiveness of three-dimensional visualisation techniques and if there is a need to update development applications accordingly.

Acknowledgements

Firstly I'd like to thank Marita for her continuous support and answering all of my questions. Secondly I'd like the to thank Xiaoye for ensuring I've met all the technical elements for my project. I'd also like to thank Andrew Foley for helping me understand all the legislative requirements that development applications have.

References

Pullar, D. V. and Tidey, M. E. (2001). Coupling 3D Visualisation to Qualitative Assessment of Build Environment Designs. Landscape and Urban Planning, 55(1), 29-40.

Analysis of Reliability and Availability of Modern Digital Substation Communication Systems Based on IEC 61850

School of Mechanical and Electrical Engineering

Praveen Lakshmana

Master of Engineering Science (Power)

Supervisor – Dr. Narottam Das

Index Terms – Ethernet, IEC 61850, HMI, Substation Automation System.

1. Introduction

The implementation of legacy substation automation system protocols and the following architectures which provides the basic functionalities. With improvements in the modern systems in automation industry, it is now feasible for the power system in substation automation technologies. The main technical automation functionalities include Ethernet switches, TCP/IP and WAN networks. This international standard has made a significant improvement for the power systems in the substation automation systems in both cost and performance.

The international standard IEC 61850 is an Ethernet based communication standard used in the power generation and substation. The main aim of IEC 61850 is to integrate all the protection, control, measurement and monitor functions within the substation for the purpose of interlocking, protection and tripping.

2. Background

In late 1980's, under the supervision of Integrated Utility Communication (ICU) program, IEEE initiated an architecture called Utility Communication Architecture (UCA). The objective was to monitor and control the electrical power utilities for interoperability between different control systems in a substation. The standard communication architecture was called UCA version 1.0. The version designed did not provide a detailed description on how this architecture can be practically implemented. Hence the use of this architecture in electrical power industry became limited. Integrated Utility Communication (IUC) continued their efforts to build a new architecture and numerous research projects such as substation integrated protection, control and data acquisition, which were later called as UCA version 2.0. Multiple protocols including proprietary protocols with costume communication links were designed. An IEC project group of 50 members from all over the world worked and responded to all concerns and objectives and finally created IEC 61850.

3. Methodology

The calculations are aimed at evaluating and repairing the common errors associated with the SAS. My paper aims at reducing these errors. The following points gives us a clear idea on what are the targets are:

- Quantitative evaluation of repair on the system modelling which concerns about MTTF, MTTF[1st], rate of repair, availability of SASs on different architectures.
- Depending on the reliability and availability comparing repairable SASs.
- Assessing MTTF and MTTF[1st] on the ground of repairable and non-repairable.
- Analyzing the most effective impacts after repairable SAS performance.

4. Key outcomes

- This paper focuses on different architectures of substation automation system associated with the reliability block diagram. To calculate the mean time failure, equations are derived and calculated for the systems availability and reliability.
- The architecture is designated in different architectural designs, which will further discuss and calculated for the same.

5. Conclusion

It is observed that the ring architecture is the reliable architecture as it requires only one ESW to communicate between extreme ends of IEDs. It also has less MTTF when compared other architectures. This method can be used for different substation layouts to obtain optimum reliable and available topology for a particular substation.

6. References

1.Mackiewicz, R., December 2006. *Overview of IEC 61850 and benefits.* 2006, Power Systems Conference and Exposition, 2006. PSCE '06. 2006 IEEE PES.

2. Kanabar, M.G. and Sidhu, T.S., 2009, July. Reliability and availability analysis of IEC 61850 based substation communication architectures. In*2009 IEEE Power & Energy Society General Meeting* (pp. 1-8). IEEE.

3. Andersson, L., Brand, K.P., Brunner, C. and Wimmer, W., 2005, June. Reliability investigations for SA communication architectures based on IEC 61850. In *Power Tech, 2005 IEEE Russia* (pp. 1-7). IEEE

Modelling and analysis of multi-junction photovoltaic cells using MATLAB/Simulink for the improvement of conversion efficiency

Sponsor – School of Mechanical and Electrical Engineering

Anthony Laurent

Bachelor of Engineering

(Honours) (Power)

Supervisors: Dr Narottam Das, USQ

Andreas Helwig, USQ

Keywords: Multi-junction solar cell, Matlab/Simulink, double diode model

Figure 1 - A schematic representation of a triple junction solar cell with and without tunnel junctions. Image adapted from (Cotal et al., 2009).

1. Introduction

Multi-junction solar cells (MJSC) provide many avenues for further research and development opportunities related to the photovoltaic (PV) industry. This project will research, model and analyse multi-junction PV solar cells (MJSC) using Matlab Simulink to improve energy conversion efficiency due to better conversion response to a broader light spectrum.

2. Background

The slowing rate of advancement in conventional silicon (Si) photovoltaic cell technology has continued to reduce investment returns in silicon PV efficiency research. MJSC's provide an alternative to greater potential for photovoltaic efficiency improvements.

3. Methodology

An extensive and systematic literature review will be conducted in two stages, and confirmed through simulation within the Matlab Simulink environment.

Stage one of research will be conducted to evaluate and compare the single diode model (D1) and the double diode model (D2), and determine how the two models are simulated within the Matlab/Simulink environment.

Stage two of research will then be conducted to identify conversion efficiency in different proven multi-junction solar cells (MJSC), and how the cells are modelled. This will also determine how the MJSC is simulated within Matlab Simulink to review and analyse appropriate methods that track the maximum power point (MPPT) for each of the identified MJSC.

4. Key Outcomes

In the first stage of the project, it is expected that the simulation will confirm that the theoretical D1 model requires fur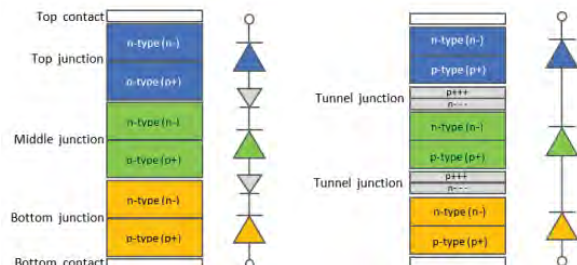ther improvements in accuracy when compared to the D2 model. The second stage of the project is expected to reveal that the simulation confirms that the maximum performance of each selected MJSC will theoretically exceed that of the single junction Si cell.

5. Further Work

Provide a new MJSC design with an improved conversion efficiency based on the identified simulation and subsequent results.

6. Conclusions

An intimate knowledge and ability to model the group III-V material alloys and photon spectrum interaction provides greater potential for efficiency improvements in MJSC's.

Acknowledgements

References

Cotal, H., Fetzer, C., Boisvert, J., Kinsey, G., King, R., Hebert, P., Karam, N. (2009). *III-V multijunction solar cells for concentrating photovoltaics*. *Energy & Environmental Science, 2*, 174-192.

Das N., Wongsodihardjo, H., & Islam, S. (2015). *Modeling of multi-junction photovoltaic cell using MATLAB/Simulink to improve the conversion efficiency*. Renewable Energy, 74, 917-924.

Developing a Road Strategy suitable to the Burdekin Shire

Sarah-Jane Lazzarini

Bachelor of Engineering (Honours) (Civil)

Supervisor: Mr Trevor Drysdale, USQ

Keywords: Burdekin, low-volume roads.

1. Introduction

Local governments are responsible for road infrastructure, plus a wide range of public services including essential utilities and community facilities. The eclectic array of services obliges local governments to embrace and maintain a substantial infrastructure assets base. The degree of infrastructure necessitates not only substantial initial investments, but also continued expenditure to maintain and renew assets over the course of each respective projected lifecycle. A challenge exists for rural local authorities to sustainably maintain their asset base, without introducing excessive burden on the ratepayers and the community being serviced.

2. Background

The Burdekin Shire promotes one of the most productive agricultural districts in Australia. Considering its static population, Burdekin Shire Council is an organisation that spans a large geographic area, and achieving consistency of strategic approach across that expanse could be a considerable challenge. The size of the region is also reflected in the stretch of the low volume road network managed by the Council. Currently, Burdekin has minimal formal documented strategies and standards specifically relating to the management of roads.

3. Methodology

The first stage was a review of the available literature concerning road system management and operation practices that could be of relevance to the Burdekin region. Stage two incorporates the application of knowledge and investigative measures from the literature to undertake an analysis (Refer Figure 1) of a
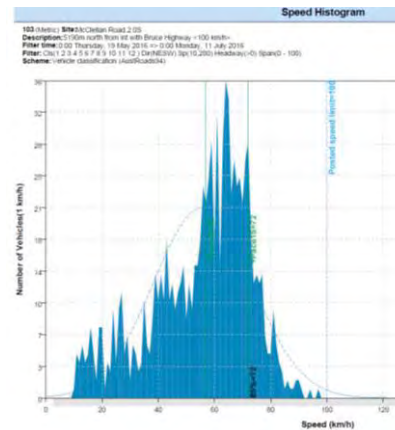

Figure 1 – Speed Histogram

sample of existing roads within the Burdekin Shire and develop preliminary road management concepts for consultation. Stakeholder consultation comprises the third phase of the research task and the final stage of the research will focus on the production of frameworks that will guide road management system operations suitable to the Burdekin Shire.

4. Key Outcomes

Wilmar offered access to corporate data for my research project work. This has been instrumental when analysing the traffic data collected, particularly near cane sidings.

5. Further Work

Stage 3 and 4 are yet to be finalised. The data collection phase is almost complete and the project is in the midst of the analysis.

6. Conclusions

Strategic focus is not universal and modified practices to suit the context are encouraged by industry experts.

Acknowledgements

Cheers to Callan Paige and Mr Trevor Drysdale whose support has been indispensable.

References

Austroads 2014, Guide to Traffic Management Part 5 – Road Management, Austroads, Sydney

Eppell, T., Zwart, J. 1997, Hierarchy: The Next Step, Eppell Olsen and Partners

Gennaoui, F.R. 1986, Road Hierarchy in Country Areas, Australian road research, vol. 16, no. 4, pp. 250-258.

Design of High Modulus Asphalt Overlay for Concrete Pavement

School of Civil Engineering and Surveying

James Lister

Bachelor of Engineering

(Honours) (Civil)

Supervisor: Dr Andreas Nataatmadja

Keywords: Asphalt overlay, high modulus, concrete

1. Introduction

Australia has over 800 000 Km of roads and the majority of the main road networks were completed some time ago. Over two-thirds of our goods are transported by road freight, placing significant pressure on the road system (Sharp and Johnson-Clarke,1997). A cost-effective rehabilitation method to increase the longevity of the road network is needed.

2. Background

Asphalt overlay is the most common type of pavement restoration; and the two widely used methods are a thin asphalt concrete mix or simply thin asphalt (Cülfik, 2014). In Australia, Austroads predominantly guides the standard for road design. There are existing specifications in regards to asphalt, however a method is yet to be adapted for high modulus overlay on top of cracked concrete pavement. The aim of the project is to propose a technical guide in the application of high modulus asphalt overlay on top of concrete pavement.

3. Methodology

Pavement designs were simulated using the finite-element program EverFE. This program simulates conditions such as loading, material characteristics, subgrade support, pavement deflection and environmental factors (Nataatmadja, 2015).
Material properties and pavement geometry in the designs simulated were gathered from studies on a similar pavement design, with a significant of guidance from the Austroads Guide technical papers. The focus of the results is the maximum stress and strain in the asphalt and concrete layers.

4. Key Outcomes

The maximum strain in the asphalt layer was assessed simulating a dual wheel single axle load of 80kN, based on the Austroads mechanistic design procedure. Current results indicate that if the cracked concrete pavement is removed and repaired correctly, an asphalt overlay minimum thickness of 70mm will be appropriate for this type of loading situation (Figure 1).
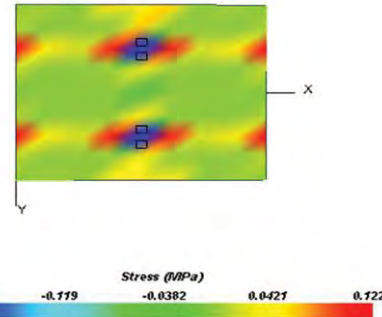

Figure 1 – Typical stress distribution in top of asphalt layer (Asphalt 70mm thick, E = 4000MPa)

5. Further Work

This project includes finalising modelling pavement configurations and making a recommendation on the most economical and robust design. Future projects should investigate modelling multiple slabs (simulating repaired sections) underneath a single asphalt layer, which is beyond the capabilities of EverFE, and a cost analysis comparing rehabilitation methods.

6. Conclusions

Although a conclusion is yet to be made current results are promising, showing that providing the existing pavement is repaired correctly a minimum 70mm thick high modulus overlay is an appropriate rehabilitation method for a standard design of rigid pavement. Although further investigations will be needed to monitor the amount of maintenance that will be needed as cracking is common.

Acknowledgements

I would like to thank my family, particularly my wife Natalie for her support. A special thank you to my supervisor Dr. Andreas Nataatmadja for his knowledge and guidance in this area he knows so well. The standard for pavement designs Austroads Guide (2008-2012) has also been an invaluable source of material.

References

Austroads.(2008). Pavement Structural Design, Austroads Guide to Pavement Technology, 20-67.

Cülfik, M. S. (2014). Serviceability and structural performance of asphalt overlays, P I Civil Eng-Transp, 168(3),231-238.

Nataatmadja,A.(2015), Design of asphalt overlay for concrete pavements, Research Proposal, USQ.

Sharp, K. G, and Johnson-Clarke, J. R. (1997) Australian experience in the accelerated testing of pavements. (IRF) World Meeting, Toronto, Canada.
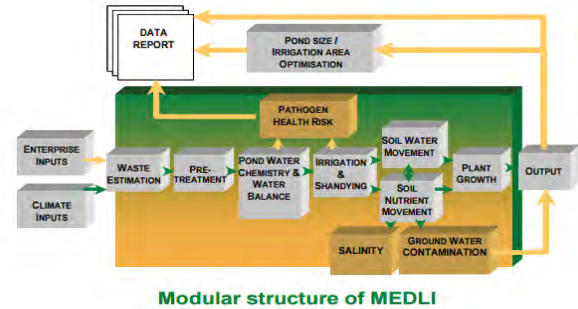
A validation of the model for effluent disposal using land irrigation (MEDLI)

Sponsor – School of Civil Engineering and Surveying

Mark Lowry

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Malcolm Gillies, USQ

Dr Simon Lott, WaterBiz Pty Ltd

Keywords: Validation, MEDLI, Effluent Disposal

1. Introduction

The Model for Effluent Disposal using Land Irrigation (MEDLI®) software models the entirety of effluent stream from its creation to disposal and outputs a recommendation on the amount of effluent that can safely be applied to a particular land area. The program requires the inputs of climate data and effluent production variables to produce the simulated scenario.

This research project aims to compare field collected water and soil data from beef cattle feedlots with simulated outputs from MEDLI®, thus providing a validation of the program.

2. Background

The Queensland regulating authority requires that proposed wastewater disposal through land irrigation is modelled in terms of; storage, treatment and disposal. The aim of the modelling is to determine a water and nutrient balance to determine a suitable size of irrigated land area for the disposal of the effluent. MEDLI is the modelling tool recommended by Queensland Government. Currently, research aimed at validating MEDLI against field data is limited.

3. Methodology

This research comprises of three case studies generated from data collected at different feedlots. The conditions of each scenario where simulated in MEDLI to produce model outputs. The simulated and field data will then be compared using coefficient of determination (R^2) and coefficient of efficiency (E) statistical analysis methods.

Figure 1 – Structural Schematic of MEDLI
(source: MEDLI Technical Manual)

This will provide a determination of the accuracy of the predicted data.

4. Key Outcomes

The key outcomes for this research is to ascertain if predictive software recommended by the Queensland Government provides accuracy in its predictions.

5. Further Work

Whether or not variation is found between simulated and real world outcomes this research could be used to inform future investigation into either establishing causes and solutions to discrepancies or further validation of MEDLI used in enterprises other than beef cattle feedlots.

6. Conclusions

At time of writing, analysis of field and simulated data sets have not yet been completed. It is envisaged that finalisation of the results will establish if variation exists between each data set and determine whether MEDLI is a useful prediction tool for managing effluent disposal in beef cattle feedlots.

Acknowledgements

References

Gardner, T, & Davis, R. (1998). MEDLI Version 1.2 Technical Manual. Queensland Department of Natural Resources,

Singer, M., & Munns, D. (2006). *Soils: An Introduction* (6th ed.): Pearson.

Optimization of GNSS Control Networks in Long Line Surveys using Geoscience Australia's AUSPOS Service and Static Baselines

Nick Lund

Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Assoc. Prof. Peter Gibbings, USQ

Keywords: GNSS, AUSPOS, Network Optimization.

1. Introduction

Global Navigation Satellite Systems (GNSS) are commonly used in the surveying industry for establishing large geodetic networks where conventional terrestrial surveying methodologies are considered inefficient. A good example of this is long line control networks, typical of that of a pipeline project, rail corridor, or long line easement. Surveys of this nature typically require a lot of planning and time to complete. This project looks at the current adopted methods for establishing long line control networks, and attempts determine methods of optimization using different post-processing methods, while still meeting the ICSM SP1 standards.

2. Background

This project looks at the current adopted approaches for establishing long line control networks, and attempts to determine a method that optimizes the process. Different methods can be used dependant on the quality of network required and the time constraints often associated GNSS network surveys.

3. Methodology

A long line static GNSS survey was carried out, approximately 35km in length. The data was post-processed in a number of different configurations in Trimble Business Centre and also by AUSPOS. The positional, relative, and survey uncertainties were then calculated to validate the reliability of each method and the amount of time taken to post-process each survey was also document to provide a guideline on what methodology should be adopted to carry out a long line control networks. Figure 1 illustrates the average positional uncertainties calculated for a number of the methodologies tested.

4. Key Outcomes

The main outcome of this project is to determine the most efficient way to establish a long line control
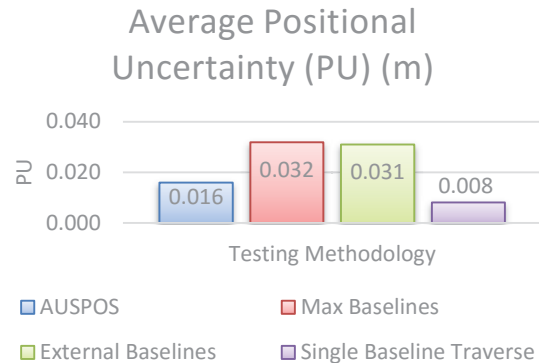

Figure 1: Average positional uncertainties for a variety of the methods tested.

network by GNSS. This is measured on a time/cost approach which also takes into account the positional, survey, and relative uncertainties of the survey. Initially it was predicted that a conventional approach with closed figures and all dependant baselines removed was going to provide the best results, but a single baseline between stations and constraining the survey to Regulation 13 CORS sites at each end of the survey has so far produced the most reliable results.

5. Further Work

The further work in this project includes completing the final testing methodology analysing the results of that methodology. After this is completed, a time/cost analysis can be completed and a guideline on how to approach these surveys can be put together.

6. Conclusions

This project found that there is a number of configurations that can be used to approximate coordinates reliably depending on project requirements and time constraints in long line surveys. This is key in producing more efficient surveys that still meet SP1 requirements.

References

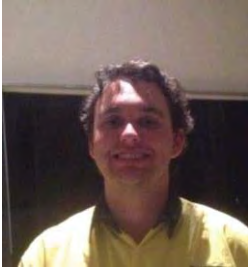Ebner, R. & Featherstone, W.E. (2008). How well can online GPS PPP post-processing services be used to establish geodetic networks? *Journal of Applied Geodesy.*

Investigation of Dam Wall Deformation Surveys

Sponsor – Toowoomba Regional Council

Joshua Lynch Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Dr Xiaoye Lui, USQ

Jon Bradbury, TRC

Keywords: Deformation Monitoring.

1. Introduction

Dam walls are monitored by surveyors periodically to ensure that there is no deformation movement within the dam wall. Surveyors have been doing these for years but what determines the quality of these measurements. This research project aims to evaluate Hunter and Fells guidelines using monitoring data and how this guideline can be enhanced with a survey field procedure to produce the best results in the shortest time.

2. Background

Dam Walls are extremely important assets to the community but pose a large threat to both the environment and people living downstream if the dam wall were to fail. Cressbrook Dam, Cooby Dam and Lake Perseverance are all maintained by Toowoomba Regional Council all situated to the North of Toowoomba. These dam walls need to be monitored using qualitative and quantitative data to ensure they don't fail.

3. Methodology

There are many varying opinions on what is the best survey method to conduct a valid deformation survey. Firstly I will use the case study data to evaluate whether or not Hunter and Fells movement guidelines can be applied for the general surveyor to use. This will involve developing a spreadsheet that can interpret coordinates and organise them in a way to aid the process.

Secondly I have done observations using robotic and non-robotic total stations. The data has been processed so that the different methods of survey can be analysed

Figure 1: Picture of Cressbrook Dam Survey Site

in a least squares adjustment using Starnet Software. These survey methods will then be applied to the literature guidelines to determine the most effective procedure of dam wall monitoring.

4. Key Outcomes

The key outcomes to date is that an effective excel spreadsheet has been developed to analyse the coordinate values of a CSV to allow ease of applying survey data to Hunter and Fells movement guidelines. All the field work has been completed as well. The robotic total station was by far easier to use but hasn't shown any significant differences in measurement as of yet. Another interesting finding was that the data surveyed from two stations below the monitoring point achieved a different height compared to the station measuring above the monitoring point.

5. Further Work

The focus for the remaining portion of the project will be analysing the processed data as well as continuing to write the dissertation from those conclusions.

6. Conclusions

At this stage of the project it is becoming apparent that to monitor the pointe you would only need to setup from 1 station if they have two rounds read to them. Although the control coordinates need to be at a high order to achieve good rounds data.

Acknowledgements

I would like to thank my supervisor Dr Xiaoye Lui for her guidance and support as well as Mr Luke Czaban for his technical advice. I would also like to thank Mr Jon Bradbury for his support throughout this project.

References

Hunter. G & Fell.R (2003). The Deformation Behaviour of Embankment Dams, University of New South Wales, Sydney

Abrasive Wear Behaviour of Coir Fibres Reinforced Epoxy Composites

Sponsor –School of Mechanical Engineering and Surveying.

MALLAMPATI SURAJ

Master of Engineering Science

(Mechanical)

Supervisors: Dr Belal Yousif Associate Professor, University of Southern Queensland, Toowoomba, QLD, Australia.

Keywords: Epoxy Composites, Grade papers, Tri biological Behaviour, Natural and Synthetic Fibres.

1. Introduction

Global Warming and petroleum reserves depletion has increased concern among the scientists to focus on Natural Fibres such as coir, jute, sisal. Natural Fibres Reinforced with fibre composites gained more attention due to its unique properties like, Available in abundant, Low density properties, ease to separate for grade, Carbon dioxide Neutrality, Biodegradable, and Acceptable Specific Properties. These Composite materials is the best solution for aerospace and structural industries. According to Bajpai, yousif et al., 2013 had provoked the effect of friction and wear to the machinery. This made many researchers to work and study on tri biological behaviour of developed polymer composites.

2. Background

Nowadays, friction and wear are the main cause for loss of machinery in industrial and other manufacturing industries in which wore out materials or machinery components are to be replaced immediately with heavy loss. This friction on the energy surface are affected due many parameters like sliding Velocity, temperature, and applied load on the Composite material. In addition to these Myshkin et al., in the year 2015 had reported that friction is due to three elements types such as, Interfacial bonds, Strength of the material, and due to shearing and rupture of the contacted material

3. Methodology

Coir fibres composites are selected for this project. Preparing samples of composite coir fibre material, Conducting Block on Ring (BOR) Machine Test. And examining under Scanning Electron Microscope (SEM) Machine.

4. Key Outcomes

The outcomes for this report are studying the abrasive wear behaviour of the developed composites under different applied loads and different Orientations (parallel, Anti- parallel) for a three-body abrasive wear under dry conditions. This understanding of abrasive wear behaviour helps the industries and machinery not to damage in abundant

5. Further Work

To study the Abrasive wear behaviour of Natural fibre polymeric Composites. Develop a coir fibre composite based on natural fibres. Epoxy/coir fibres will be developed. We will study on the interfacial adhesion of the natural fibre composites with the matrix/Structure. Study Tribology of the develop materials using abrasive mechanism. Evaluate and analysis on the final outcomes.

6. Conclusions

The values are noted down carefully noted in tables and calculations are performed for the obtained values, and few graphs can be plotted for frictional forces to time period. And then other graph is plotted on weight losses to the time phase for finding the frictional wear behaviour.

Acknowledgements

References

- YOUSIF, B. F. 2013a. Design of newly fabricated tri biological machine for wear and Frictional experiments under dry/wet condition. Materials & Design, 48**,** 2-13.
- FRIEDRICH, K., LU, Z. & HAGER, A. 1995. Recent advances in polymer Composites' tribology. Wear, 190**,** 139-144.
- Mehar, SK 2009, 'Weathering Behaviour of Bagasse Fiber Reinforced Polymer Composite', National Institute of Technology Rourkela.

Asset management – Switching to hybrid bearing

School of Mechanical and Electrical Engineering

Desmond Maravanyika

Bachelor of Engineering (Honours)

(Mechatronics)

Supervisors: Mr Bob Fulcher, USQ

1. Introduction

The main objective of this project is to design and test hybrid bearings in Rail Engineering. The idea is based on their claimed superior Chemical, Mechanical and Tribological qualities over conventional steel bearings.

2. Background

High operating cost, coupled with softening of Iron ore prices, had triggered the need to run the business in a more efficient manner. Bearing failures attributed to 70% of recorded downtime. All ideas considered were focusing on reducing the volume of work through the shop and promoting productivity through high plant availability. Investigation conducted by 2 main bearing manufacturers indicated that rolling elements attributed to 80% of all bearing failures. There is no direct capital for the probable design solution. The management is expecting savings realised from change management system to sponsor the project.

3. Methodology

After considering the problem statement and possible design solutions, 3 test bearings comprised of Full Hybrid, Semi-Hybrid and conventional steel bearings are being tested on a sample of wagons. Two bearings from each family shall be recalled every 6 months, unless an urgent situation arises. An informed decision based on the outcome of such strip down analysis would be easily made.

4. Key Outcomes

The first recall is scheduled on 20 August. I am looking forward to strip down, measure and note any
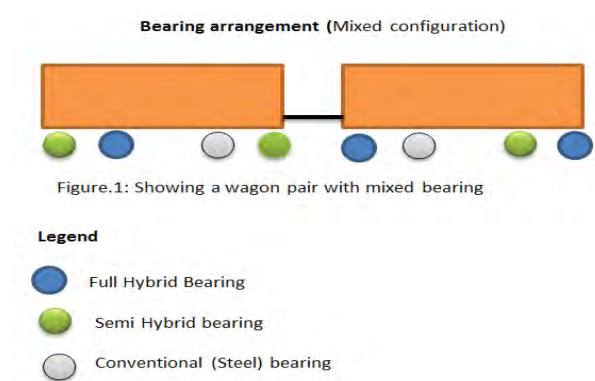

Figure 1 - Sample Diagram

dimensional deviation, including lubricant contamination, as a means of measuring wear rates and projecting lifespan. Recommendations based on the outcome of this analysis would then be made per respective bearing type.

5. Further Work

A task specific, workshop based, bearing testing facility where parameters such as loading and speed could be varied, is required to speed up the testing process.

6. Conclusions

Basing on the data from bearing sensors, all bearing under testing are still operating within the specifications. However, it is still too early to judge the performance as a success. More time and information is required. Further guidance would be obtained from a strip down analysis.

Acknowledgements

References

ANDERSSON, P. 2006. *Advanced ceramic materials in tribological service.* Tribologia*, 25,* 3-19.

ARNOLD, G. E. *Exploring the potential for the application of ceramic bearing technology to the wheel/rail interface.* Proceedings of the ASME/IEEE Joint Rail Conference and the ASME Internal Combustion Engine Division, Spring Technical Conference 2007, 2007. 53-59.

Optical Access Engine – Design of Pneumatic Clamping Head

Sponsor – School of Mechanical and Electrical Engineering

Gabriel Martin

Bachelor of Engineering (Mechanical)

Supervisor: Professor David Buttsworth, USQ

Keywords: pneumatic, actuator, stress

Figure 1 – Before and after position of engine clamp

1. Introduction

This project involves the design of a pneumatic (air-powered) actuator that seals of an optical access engine combustion chamber. The mechanism can be considered as a linear pneumatic (air powered) actuator. The actuator design was based on the function of a typical pneumatic cylinder found in pneumatic systems. The actuator design continues the development of an optical access engine for USQ Toowoomba Campus.

2. Background

Optical Access engines enable analysts to study the dynamics of fuel droplets and to visualise the characteristics of the flame front in the combustion chamber during engine running. Soot forms on optical components due to combustion. Sooting can impede any diagnostic equipment, particularly lasers, from transmitting light to the combustion chamber. Being able to clean optical components quickly in between experiments is therefore very important.

3. Methodology

Software such as Autodesk AutoCAD, Inventor and MATLAB were used for creating 3D and mathematical models. An iterative approach was used where different parts of the system would be designed and if one part of the system did not yield reasonable results then the design would be modified accordingly.

4. Key Outcomes

Several main components of the system were identified and analysed. A 2-dimensionl, general layout of the system was created. It has been found that even simple vertical motion as shown in Figure 1 involves complicated dynamics. Physical and thermal stress analysis have been applied to the components exposed to stress.
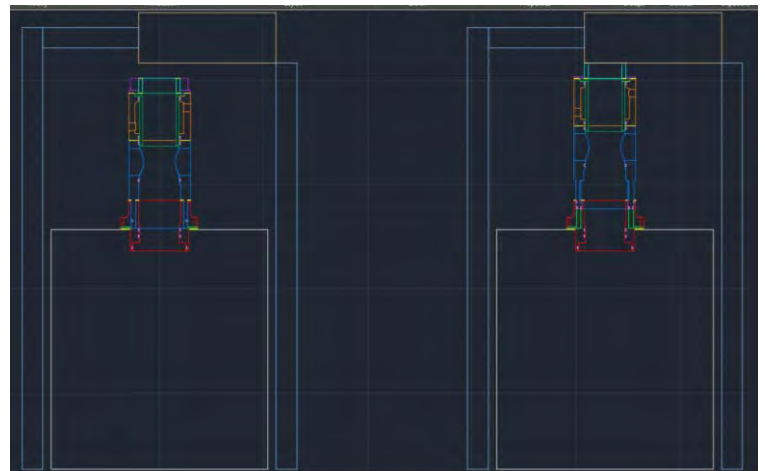
A mathematical model using MATLAB was developed to understand how the system responded to certain pressures and working environments.

5. Further Work

More detailed parameters, such as detailed friction characteristics, can be implemented into the model to replicate a realistic system. Fatigue and reliability analyses can be performed for measuring the system's feasibility.

6. Conclusions

This project has developed the optical access engine for USQ Toowoomba. This work will see the university being one step closer to potentially commission and fabricate an optical access engine for research.

Acknowledgements

I would like to thank my supervisor, Professor David Buttsworth, for his expert guidance during the project work. I am also thankful to my loving family who have been a firm support for me during the difficult times.

References

Roylance, David; August 23 2001, 'Pressure Vessels', Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139, PDF p. 102 chart 2.22

Juvinall, Robert C.; Marshek, Kurt M.; 'Machine Component Design Fifth Edition', 2012, John Wiley & Sons Inc.

Tressler, J.M. et.al; 'Dynamic Behaviour of Pneumatic Systems for Lower Extremity Extenders', Proceedings of the 2002 IEEE International Conference on Robotics & Automation Washington, DC, May 2002, University of California at Berkeley, Berkeley, CA 94720, p. 3249-3253

Improved Transfer Chute Design Using DEM Software to Predict Material Flow Behaviour

School of Mechanical and Electrical Engineering

Alex Mason

Bachelor of Engineering (Honours)

(Mechanical)

Supervisors: Dr Canh-Dung Tran, USQ

Mr Mark Rennie, CABS

Keywords: Discrete Element Modelling (DEM), Transfer Chute, Design.

1. Introduction

This project investigates the use of Discrete Element Modelling (DEM) software to simulate the flow in an existing transfer chute and validate the proposed chute improvements at the Kwinana Bulk Terminal (KBT). The purpose of the chute modifications is to improve the operating costs of the facility, by reducing spillage and/or increasing capacity and reducing maintenance down time.

2. Background

A number of problems existed with conveyor RC01 feed chute at KBT including: spillage, poor belt tracking and lack of load profile. This was caused by poor material flow control in the existing conveyor loading boot.

Transfer design techniques have improved over the last 50 years, with a specific focus on resolving transfer problems by improved material flow control (Benjamin, Donecker, Huque, & Rozentals, 2015). These techniques, along with the ability to model granular flow using DEM software, allow the problems experienced with RC01 to be replicated and the new chute design validated.

3. Methodology

The existing transfer chute was videoed during operation to identify the material characteristics and the specific problems being experienced. A 3 dimensional computer model of the transfer station was created and then imported into DEM software. The DEM software was used to run simulations with varying material characteristics until the simulation matched, as close as possible, the existing chute operation. An improved
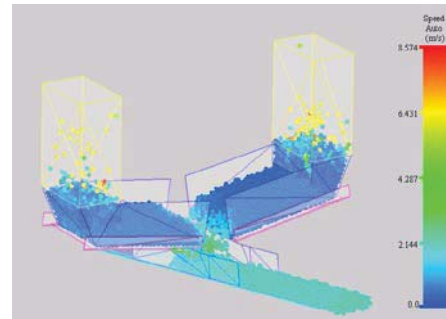

Figure 1 – DEM simulation of transfer chute

chute design was created that focused on controlling the material flow. The improvements were then validated by the DEM software.

4. Key Outcomes

To date lack of load profile and belt tracking issues have been identified and recorded. An effective DEM simulation has been achieved. Design improvements for the chute are now being developed and these improvements are expected to resolve the identified problems and increase capacity by 20-25%.

5. Further Work

Final simulation of the improved design needs to be completed. Future work will involve a detailed design and costing of the transfer chute for installation at KBT. This further work will need to be commissioned by Fremantle Port Authority (FPA).

6. Conclusions

This project has identified areas of improvement of the transfer chute at KBT and developed a methodology and the necessary skills that will form the basis of future transfer chute improvement work.

Acknowledgements

I would to thank Mr Mark Rennie for his guidance and support, my supervisor Dr Cahn-Dung Tran for advising me on the academic requirements and FPA for allowing access to their site for the purposes of this project. I would also like to thank my family for their patience.

References

Benjamin, C., Donecker, P., Huque, S., & Rozentals, J. (2015). *The Transfer Chute Design Manual for Conveyor Belt Systems*: Conveyor Transfer Design Pty Ltd.

Behaviour of geo-polymer concrete beams reinforced with combined GFRP bars and steel reinforcement

Sponsor – V-ROD Australia

Nichal Mathi

Master of Engineering Science (Structural)

Supervisors: Dr Allan Manalo, Dr Ginghis Maranan

Figure   1   -   Sample   Diagram

Keywords: hybrid beams, ductility, FRP bars, steel reinforcement, Geo-polymer concrete.

1. Introduction

Fibre-reinforced polymers are becoming very promising candidates for reinforcing concrete structures. While high-strength, concrete beams reinforced with FRP bars behaved linearly up to failure. It is anticipated that by combining FRP and steel reinforcements, the concrete beams will exhibit high strength and ductile failure behavior. The main aim of this project is to investigate the flexural behavior of the beam casted with the combination of FRP and steel reinforcement.

2. Background

Hybridization interests structural engineers as a good alternative to overcome the lack of ductility in FRP bars. To alleviate the corrosion caused by steel reinforcements and design cross-sections with homogeneous, hybrid reinforcements are shown as best practical effective design solution for concrete structures.[1]

3. Methodology

The objective of this research is to investigate the flexural behavior of geo-polymer concrete beams reinforced with combined GFRP bars and steel reinforcement. The main parameter that will be investigated in this study is the amount of the steel reinforcement. The assessments on the behavior of the beam will be done based on the experimental results such as, load deflections, beam stiffness, maximum peak load, maximum mid span deflection, cracking factor, failure mode, and crack. These results will then be compared with the conventional concrete reinforced with GFRP bars and steel reinforcement. Theoretical evaluation of the behavior of the hybrid beams will be also conducted.

4. Key Outcomes

The main outcome of this research is to understand the flexural behavior of hybrid beam i.e. is the combination of steel and GFRP reinforcement. If the results are positive and this reinforcement procedure can be the best alternative for existing reinforcement.

5. Progress to date

The casting of beams was completed and molds are separated from the beams. The beams are being cured and will be subjected to four-point static bending after 28 days of concrete pouring.

6. Summary

Upon my literature review so far, the behavior of a hybrid GFRP- steel reinforcement beam was recently analyzed. The outcomes are, the yielding of steel ensures the ductility, and the strength of GFRP increases ultimate capacity after steel yielding [2]. My future works include experiments and analyzing the results, literature review and finally report writing.

7. Acknowledgements

I would like to appreciate Dr. Allan Manalo and Ginghis Maranan for their contribution so far.

References

[1] Qu, W. J., and Huang, H. Q. (2009). "Flexural behaviour of concrete beams reinforced with hybrid (GFRP and steel) bars." *J. Compos. Constr.,* 10.1061/(ASCE)CC.1943-5614.0000035, 350-359.

[2] Newhook, J. p. (2000). "Design of under-reinforced concrete T-sections with GFRP reinforcement." *Proc., 3rd Int. Conf. on Advanced Composite Materials in Brdges and Structures,* J. Huar and A.G. Raza-qpur, eds., Canadian Society for civil Engineering, Montreal, 153-160

Validation of Commercial Precision Spraying Technology using Autonomous Agricultural Robots

Sponsor – SwarmFarm Robotics, National Centre of Engineering in Agriculture

William McCarthy

Bachelor of Engineering (Honours) (Agricultural)

Supervisor: Dr Cheryl McCarthy, USQ

Keywords: Precision Spraying, Spectral Sensing, Weed Mapping

1. Introduction

This dissertation aims to develop a standard procedure for evaluating commercial weed detect, spot spraying systems currently used in agriculture. This will be achieved through the development of a WeedCheck module which can interface to existing spot spraying systems to determine whether chemical was delivered to the weed. Trials were undertaken using SwarmFarm's autonomous robotic platform.

2. Background

Precision spray technology has the potential to revolutionise weed management through more effective and efficient control of weeds. The sensors used for precision spraying detect plants in fallow (i.e. differentiates green from brown) and delivers a predetermined chemical. Spot spraying is a more economical control strategy over blanket spraying. The adoption of this technology, however, has been steady as farmers tend to see precision spraying technology as unreliable. Therefore, the development of the WeedCheck module being developed for this thesis will give farmers quantitative data on the true hit and miss rates of spot spraying technology.

3. Methodology

The project involves 3 main stages including software design, hardware design and field trials. Hardware included a Raspberry Pi with a camera module for capturing images. Pink dye was used as a marker for easy identification of weeds that were hit. Software design included the use of ROS (Robot Operating System). ROS is a collection of software frameworks for robotic development. ROS was used in this project to capture a signal when weeds were detected to record the GPS coordinates of that weed. This signal also triggers a camera to capture an image of the weed. The images were then observed and labelled as a hit if pink dye was seen and a miss if no dye was detected.

4. Key Outcomes

The WeedCheck module developed has the potential to interface to existing weed detection platforms. When a weed is detected the module stores the exact GPS position of the weed and captures a photo of the weed after chemical application. This allows visual confirmation that the chemical was delivered to the actual weed not the surrounding ground, validating the accuracy of spot spraying technologies.

5. Further Work

Further implementation of computer vision software could allow automatic, real time validation of each weed through the use of colour thresholding.

6. Conclusions

Once data collection has been completed under a variety of different environmental conditions conclusions will be drawn on the success of the WeedCheck module.

Acknowledgements

I would like to acknowledge SwarmFarm Robotics for the use of their robotic platform and weed detection hardware. Also my supervisor Dr. Cheryl McCarthy for her support, patience and assistance throughout the entire thesis process.

References

Paap, A. J. (2014), Development of an Optical sensor for Real-Time Weed Detection Using Laser Based Spectroscopy, PhD thesis.

Baillie, C., Fillols, E., McCarthy, C., Rees, S. & Staier, T. (2013), 'Evaluating commercially available precision weed spraying technology for detecting weeds in sugarcane farming systems Extract from final SRDC report NCA011 Sugar Industry . Final Report . National Centre for Engineering in Agriculture'

Retrofittable Presenter Tracking Camera Mount

Sponsor – School of Mechanical and Electrical Engineering

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Bachelor of Engineering (Honours) (Electrical and Electronic)

Supervisor: Dr Andrew Maxwell
Keywords: Presenter Tracking, Camera, Computer Vision.

Figure 1 – Prototype face tracking algorithm utilising mean shift colour density tracking, implemented in OpenCV.

1. Introduction

This research project investigates the feasibility of constructing a camera mount which has the ability to track a presenter moving within a presentation space. Such a system would eliminate the need for a camera operator, or in contexts where a fixed camera view is normally utilised, would result in an improvement in the quality of content produced. This mount is intended to be easily retrofitted to existing equipment (such as tripods and cameras) in order to keep implementation costs low. The project aims to produce a solution incorporating tracking methods which is cost-optimised and suitable for use by single-operator content producers.

2. Background

Traditionally, when presentations are recorded without the assistance of a camera operator, a fixed camera view is used throughout the presentation, restricting the movement of the presenter within the presentation space. Using multiple cameras can alleviate this problem, but introduces a time-consuming process of editing the multiple recordings into a final video. Presenter tracking aims to eliminate these problems by emulating a camera operator. Commercial camera tracking systems already exist, however they can be cost-prohibitive, usually require a professional installation, and are restricted to the space in which they are installed. This project will identify tracking techniques which can be easily implemented for tracking, and are simple to use, portable, cost-optimised, and compatible with existing equipment.

3. Methodology

The literature provides an array of techniques suitable for tracking presenters, such as image processing, wearable infrared beacon tracking, and sound source localisation, among others. A set of specifications encompassing physical and operational characteristics were defined based upon user requirements, and key criteria and an evaluation method were developed from them. Image processing was identified as a suitable ca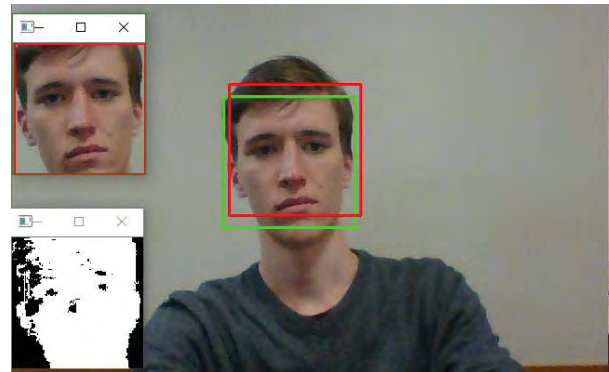ndidate as the basis of a tracking algorithm, mainly due to recent improvements in hardware capabilities and the availability of image processing libraries such as OpenCV. A Raspberry Pi single board computer has been used to test the operation of the prototype tracking algorithms. The development of this algorithm is a key objective of this project, and will undergo a simulation and optimisation process. An example of a rudimentary face tracking algorithm utilising face detection and mean shift object tracking is shown in Figure 1.

4. Key Outcomes

The tracking algorithm is still being developed and tested, however it is expected that a suitable tracking implementation will be finalised at the completion of the project. This system will be validated through a series of operational tests and evaluation against the defined criteria.

5. Further Work

A simplistic camera steering system has been developed to aid in the tracking algorithm development. Future work could involve improving the design of this system to be efficient and noise-free.

6. Conclusions

It is not possible to comment on the results of the project until testing has been completed. However, it is anticipated that a tracking algorithm which meets the evaluation criteria will be developed.

References

OpenCV.org (2015) Meanshift and CAMshift. <http://docs.opencv.org/3.1.0/db/df8/tutorial_py_meanshift.html>

An Investigation of the Predictive Accuracy of Salinity Forecast using the Source IMS for the Murray-Darling River

Sponsor: School of Civil Engineering and Surveying

Murray-Darling Basin Authority, Canberra

Harry Mccullagh

Bachelor of Engineering (Honours) (Civil)

Supervisor: Dr Md Jahangir Alam, USQ

Keywords: Source IMS, Salinity, Murray-Darling Basin.

1. Introduction

Water quality modelling plays a significant role in the effective planning and operation of the Murray-Darling Basin. This research project investigates the effectiveness of salinity modelling within the Source Integrated Modelling System (IMS) and investigates opportunities for model refinement.

2. Background

The Murray-Darling Basin Authority (MDBA) has recently developed a daily time step model, using the Source IMS, of the Lower Darling River. The model, which is yet to be fully adopted, is currently being tested in order to build confidence in both the Source IMS and the model itself. As a result, the potential for further refinement of the model exists in order to ensure that the most effective salinity modelling methods are being utilised.

3. Methodology

In order to complete the project, three stages were required. Stage one related to the project's preparation. This involved receiving the model, completing a familiarisation of the software and completing a literature review focused on salinity modelling. Stage two represented the development of case study sections and analysis of the salinity routing method used. Finally, stage three involved testing the model and examining the effects of varying salt inflow.

4. Key Outcomes

Case study locations have been discussed in regards to their representation within the model space. An analysis of the baseline model run (figure 1) has been completed. Experiments involving the variation of salt inflow load along with data smoothing techniques are ongoing.
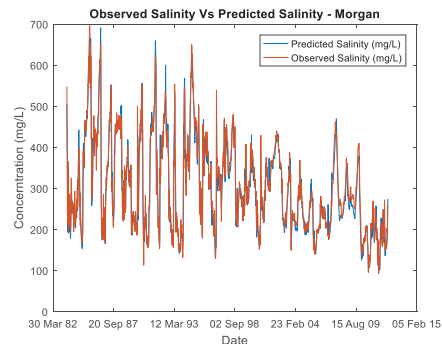

Figure 1 – Observed vs Predicted Salinity (Morgan - Baseline)

5. Further Work

The further work required involves the continued testing of new additional salt inflow time series and data smoothing techniques at the remaining case study sites and scenarios. Analysis of the historical flow and salinity loads to determine the salt load will be completed.

6. Conclusions

This research provides an assessment of the accuracy and validity of the existing modelling methods used in the newly developed MDBA Source model. The research hopes to provide improved functionality in forecasting salinity levels within the Murray and Lower Darling Rivers.

Acknowledgements

References

Bethune, M, Hardy, MJ, Teng, J, Lerat, J 2015, 'Implementation of source, the national hydrologic modelling platform, by the MDBA', 36th Hydrology and Water Resources Symposium 2015: The art and science of water, Barton, ACT, pp.1123-1130.

Welsh, WD, Vaze, J, Dutta, D, Rassam, D, Rahman, JM, Jolly, ID, Wallbrink, P, Podger, GM, Bethune, M, Hardy, MJ, Teng, J & Lerat, J 2013, 'An integrated modelling framework for regulated river systems', Environmental Modelling & Software, vol. 39, pp. 81-102.

Effect of Time Interval Variations on Network RTK in a High Multipath Environment

School of Civil Engineering and Surveying

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Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Assoc Prof Peter Gibbings, USQ

Keywords: Network RTK, GNSS, Multipath, CORS.

1. Introduction

Real-Time Kinematic (RTK) Global Navigation Satellite Systems (GNSS) has been a tool used by surveyors for over 20 years, since its inception the technology and applied uses have changed dramatically. In recent years the introduction of more satellites to the GNSS constellations and a more reliable and increased availability of Continuously Operating Reference Stations (CORS) in Australia has made RTK GNSS a tool surveyors choose to use more often over traditional survey methods.

Multipath is one of the common site specific errors affecting RTK GNSS systems and is one of the factors why survey regulators such as the Intergovernmental Committee on Surveying and Mapping state that the recommend observation time for a single survey control point is an average of recorded positions for at least 1 minute after the rover has successfully initialised and must be observed at least twice with at least 30 minutes between the two observations (ICSM 2014).

2. Background

With such a large focus on time variations surrounding the redundancy of GNSS observations and with little research on how site specific errors are effected by the changing satellite orbits. This is where the question of how does this time variation affect the observations? The research follows on from (Bein 2015) a previous research project that looked at time variations on RTK GNSS derived distances. With his findings noting that taking observations in quick succession had no effect on the accuracy. However, (Bein 2015) conducted his research is almost laboratory type conditions. Which is why this research is applied to a high multipath environment.

Figure 1: High Multipath Environment

3. Methodology

A large amount of Network RTK GNSS data was collected in a multipath free environment and a multipath present environment (See figure 1). With a RTK GNSS receiver using a network solution via the SmartNet Aus CORS Network. Residuals were calculated and analysed over time and analysed using the recommended time window of 30 minutes and a much shorter window.

4. Key Outcomes

Are there any affects to Network RTK GNSS observations when analysed against time variation in a high multipath environment?

Will the analysis align with current recommended RTK GNSS survey methods?

5. Further Work

Further research is required using different model GNSS receivers, CORS Networks and when satellite constellations improve further.

6. Conclusions

No significant correlation between time variations and accuracy using Network RTK GNSS which aligns with (Bein 2015) research.

References

Bein, V 2015, 'Effect of Time interval variations on RTK Derived Distances', USQ

ICSM 2014, 'Guideline for Control Surveys by GNSS SP1 V2.1, Commonwealth of Australia

Tidal predictions in ungauged estuaries for boat ramp access windows

School of Civil Engineering and Surveying

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Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Dr Zhenyu Zhang, USQ

Figure 1 – Murry's creek tide profile.

Keywords: Tides, Prediction, boat-ramps

1. Introduction

Many boat ramps in Central Queensland are only accessible in the upper half of the tidal cycle. This study used an innovative method of observing tide levels and simultaneously relating these observations to a nearby standard tide gauged port to predict access windows.

2. Background

Currently predicting when the ramp is accessible is a mixture of local knowledge and some educated guesses. Central Queensland, like most areas in Queensland has experience a huge growth in recreational boating. This has increased pressure on the boat ramp access and created demand for greater use of marginal ramps (Boon, Dwyer, Hooper, & Williams, 2011) . The ability to optimize the use of availably time at these ramps may reduce the pressure on more established ramps.

3. Methodology

Three test sites located in Central Queensland around the Mackay area were selected based on the tide dependant nature and also for the variability of the site characteristics. Each site was observed twice, once during a larger tide, and again during a small tide, The time and height was then compared to simultaneous records at the nearby standard port, Mackay outer harbour (MOH) (Queensland Government, 2015) . Using a linear relationship between the amplitudes of the two site observations and the predicted MOH amplitude, the access time can be predicted.
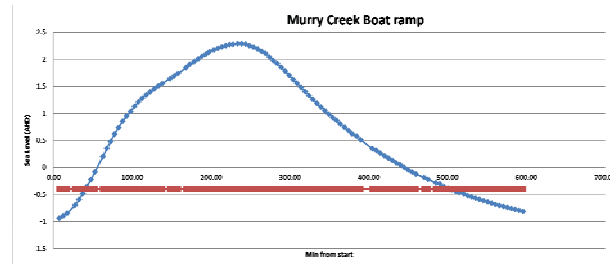
4. Key Outcomes

The study developed a technique to measure the tidal shape (height and time) with limited resources. The data enabled adequate predictions of access windows in 2 out the 3 sites.

5. Further Work

At present with only 3 ramps in the study. The final product could be an easy to use phone application, that enables date and location to be selected, and boat-ramp access times displayed.

6. Conclusions

Using the linear interpolation method an adequate prediction of access times was achieved in 2 of the 3 sites. Localised meteorological factors can influence access times.

Acknowledgements

I would like to thank my supervisor, Dr Zhenyu Zhang for his guidance and support.

References

Boon, C., Dwyer, E., Hooper, T., & Williams, M. (2011). Recreational Boating Facilities Demand Forecasting Study (Vol. 2016, pp. 246). Brisbane, QLD: Queensland Government.

Queensland Government. (2015). Storm tide data and tide predictions for Mackay. Retrieved 26th October, 2015, from https://www.qld.gov.au/environment/coasts-waterways/beach/storm-sites/mackay/

FireNET – A Vehicle Adhoc Network (VANET) Application

School of Mechanical and Electrical Engineering
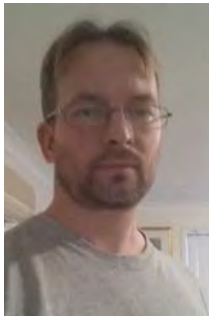
Todd McFarlane-Smith

Bachelor of Engineering (Software)

Supervisor: Prof Wei Xiang, USQ

Figure 1 - The VANET System Architecture

Keywords: Vehicle Adhoc Networking (VANET), Situational Awareness, Firefighting

1. Introduction

Vehicle Adhoc Networks (VANET) will provide greater Situational Awareness for vehicles and drivers on our road systems. Currently there is eyesight technology in our vehicles that facilitates heightened driver awareness of road conditions immediately in front of their vehicle. VANET's will provide a driver with increased Situational Awareness of road conditions and surrounding vehicle behaviour in front and behind the vehicle.

2. Background

VANET technology has applications that will increase awareness of road conditions and reduce the incidence of road accidents. The IEEE 802.11p Working Group developed an amendment to the IEEE 802.11 Wireless Communication standard that specifies VANET requirements for communication equipment that has been incorporated into the IEEE 802.11-2012 version of the standard.

However, a dependency for the success of VANET technology is the wide adoption of the technology. Successful VANET communications require a vehicle to be fully aware of all vehicles around it on the road. This will require full adoption of VANET systems in all vehicles. The general population will need to be confident in the ability of the technology to perform satisfactorily over an extended period of time.

3. Methodology

A Case Study methodology was employed in this project by developing a VANET application for the firefighting industry so that firefighting vehicles will be aware of where other vehicles are located on an active fireground. This will increase the Situational Awareness of firefighters and thus help to save lives and property.
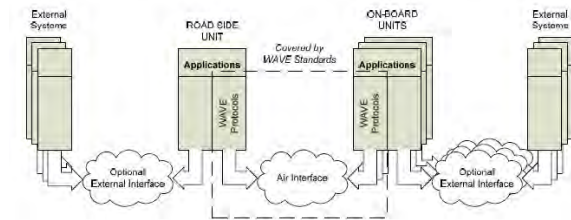
A Java-based VANET Software Development Kit (SDK) that can be re-used for other VANET communication applications will be implemented in a vehicle based application that will execute on an on-board unit (OBU) in a firefighting vehicle, and the application will communicate with other nearby OBU's to display a proximity map of the surrounding vehicles.

4. Key Outcomes

A key outcome of this project is a VANET SDK that can be consumed by other applications for other industries. Another key outcome will be a VANET application that can be marketed to the firefighting industry as a solution to the problem of poor Situational Awareness.

5. Further Work

The next step in this project is to deploy the VANET application to multiple OBU's in firefighting vehicles and execute field tests in an actual fireground situation.

6. Conclusions

A key conclusion to this project is to produce a commercially viable VANET application for the firefighting industry to improve a firefighters Situational Awareness. Other VANET applications can be developed through the VANET SDK for other industries to help improve the public's confidence in VANET technology and its benefits.

References

Radu Popescu-Zeletin, Ilja Radusch, M. A. R. (2010), *Vehicular-to-X Communication: State-of-the-Art and Research in Mobile Vehicular Ad hoc Networks*, Springer

McKenzie, J. & Ryan, S. (2009), *Report of the investigation team - strike team*, Country Fire Authority

Functional Design Report:

Corry's Road Sewerage Augmentation

School of Civil Engineering and Surveying

Josh McLinden Bachelor of Engineering (Honours) (Civil)

Supervisors:

Dr Malcolm Gillies, USQ

Mr Allan Hruz, AlburyCity

Keywords: Sewerage Augmentation, Functional Design

1. Introduction

The aim of this project is to investigate and report on a suitable functional design for implementing the augmentations and upgrades that will be required to cater for future flow demands associated with the development of the Thurgoona Suburb of Albury in the area surrounding the Corry's Road.

2. Background

The AlburyCity Council is required to provide residents of the Thurgoona suburb of the Albury LGA with adequate sewerage disposal service. It is expected that the Thurgoona regions population is going to rapidly increase in the coming years, leaving existing infrastructure undersized for the AlburyCity Council to fulfil its sewerage servicing requirements under the Local Government Act 1993.

3. Methodology

The Methodology employed for this project has consisted of the five main phases of the project, which were as follows:

- Start Up Phase

This phase involved the researching of previous Functional Design Reports (FDR) and examining areas for Literature Review.

- Literature Review Phase

This phase includes all literature research that is required for the project and the Project Preliminary Report.

- FDR Investigation Phase

This phase investigates the project scope, basis of design, site conditions, stakeholders and initial design.

- FDR Drafting Phase

The FDR Drafting Phase is more detailed stage of the design aspects of the project become more specific.

- Final Dissertation

This Final Dissertation Phase will involve preparation for the conference seminar where the project will be presented.

4. Key Outcomes

This project aims to deliver a Functional Design Report with recommendations for proposed upgrades and augmentation to the Corry's Road sewerage network.

5. Further Work

Completion of any detailed designs required for any recommended augmentations and provide AlburyCity with the opportunity to supply commentary.

6. Conclusions

Preliminary calculations indicate that the use of 'innovative' solutions to increase the capacity of the existing sewer system may be more cost effective.

7. Acknowledgements

I would like to thank my supervisor, Dr Malcolm Gillies for his ongoing support and guidance through the course of this project.

To the industry professionals, Greg Whorlow, Alan Hruz, Bradley Ferris, and Benjamin Falconer from the Albury City Council.

8. References

GHD (2015). *Albury Citywide Sewerage Strategy Report*

Y. M. Deng, G.A. Britton, S.B. Tor. (2000). *Constraint-based functional design verification for conceptual design.*

E. Mudge (1968). *The preparation and Use of the Value Engineering Functional Chart,*

Assessment of LiDAR for the Estimation of Canopy Heights in Breeding Trials

School of Civil Engineering and Surveying

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Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Professor Armando Apan USQ

Dr Jose Jimenez-Berni CSIRO

Keywords: LiDAR, Accuracy, UAV, Breeding Trials, Crop Height

1. Introduction

This project is collect data from different sources/platforms to identify crop height and then to validate the accuracy of the LiDAR data against proven methods. Using a UAV based LiDAR sensor we collected point cloud data to compare against surveying data from a total station instrument and a more traditional method of using a ruler (levelling staff). This project can then be used in further implementing this technology for future research.

2. Background

Canopy height is a key trait of the different varieties. It is measured routinely in breeding trials and it has been essential during the green revolution. Canopy height is traditionally measured with a ruler or stick which can be time consuming and result in lack of accuracy. So finding faster and more accurate ways to measure canopy height is critical for plant breeders in order to allow the operation on large scale field trials.

3. Methodology

Using a LiDAR sensor on a UAV platform and collecting a point cloud for comparisons using CAD to determine the height and then comparing this data with the data collected from both proven ground based LiDAR senor and traditional ruler based measurements to try and determine the accuracy of the LiDAR data.
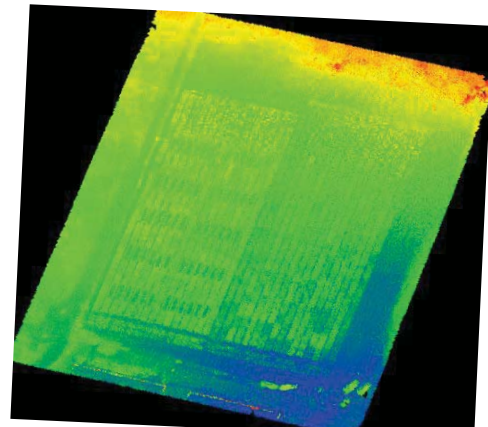

Figure 1 LiDAR Imagery of Breeding Plot

4. Key Outcomes

To determine if crop height can be measured with data from UAV platform LiDAR sensor and how that data compares with survey instrument data and traditional data from measuring with a ruler. Comparing this data to see what differences there may be and if those differences are within acceptable limits for the accuracy needed by researchers.

5. Further Work

Researchers can take this information and use it provided we show the accuracy is acceptable for implementation into larger trial breeding plots and eliminate a large volume of work currently undertaken.

6. Conclusions

This has been an interesting project which will have valuable information in the plant breeders quest to improve the way they collect the data needed for their research.

Acknowledgements

References

Cozzolino.D *, Porker.K ,Laws.M. Agriculture 2015 An Overview on the Use of Infrared Sensors for in Field, Proximal and at Harvest Monitoring of Cereal Crops, 5, 713-722

Deery. D, Jimenez-Berni. J, Jones.H, Sirault.X, Furbank.R, 2014, Proximal Remote Sensing Buggies and Potential Applications for Field-Based Phenotyping, Agronomy, 4(3)

Developing strategies for improving design standards for passing lane design on Rural Highways in Queensland

Sponsor –School of Civil Engineering and Surveying

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Supervisor: Dr Soma Somasundaraswaran,
USQ

Keywords: auxiliary lane, regional, overtaking

1. Introduction

Slow traveling vehicles are a common occurrence seen on regional highways within Queensland these vehicles create queuing congestion. Reducing congestion on regional highways can be achieved through implementation of auxiliary overtaking lanes. Project was designed to research design standards of auxiliary lanes to determine how designing an auxiliary lane is determined. The project analysed crash data from selected highways within in Queensland to help develop improved strategies for auxiliary lane design.

2. Background

Common locations for overtaking lanes are on upgrades as heavy vehicles slow down due to large loads being hauled. Leading problem of overtaking lane placement occurs when heavy vehicles need to overtake slower vehicles, as heavy vehicles require a longer amount of road. Most overtaking lanes located on upgrades it is near impossible for heavy vehicles to overtake safely, thus the heavy vehicle remains behind the slower vehicle causing congestion to occur.

3. Methodology

Methodology was to thoroughly analyse crash data to achieve a good representation of accident rates of all Queensland Highways. Analysis of data was conducted to a high quality to ensure information found was beneficial to the research in determining if auxiliary lanes could reduce the crash rate. Figure 1 displays the accident rates of Queensland Regional Highways.

4. Key Outcomes

Results found showed that the New England Highway displayed the highest accident rate. This outcome was interesting as New England only achieved third highest
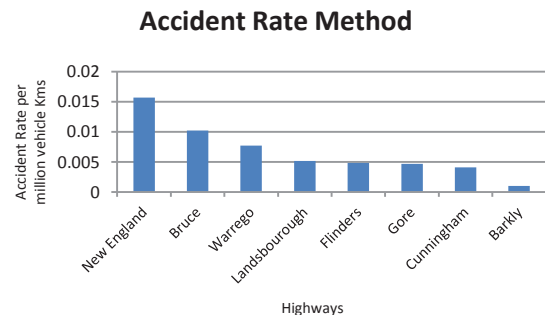

Figure 1 – Accident Rate of Queensland Regional Highways

amount of accidents. New England, Bruce and Warrego Highways were identified as three highest accident rate highways. High crash prone sections were found through analysing crash data. Crash prone section road alignments were examined to compare with design standards. Proposed improvements of overtaking lane placement were then created to increase service level.

5. Further Work

Examining of proposed improvements was unable to be conducted due to no having access to TRARR or simular simulation models. Further analysis could determine if proposed strategies would have a considerable effect on improving service levels.

6. Conclusions

Highest number of accidents does not always achieve the highest accident rate. The findings also showed that overtaking crash prone sections can be easily found in some circumstances however can also be very difficult as measuring the need for overtaking lanes is difficult to achieve using crash data. Crash data only displays when an accident has occurred it does not display when queuing congestion has occurred and the increased risk of an accident occurring.

Acknowledgements

Thank my supervisor Dr Soma Somasundaraswaran for his knowledge and guidance throughout my project.

References

OSU, n.d. Analysis of Accident Statistics, Corvallis: Oregon State University .

TMR, 2002. Chapter 15: Auxiliary Lanes. Road Planning and Design Manual, Issue 1, pp. 1-24.

Austroads, 2010. Guide to Road Design Part 3: Geometric Design, Austroads Ltd.

Recent Trends of Stabilisation Methods – A Case Study for Rural Roads by Councils in the New England Region of NSW

Matthew Mepham

Bachelor of Engineering (Civil)

Supervisors: Dr Jim Shiau, USQ

Keywords: Stabilisation, Pavement, Local Materials

1. Introduction

Local gravel materials are used by councils in the New England Region of NSW for pavement construction as they are readily available and keep the construction cost down. The issue of using these materials are they may not meet the specification requirements. This can have impacts on the performance and safety of the road. Therefore these materials need to be improved through the process of stabilisation to make the material suitable for use. A selection of these stabilisation agents will be researched and compared with each other through testing of a locally available natural gravel material.

2. Background

Councils in the New England region of NSW like to use readily available materials where possible from their local gravel pits for pavement construction; however these materials do not always meet the required specifications. Therefore material properties need to be modified to improve their performance. This is done through material stabilisation.

The focus of this project is to investigate the currently used methods of stabilisation by councils in the New England region and compare them to an innovative method such as bitumen emulsion.

3. Methodology

To compare the different stabilisation agents for improving the material properties, various tests will be conducted. These tests include a Particle Size Distribution, California bearing Ratio and Capillary Rise Test. Each of these tests will be performed using the Roads and Maritime NSW testing procedures to ensure accurate results and comparisons. Below is a photo of the CBR Sample Moulds soaking in a water bath for the minimum of 4 days as required.

Figure 1: CBR Mould Soaking

4. Key Outcomes

As testing is still in progress, testing outcomes are not available. However, through research I am expecting an increase in the strength of the materials with the cementitious and self-cementing agents. The bitumen emulsion may increase the strength only slightly. The bitumen is expected to have excellent water repelling properties whereas the cementitious and self-cementing agents are expected to be poor.

5. Further Work

Testing of the sample material is ongoing but will be completed soon. A comparison of stabilisation agents will be conducted, a theoretical pavement design and a sensitivity analysis will be the final tasks to be completed for this research project.

6. Conclusions

The key conclusions of this project will be that different stabilisation agents will have different effects on the material properties and these need to be considered and tested for when choosing an agent to use in pavement construction.

Acknowledgements

References

Roads and Maritime Services 2012, Test Method T117 – California Bearing Raito of remoulded specimens of road construction material, 3rd Edition, *Roads and Maritime Services*

Austroads 2012, Guide to Pavement Technology, 3rd

Edition, *Austroads*, Sydney

GeoPave 2006, 'Bitumen Emulsions', *GeoPave Technical Note,* no. 46

A Qualitative Assessment of Photogrammetry for use in Monitoring Bridges

School of Civil Engineering and Surveying

Timothy Michael

Bachelor of Spatial Science (Honours) (Surveying)

Figure 1 - Modeling an Inukshuk with an iPhone in Photo - Modeler

1. Introduction

The development of better photogrammetry software and technology that is available today, allows for the increase in the quality of 3D model precision and accuracies that can be achieved when using point clouds methods will be very beneficial towards faster surveys.

My research project will provide the foundation of the use of photogrammetry point clouds with traditional methods of monitoring surveys for the determination of movements on bridges. The data obtained from my research project can also be implemented in many other fields within the construction/monitoring industry.

2. Background

My project will expand on the use of photogrammetry point cloud methods to determine if the technology is ready for use or if, the need for more improvements towards the software and technology need to be solved before photogrammetry can be implemented in monitoring surveys.

3. Methodology

The projects methodology will used traditional methods of monitoring surveys for control data. The photogrammetry point cloud method will use an iPhone camera and photomodeler for the creation of the point cloud. The use of control points on the bridge will be used to determine the movement of the bridge. All traditional methods of the monitoring survey will be followed with further implementations to reduce errors.

Photomodeler will be used for all photogrammetry data, as Civilcad will be used for all total station data. The data will then be visually displayed and the use of excel will be used to show differences.

4. Key Outcomes

I wish reduce the overall work time and effort that traditional surveys take to complete, also provide more opportunities for photogrammetry to be further used in other surveying tasks.

5. Further Work

Further research into the following topics can be: analyse the environmental effects on the camera (temperature, climate) and the camera quality (what may be the minimum).

6. Conclusions

The project will provide foundations for high precision photogrammetry to start being used or tested. Previous studies have been successful but not to such a large scale with many factors effecting.

Acknowledgements

I would like to thank my supervisor Miss Jessica Smith as she has provided me with the initial idea. I would also like to thank Miss Jessica Smith for the guidance and overall help within this final year project which i appreciate.

References

Figure 1 - Eos Systems Inc (19-02-2010) Modeling an Inukshuk with an iPhone in PhotoModeler - Eos Systems Inc, Viewed 19-07-2016 <http://info.photomodeler.com/blog/modeling-an-inukshuk-with-an-iphone-in-photomodeler/>

Louis Peck, Lightpoint Data 2015, Can you Measure Crush with an iPhone?, viewed 22nd of may 2016,<http://lightpointdata.com/articles/2014/1/20/canyoumeasurecrushwithaniphone>.

Glover, P.V. 2013, Building surveys, 8th edn, Routledge/Taylor & Francis Group, London.

Examining the Hansen Global Forest Change (2000 – 2014) Dataset within an Australian Local Government Area

School of Civil Engineering and Surveying

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Bachelor of Spatial Science (Honours) (Geographic Information Systems)

Supervisor: Prof Armando Apan, USQ

Keywords: Hansen Global Forest Change, Land Use Change, GIS, ArcMap, Spatial Analysis, Zonal Tools.

1. Introduction

Human activities have long changed the state of land cover on the surface of the earth; however, since the industrial revolution that rate of change has reached such proportions that the very biogeochemical systems that sustain the biosphere of the planet have been impacted. Forests are an essential component in the biogeochemical processes that maintain a balanced geosphere (Meyer & Turner II 1992).

This project provides a spatial analysis of forest loss in the region covered by the Sunshine Coast Council against various datasets.

2. Background

This project utilized the Hansen global forest change dataset, which is a time-series analysis of high (30m) spatial resolution Landsat images aimed at capturing the global forest extent and change from the years 2000 to 2012 (Hansen et al. 2013).

The aim was to test the hypothesis that "Forests are lost when land use is converted to another use" and to reveal which land use changes contribute to forest loss. Analysis over vegetation management areas was also performed to give an indication of the effectiveness of conservation efforts.

3. Methodology

The ArcGIS *tabulate area* tool was used to analyse the areas of the Hansen dataset against a set of "zones" defined by the datasets of interest. The LGA as a zone gave a summary, whilst the other datasets, tabulated via a specified attribute, gave more detail.

To support this process, the Hansen dataset was used, along with an array of other datasets in which it was hypothesised could have an influence on forest cover. Each dataset was clipped to the study area and projected to a common projection to conserve storage space and speed up processing.
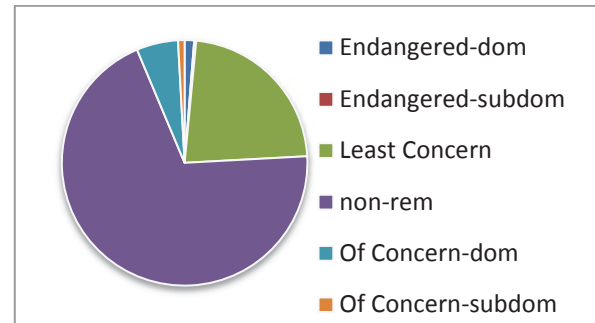

Figure 1 – Forest Loss 2000-2014 within Remnant Vegetation Management areas, plantations removed.

4. Key Outcomes

The analysis has provided key insights into forest loss within the study area. In particular, when the Remnant Vegetation Management Areas was analysed, it revealed that there was a relatively small amount of forest loss (ha) in the endangered ecosystem areas, see Figure 1. The analysis of forest loss over land use types and Broad Vegetation Groups (BVG) is on-going.

5. Further Work

The methods developed in this study could be used to provide analysis against other datasets, for example slope and aspect.

6. Conclusions

The analysis conducted in this project successfully quantified the effectiveness of vegetation management strategies in the study area. This study confirmed that the Hansen dataset is successful at performing analysis at the local government scale, though it doesn't discriminate types of forest loss i.e. plantation to virgin forest.

Acknowledgements

References

Meyer, W. B. & Turner II, B. L. (1992). *Human population growth and global land-use/cover change:* Annual Review of Ecology and Systematics 23(1), 39-61.

Hansen, M. C., et al. (2013). *High-resolution global maps of 21st-century forest cover change,* Science 342(6160), 850-853.

Analysis of Road Safety Trends at Signalised Intersections in Toowoomba

Sponsors: School of Civil Engineering and Surveying
              Toowoomba Regional Council

Ross Milton

Bachelor of Engineering (Civil)

Supervisors: Dr Soma Somasundaraswaran, USQ

Keywords: Traffic Safety, Signalised Intersections

1. Introduction

The aim of this research project is to identify signalised intersections which are performing well in terms of Road User Safety and to identify intersection features which aid in the reduction of road crashes at signalised intersections in Toowoomba. One of the main objectives was to develop an intersection classification system which enabled intersections to be categorized by their geometry and signal phasing.

2. Background

In 2014, 1186 fatalities occurred as a result of road crashes across Australia, with 223 fatalities occurring on Queensland roads. Previous studies indicate that intersections are one of the most hazardous locations on the road network. In Toowoomba 64% of all road crashes occurred at intersections. The road and traffic environments are constantly changing with time and road crash studies should be carried out regularly.

3. Methodology

Initially road crash data, traffic counts and intersection profiles were collected for the chosen study period. From here a proposed intersection classification model was developed and tested. All identified intersections were separated into groups based on this classification model. This model was designed to classify intersections based on their geometry (e.g. No. of traffic lanes, slips lanes, right turn lanes), signal design (Diamond, split or two phase) and traffic volume
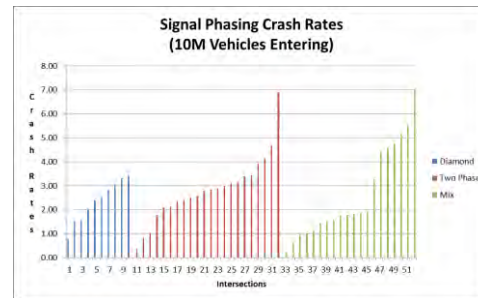

Figure 1 – Crash Rates for Different Signal Phasing

4. Key Outcomes

After a few iterations the classification model has been finalised and all intersections have been separated into groups with based on their configuration. Currently the crash rates for these categorised intersections are being compared with other categories to determine if any trends exist. So far the crash data seems to indicate that signal design significantly affects crash rates at intersections.

5. Further Work

Further analysis of crash data and comparison of intersection groups to determine which particular intersection configurations performs well. If time permits current road safety strategies will be compared to other safety strategies employed nationally and internationally.

6. Conclusions

Work is still in progress but at the completion of this study it is hoped that intersections that are performing well and others that are not performing as well will be identified. It is also an objective to determine if a particular intersection configuration produces a consistent type of road crash.

Acknowledgements

References

Austroads 2013, 'Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings', Sydney.

ASSESSMENT OF ENERGY USAGE FOR HOTELS

Sponsor –School of Mechanical and Electrical Engineering

Mohammed abdul zaheer

Master of Engineering Science (Mechanical)

Supervisors: Gaungnan Chen, USQ

Andreas Helwig, USQ

Keywords: Alternative energy sources, renewable sources

1. Introduction

Over the past 20 years, the hotels industry has been rapidly growing to provide larger number of employers in the world approximately 200 million people. Hotels benefit the national economy but also impose serious environmental threats. The over explosion of nature for short term profit oriented is self-destructive approach. To preserve this environment for our future generation, renewable energy resources should be adopted in place of fossil fuels or conventional resources for generating energy.

2. Background

The hotel industry is one of the most energy and resource intensive branches of tourist industry. Energy of significant amount is consumed in hotels for providing the services and comfort to guest; many guests are willing to pay for these exclusive entertainment and treatment. Hotel's energy efficiency is relatively low than the other buildings of same size, but their (hotels building) environmental impact are more than the other buildings. This bad effect on the surrounding is triggered by the massive wastage or local's consumption as well as resources those are imported (e.g. food, water, electricity, fuel). The emission released by hotels to water, air and soil also depleted their purity.

3. Methodology

I'm going to use home pro software to know how much energy produced using alternative energy sources like wind, solar, hydro power, and how it will be supplied to each and every area of hotel like hotel rooms, and kitchen section, parking, laundry and other areas.

4. Key Outcomes

In study it is found that the hotels have the potential to significant saving on energy use and which is highest than that of saving from households, transports and the manufacturing industries. EU hotels are in a good position as world third largest renewable power capacity is in the European Union.

5. Further Work

I'm going to use home pro software in my final project to know the energy usage requires for each and every place in the world it may be wind energy or solar, thermal energy it will gives the brief introduction about the usage of home pro software and helps to know how much energy generated in designated area of the project.

6. Conclusions

With the growing industry of hospitality, energy consumption also rises. But the conventional energy resources are limited in nature. So we have to use alternative resources which also must be abundant in nature. Geo thermal energy resources in hotel cover up the 70% of energy consumption, this also result in 66% cost saving for the hotel.

Acknowledgements

References

Hotel Energy Solutions, 2011, Fostering Innovation to fight climate change-Public report, Hotel energy solutions project publications, Visited 24 May 2016, Available: <http://www.hotelenergysolutions.net/sites/all/files/docpdf/hesreport2.pdf>

Endovascular Repair of Type B Aortic Dissection: A Study Using Computational Fluid Dynamics

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Master of Engineering Science (Mechanical)

Supervisors: Dr Ruth Mossad, USQ

Keywords: True Lumen, False lumen, Thrombosis, re-entry tear,

Introduction: Type B aortic dissection is a life threatening disease that occur due to the formation of false lumen from the true lumen of aorta. The false lumen may rupture as time passes creating thrombosis and alter the blood flow through the aorta. CFD can be used to vary the size of aorta and alter the blood flow pattern.

Background: Improper diet and stressful lifestyle are the reasons contributing the contributing factors that lead to type B aortic dissection (TBAD) or formation of false lumen from the aorta. Effective treatment by stent grafting require more study on the aortic condition of the patient regarding various bio- mechanical factors.

Methodology: Geometry Modelling: Modelling software ANSYS will be used to make the simplified aortic structure consisting of two chambers namely true lumen and false lumen.

Source: Geometry of Aorta created using ANSYS

Meshing of geometry: The meshing of the geometry will be done to obtain precise results regarding the shear wall stress that lead to the rupture of the wall.

Boundary conditions: The boundary conditions including inlet and outlet velocity, pressure, viscosity, density etc. are set in order to carry out the analysis.

Computational Fluid Dynamic Analysis: The aortic model created with ANSYS will be transferred to FLUENT, the software that is used to study the flow dynamics of the blood. The blood flow will be altered depending upon the factors like false lumen to true lumen area ratio, tear size and re-entry tear position.

Key Outcomes: The flow dynamics of the patient with aortic dissection is compared with normal boundary conditions to obtain the results of thrombosis, wall shear stress and point at which the rupture of the wall may occur. This help doctors to decide the optimum condition for the effective surgery to be carried out.

Further Work: Expanding the scope of the analysis to include more factors such as varying blood pressure of the patient. Also the diabetic conditions of the patients can be analysed which alter the results.

Conclusions: The thrombosis effect, the rate of blood flow, blood pressure and aortic wall stress and strain will help the practitioner to know the condition of the patient. By providing the best treatment will give the patient a healthy life ahead with guarantee that further problem may not arise in the future.

References: Fan, Y et al., 2010. Analysis of Blood flow in a dissected aorta by computational fluid dynamics. Journal of Biomedical Science and Engineering, [Online]. 2010, v. 3 n. 9, p 900-907. Available at: http://hdl.handle.net/10722/197211. [Accessed 3 June 2016].

Improving Project Delivery through the Application Project Management Techniques

School of Mechanical and Electrical Engineering

Aron Molloy

Bachelor of Engineering (Honours) (Mechanical)

Supervisors: Mr Bob Fulcher, USQ

Mr Stephen Bastian, Water Business

Keywords: Project Management, Project Delivery and Project KPI's.

1. Introduction

Substantial investment was made into regional water infrastructure in Australia in the 1950's and 1960's. Much of this infrastructure is now reaching the end of its usable life and will need to be replaced in the near future. However, in the preceding years a shift has occurred in the water industry from a government subsidized industry to user pays businesses (Coombs & Roberts 2007). To deliver projects in a timely manner it is important that water authorities undertake their project work using proven project management techniques.

2. Background

In 2013, Infrastructure Australia presented findings to show that on average, 48% of projects fail in Australia. The Auditor General of New South Wales suggests that a project has failed if it does not meet one of the three controlling constraints of - time, cost or performance. (Achterstraat 2013). The aim of the project is to identify limitations in project delivery of a regional water authority. Then to address any limitations through developing an In-house Project Management Tool that uses proven Project Management techniques as its foundation.

3. Methodology

The methodologies utilised in the completion of this research were both quantitative and qualitative in nature. Data was collected on the effectiveness of the current project management systems utilised by the company. Meetings were held to assess the current and future needs of the business and what criteria an 'In-House project Management Tool' should address. To build the PM Tool extensive research was conducted into programming using 'Visual Basic for Applications' (VBA) in Microsoft Excel.

4. Key Outcomes

The key outcome of this research has been the development of an 'In-House Project Management Tool' using Microsoft Excel. The tool is designed to monitor how effectively a project is being delivered against measurable KPI's.

5. Further Work

To complete this research in its entirety the PM Tool needs to be tested on a Capital Project. Once tested, it will be then be possible to determine the effectiveness of the tool in aiding project delivery. Feedback from Project Managers will be used to further improve the tool.

6. Conclusions

Regional water authorities are under increased pressure to control costs to reduce the price of drinking water. Utilising proven project management techniques is an effective way that these businesses can minimise wastage on capital projects.

Acknowledgements

I would like to acknowledge and thank all the people whom have given guidance, support, assistance and their advice to aid in the completion of this dissertation. Especially, my supervisors Mr Bob Fulcher and Mr Stephen Bastian, thank you. I also thank my family, my wife Sarah and my children Grace, Scarlet and Olive for the love and support that you have all given me throughout my study.

References

Achterstraat, P. (2013). *Why Large Public Sector Projects Sometimes Fail*: Sydney, NSW.: Audit Office of New South Wales.

Coombs, G., & Roberts, C. (2007). *Economic Roundup Summer 2007: Trends in Infrastructure*: Canberra, ACT.: Australian Government the Treasury

Robotic Falling Cat

Sponsor – School of Mechanical and Electrical Engineering

Bernard Monz

Bachelor of Engineering (Honours) (Mechanical)

Supervisors: Chris Snook, USQ

Keywords: Physics; righting reflex; angular momentum

1. Introduction

This report is a mathematical look at what a cat does as it falls. The focus is on how the cat inverts or self corrects in free fall.

The cat uses no external forces to help, nor does it need help when it is released. The forces which help the cat conserve the laws of angular momentum.

A replication of one of the mathematical models as a robot has been attempted.

This report makes no attempt to investigate the deceleration forces a cat may experience or the impact of those forces on its legs and anatomy at the completion of the fall.

The mathematical approach did not require the use of live animals, as such no animal was injured during this investigation.

2. Background

Science and engineering have long pondered the mysteries surrounding cats and their ability to self-correct mid fall. The mid to late 1800's is known in the literature as having the scientific cat-dropping craze.

According to literature there have been only a few attempts to mechanically replicate a robot which uses the cat righting reflex.

3. Methodology

A mathematical model was developed and used to predict the movement of a robot. The model was developed for Matlab and indicated that the robot needed to fall from about three metres to turn over in the fall. The model incuded some constraints from a series of selected stepper motors which placed limits on the speed at which the robot could swing the legs in and out, or spin about the mid section.
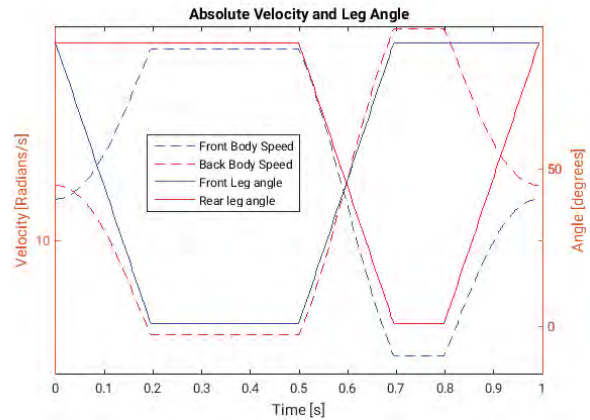

Figure 1: Absolute Velocity and Leg Angle

4. Key Outcomes

This report successfully created and can demonstrate a mathematical model of what has been called the tin can turn. This is where the cat turns by changing the difference in the moment of inertia from the front and rear sections of its body. The cat rotates its front are rear halves, swinging its legs in and out.

5. Further Work

Some of the advanced theories of how cats self correct involve gauge theory calculations. These were not attempted in this report.

Future attempts of mechanisation would involve legs which can take the impact of landing. As well as miniaturisation of the robot.

6. Conclusions

There are multiple methods used by cats for self correcting. Some of these are easy to replicate mechanically, and others require advanced robotic devices. It is not known how a cat chooses which method to turn over, however other methods for aligning a falling object appear to be less complicated.
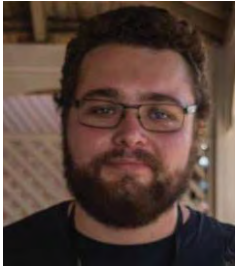
Acknowledgements

References

Kane, T.R. and Scher, M.P. 1969, A Dynamical Explanation of the Falling Cat Phenomenon, International Journal of Solids and Structures, Vol:5, page(s):663-669

B.

Using UAV's and machine vision in the early detection of combine harvester fires.

School of Mechanical and Electrical Engineering

Steven Mosetter

Bachelor of Engineering (Honours) (Mechanical)

Supervisors: Dr Tobias Low, USQ

Keywords: Machine Vision, Agriculture, Safety

1. Introduction

Fire during the harvest of crops is an ever present hazard. The combination of hot and dry conditions with a highly flammable crop material creates perfect conditions for fire to start and propagate, the result of which can be loss of production, time, equipment and the crop itself.

The aim of this project is to create a system that can actively detect fire activity so that the harvester operator has a better chance of containing the fire before it spreads out of control.

2. Background

In the past year there have been 45 incidents of fires involving agricultural equipment in Queensland alone and on average there are over 1000 harvester fires per year in the United States. Over half of these had an elapsed time of over two minutes between the start of the fire and the application of any fire suppression agent. The only current method of detection available to the harvester operator is their own keen senses.

By using the ability of CCD cameras to detect Near Infrared (NIR) and sophisticated machine vision, I believe that a cheap and effective fire detection system can be created that can alert the operator to any developing fire before the grows out of control.

3. Methodology

An extensive review of available literature regarding combine harvester fires, the use of Near Infrared (NIR) cameras in fire detection, the use of machine vision to detect fire was conducted. An experimental prototype NIR camera system was constructed with off the shelf components selected on the basis of suitability and cost and a computer algorithm was constructed to detect fire in the image feed.
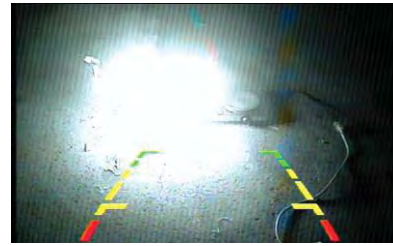

Figure 1- Fire view through a Near Infrared Camera

Using this camera system, testing was conducted using simulations designed to best replicate the types of fires that occur during harvest so that the system can produce accurate results.

4. Key Outcomes

The camera system used is quite capable of detecting any heat source hotter than 300 degrees Celsius and any fire is immediately obvious to the camera system enabling the use of relatively simple algorithms to reliably detect fire.

5. Further Work

Work remaining for the project includes further refinement of the algorithm to increase the accuracy of the system and a study of how the system could be implemented in order to achieve optimal detection including the use of Unmanned Aerial Vehicles as platforms for the sensors.

6. Conclusions

By applying a machine vision system to this problem, this project seeks to be the first step in eventually creating a fire detection system that can be implemented on numerous different platforms and could well save the agricultural industry millions of dollars every year.

7. Acknowledgements

I would also like to thank my father, Russ Mosetter, for giving me the idea in the first place. My supervisor, Tobias Low, for guiding me through the dissertation process and for his vital feedback and my good friend, Trent Pascoe, for assisting me during the testing phase.

8. References

J.M. Shutske, M. V., (2002). *Combine Fire Prevention and Control Summit.* Chicago, ASAE.

Y. Le Maoult, T. S. J. J. O. a. J. P. A., 2007. Fire Detection: A New Approach based on a low cost CCD Camera in the Near Infrared. *Process Safety and Environmental Protection,* 85(3B), pp. 193-206.

Drones, the end of traditional detail/contour survey, a comparative study of the Total Station Vs Drone in a tight urban context.

School of Civil Engineering and Surveying.

Jason Mylrea

Bachelor of Spatial Science (Honours) (Surveying)

Supervisor: Dr Xiaoye Liu, USQ

Figure 1 – TS15 Total Station and a DJI Phantom 3 Advanced

Keywords: Drone, Unmanned Aerial Aircraft Vehicles (UAVs), Total Station, Photogrammetry.

1. Introduction

Unmanned Aerial Vehicles (UAVs) or commonly known as Drones are a rapidly advancing technology and are being widely used in many applications throughout today's modern society. The aim of this project is to evaluate the accuracy of data captured via a drone to see whether if it is suitable to be used in conjunction with a Total Station to provide a more cost effective and accurate detail and contour survey.

2. Background

Using photogrammetry for surveying methods has been used for a while now mainly through the use of a fixed wing aircraft but this has been a costly exercise and only suitable for certain applications and accuracies. However with the introduction of cheap Drones fitted with cameras the question arises, are these devices able to obtain the data that is currently captured by a Total Station with the same accuracy. If so, can that data be used in conjunction with the total station to provide a better driveable or are the use of Drones on the way to replacing the Total Station in detail and contour surveys.

3. Methodology

A site set within a tight urban context was chosen that contained an existing dwelling and a variety of features such as kerb, footpath, earth banks ect. as well as being surrounded by existing dwellings on adjacent lots.

The site was captured/measured by a Total Station and the Drone. The data sets from each are analysed by comparing the horizontal and vertical positions of different features at different locations over the site.

4. Key Outcomes

The required outcomes is to find if the use of a Drone is able to give the required accuracy needed for a detail and contour survey and the time taken to capture does not exceed the benefits of what extra data/information it can provide.

5. Further Work

The ultimate goal is to capture the entire site with the Drone and compare a wider range and quantity of data points. If found to be with in tolerance and all data required was captured, then to work with an engineer/ architect in their design phase to assess which data set is more beneficial in helping them design.

6. Conclusions

As the results have not yet been completed a conclusion is difficult to formulate however the key outcome of this project is to compare the accuracy and time taken to capture the required data from a Drone is beneficial in using in conjunction with a Total Station to deliver a superior deliverable.

References

C. Álvarez1, A. R., A. Halter3, L. Garcia4. (2015). Generating highly accurate 3D data using a senseFly eXom drone.

CASA, Flying drones in Australia, viewed 8/08/2015,<https://www.casa.gov.au/aircraft/landing-page/remotely-piloted-aircraft-system>

Three body abrasion in slurry condition for Agricultural Applications

Sponsor – School of Civil Engineering and Surveying

Student Name:

Zana Najm

Masters of Engineering Science (Agricultural)
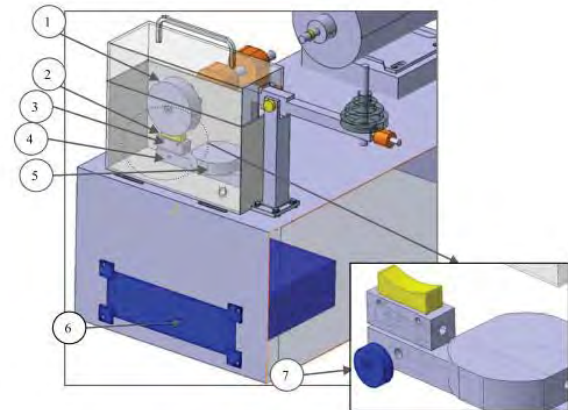
Supervisors: Dr Belal Yousif, USQ

Keywords: Mild Steel, Slurry, Abrasion.

1. Introduction

Three body abrasion wear is the most common type of wear that faces many machineries especially for the agricultural and mining industries. It is vital to understand the wear types and how they behave with the different materials and applications. The research especially focuses on slurry conditions rather than dry conditions. It would also be using the tribology machine to conduct the necessary tests for the purpose of the research. It uses the slurry environment as an abrasion mechanism and slurry steel wheel abrasion test.

2. Background

This research aims to investigate the behaviour of mild steel under slurry conditions using tribology machine. There are many types of wear that faces steel and other materials in a different application in the industry sector. There are also other forms of abrasion like two-body abrasion however, this study would only be conducted with using thee-body abrasion method as the agricultural applications mainly face this type of wear.

3. Methodology

The application of wear tests for mild steel would be oriented with the low to high speed in a slurry environment. The different louds, 10N to 50N which would be used to conduct the tests. The loud sell of tribology machine would directly measure the friction between

the counter face and the sample. Before the sample fixed to the machine, it should be weight with the weighing machine. Please see Figure 1 for an example.

Figure 1, Tribology machine

4. Further Work

The tests and analyses are in progress. Further analyses to be completed and the tests of mild steel in the slurry condition need to be carried out.

5. Conclusions

Testing and analyses are still in progress. The samples for the project are designed and ready for conducting tests.

Acknowledgements

References

Ojala, N., Valtonen, K., Antikainen, A., Kemppainen, A., Minkkinen, J., Oja, O. & Kuokkala, V. 2016, "Wear performance of quenched wear resistant steels in abrasive slurry erosion", Wear, vol. 354-355, pp. 21-31.

Petrica, M., Katsich, C., Badisch, E. & Kremsner, F, 'Study of abrasive wear phenomena in dry and slurry 3-body conditions', Tribology International, Vol. 64, pp. 196-203.

A Two Stage Compression System for the TUSQ Facility

School of Mechanical and Electrical Engineering

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Master of Engineering Science (Mechanical)

Supervisors: Prof David Buttsworth, USQ *Keywords: Compression, Hypersonic, Wind tunnel*

1. Introduction

Wind tunnels are ground facilities which operate in different speeds which in turn produces air flow in a closed and a controlled environment. Each wind tunnel facility is developed for a specific function which could be clearly seen in the case for a hypersonic wind tunnel, since no hypersonic wind tunnel could possibly satisfy all the required flow conditions required for an actual simulation. In this paper TUSQ Hypersonic wind tunnel facility which was devised by Dr David Buttsworth is able to produce an overall stagnation temperature of 600K. But for an actual simulation to occur the required temperature is 1000K at the end of the Mach 4 nozzle. The proposed method was to build a first stage compression system which would effectively heat the air isentrpoically and fed it into the first stage of compression.

2. Background

TUSQ is a free piston wind tunnel facility which is able to produce test flows in order of 200ms (Buttsworth 2010) and used in the testing of hypersonic mixing studies, aerodynamics experiments, hypersonic boundary layer studies and inlet starting conditions of scram jets (Buttsworth&Widodo 2013). The present challenge is to devise a first stage compression system for the TUSQ facility using atmospheric pressure as a blow down to propel the piston in the compression tube and produce a pipe design to connect the first and the second stage of compression.

3. Methodology

MATLAB is used to identify the piston dynamics and to create a suitable analytical model. Cero Parametric 3.0 is used to design the valve and the pipe design for the first stage compression system and FEA analysis will be produced with the help of ANSYS. Finally the pressure losses across the valves are estimated.

4. Key Outcomes

MATLAB code was written in order to identify the initial design considerations such as the length of the compression tube, the mass of the piston and the acceleration of the piston in accordance with the atmospheric blow down pressure. The results were promising are were used in the solid modelling for the pipe design.

5. Further Work

To perform a FEA analysis on the pipe design and to identify the pressure losses in the system and thereby calculate the overall temperature that is being obtained from the first stage of compression.

6. Conclusions

From this research study the TUSQ facility will be able to test and provide true simulation for Mach 4 nozzle. With the inclusion of the first stage compression system the overall stagnation temperature in the end of the nozzle section will increase from 570 K (which was recorded in the original design) to 1000 K.

Acknowledgements

References

- BUTTSWORTH, D. & SMART, M. 2010. Ludwieg tunnel facility with free piston compression heating for supersonic and hypersonic scramjet inlet starting experiments. *AIAA,* 588**,** 1-6.
- JACOBS, P., MORGAN, R., BRANDIS, A., BUTTSWORTH, D., DANN, A., D'SOUZA, M., EICHMANN, T., GILDFIND, D., GOLLAN, R. & JACOBS, C. Design, operation and testing in expansion tube facilities for super-orbital re-entry. STO-AVT-VKI Lecture Series Radiation and Gas-Surface Interaction Phenomena in High Speed Re-Entry (2013-AVT-218), 2013. 5-1-5-65.
- JONES, T., SCHULTZ, D. & HENDLEY, A. 1973. *On the flow in an isentropic light piston tunnel*, Citeseer.

Computer simulation of scouring around bridge piers

Sponsor – School of Civil Engineering and Surveying

Gary Nankervis

Bachelor of
Engineering (Civil)

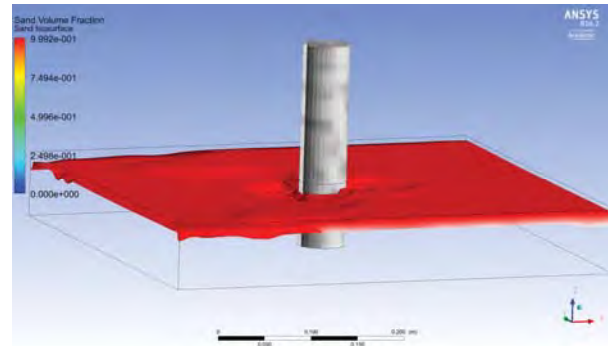Supervisor: Dr Andrew Wandel, USQ

Figure 1 – Early stages of scour development around a circular pier

Keywords: CFD, multiphase, scouring

1. Introduction

Soil erosion due to water flow, known as scouring, around bridge pier foundations has the potential to cause catastrophic failures. A study by Wardhana and Hadipriono (2003), in the USA, found scouring to be responsible for 48% of bridge failures.

To aid in bridge design, this project aims to develop a computer simulation model to predict the extent of scouring around bridge piers. For validation, the model results will be compared with those from a well-recognised physical model experiment by Melville (1975). The simulation model will then be used to examine the performance of a new pier design.

2. Background

Scour estimation methods have developed from personal design experience, to formulas derived from scale models, and more recently to three-dimensional computer simulation models.

Single-phase (one fluid) models have not been sufficiently accurate as they rely on empirical formulas to modify the lower boundary (river bed) mesh.

Multiphase (two or more fluids) simulation models offer an advantage in being able to model a movable river bed as a granular liquid flow. This eliminates the need to use empirical formulas.

3. Methodology

Computational Fluid Dynamics (CFD) is used to simulate multiphase flows around bridge piers. A commercial software package, ANSYS Fluent, is used.

The project is developed from a simple initial model and progressively expanded into the final model. Firstly, a 2d steady state model, in a horizontal plane, is used to examine the flow velocity around both a circular pier and the new pier design. Next a 2d transient model, in a vertical plane, is used to examine a normal flow velocity profile and its interaction with a sand bed. Finally, a 3d transient model is developed to examine flow disturbance and scouring (Figure 1) around each of the piers.

4. Key Outcomes

Flow patterns around the new pier are distinctly different to the circular control pier, therefore it has potential to reduce scouring.

Fluent is capable of modelling scour around piers however there are many parameter options which need to be fine-tuned to produce realistic results.

5. Further Work

The model requires many more trial runs to try and achieve realistic results for the circular control pier, before it can be used on the new pier design.

6. Conclusions

Fluent is capable of modelling bridge pier scour but the results are not yet realistic. Further fine tuning needs to be conducted.

Acknowledgements

References

Melville, B.W. (1975). *Local scour at bridge sites*. University of Auckland.

Wardhana, K., & Hadipriono, F. (2003). Analysis of recent bridge failures in the United States. Performance of constructed facilities, 17(3), 144-150.

Power Factor Improvement Using a STATCOM Inverter

Sponsor - School of Mechanical and Electrical Engineering

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Bachelor of Engineering
(Honours) (Power)

Supervisors: Dr Les Bowtell, USQ

Keywords: STATCOM, Power Factor, Photovoltaic

1. Introduction

Generation of solar energy using small scale photovoltaic (PV) arrays is becoming increasingly common amongst residential consumers as a means of offsetting their carbon footprint and reducing energy costs. A synchronous compensator (STATCOM) inverter is used to convert the generated DC voltage to AC voltage so it can be tied with the electricity grid.

2. Background

The potential for future shortages of fossil fuel sources means there is an ever increasing need to find more efficient ways of using energy. A STATCOM currently is only in operation for the hours during the day when there is sunlight and lays dormant during the evening. By improving the power factor of a local load we are improving the energy efficiency. This can lead to reduced energy bills to the consumer and less load on the electricity grid. There is also a potential benefit to other loads close, if the STATCOM could determine the reactive power requirements of the local network it would assist by supplying or absorbing reactive power.

3. Methodology

The phases of research for this project firstly involved carrying out power surveys of selected sites by installing meters on the supplying substations. The second phase was to analyse the data's usefulness towards the projects aims. Once data was verified the systems were modelled in MATLAB. Using a simulation in MATLAB the transient capabilities of a STATCOM inverter was to be evaluated when applied to the system models. The survey was also used to see if the results conformed to the ITI curve which shows the voltage region for safe operation of electrical equipment, as seen in Figure 1.

4. Key Outcomes

The sites surveyed have been found to have already rather good power factor, this could be attributed to the
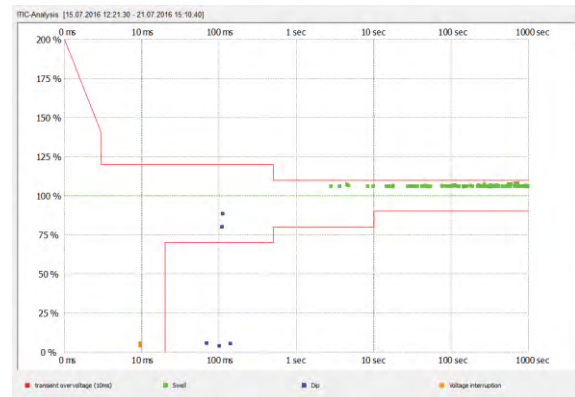

Figure 1 – ITI Curve with surveyed sites events outside normal range

fact that the sites chosen were to have large PV systems installed, and if a large amount of money had been spent on the PV system it would be safe to assume that money would also have been spent of other power factor correcting equipment. Data from other sources other than surveying needed to be used in order to complete the project on time.

5. Further Work

Tasks remaining to be completed on the project include modelling the data in MATLAB and evaluating the simulation of the STATCOM on the modelled data.

6. Conclusions

Additional work needs to be conducted before any conclusion can be made. However it is hoped that this project will in fact show that a significant power factor improvement can be made when using a STACOM interver.

Acknowledgements

I would like to thank my supervisor, Dr Les Bowtell for all his guidance and support. Lastly I would like to thank my family for their unabated support.

References

Dapu, Z., Yixin, N., Jin, Z., & Chen, S. (2005, 2005). *Reactive Power and Voltage Control in Deregulated Environment.* Paper presented at the Transmission and Distribution Conference and Exhibition: Asia and Pacific, 2005 IEEE/PES.

Escobar, G., Stankovic, A. M., & Mattavelli, P. (2000, Oct 2000). *Reactive power and unbalance compensation using STATCOM with dissipativity-based control.* Paper presented at the Industry Applications Conference, 2000. Conference Record of the 2000 IEEE.

An Assesment of the Deceleration on Horizontal Curve Component of the Austroads Operating Speed Estimation Model

Sponsor – NSW Roads and Maritime Services

Jarred Noon

Bachelor of Engineering (Civil)

Supervisor: Professor Ron Ayers, USQ

Keywords: Operating Speed, Horizontal Curves, Austroads

Figure 1: Deceleration on Curves (Austroads, 2003, Austroads, 2010a)

1. Introduction

Research from the Australian Road Research board (AARB) in the 1970's concluded that the use a constant design speed does not ensure consistency between design elements and that drivers have no concept design speed and drive at whatever speed they feel comfortable. This research by ARRB was used as the basis for the operating speed model that was adopted by Austroads in the 1980's and has remained constant ever since.

2. Background

Austroads specifies the use of their operating speed model on rural roads with operating speeds less than 100km/hr in order to determine the 85th percentile and obtain a design speed. In a lot of cases there is no operating speed data available and it has become common design practice to take the operating speed as 10km/hr higher than the sign posted speed and then take this as the design speed. Adopting an unsuitable operating speed has the potential to result in a design that is either geometrically incorrect and unsafe or exceedingly conservative and costly.

3. Methodology

Data was extracted from the RMS travel time tool which captures spot speeds of fleet vehicles every 60 seconds with the use of GPS technology. This data was analysed and the measured speed reductions were compared with the theoretical speed reductions and a revised deceleration model for horizontal curves was developed.
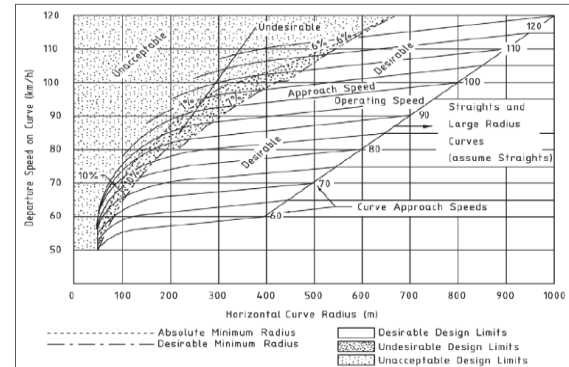
4. Key Outcomes

Using a combination of Microsoft Excel and Bentley MX Road I was able to plot the 85th percentile vehicle speed against a chainage for my numerous horizontal curve sites. I observed a declaration in vehicle speed occurring approximately 100m before the start of the horizontal curve which is substantive to the research done by AARB.

5. Further Work

I have received permission from the RMS to use one of their speed radar guns which I will use to validate my results and the current Austroads models. I will then recommend potential amendments to current design standards that consider the evolution of driver speed behaviour and vehicle performance.

6. Conclusions

So far my analysis is showing that existing Austroads deceleration model for horizontal curves provides a conservative estimation of vehicle operating speeds.

Acknowledgements

I would like to thank Ron Ayers (USQ) for providing his knowledge and guidance as my supervisor, Nick Klados (RMS - Library Technician) for his help locating research papers, Laura Sham (RMS – Journey Information Analysist) for providing me with the raw speed data and Andria Kelly (RMS – Road Design) for helping me analyse data.

References

MCLEAN, J. 1979. An alternative to the design speed concept for low speed alinement design. Transportation research record, 702, 55-63.

Identification of Cement Manufacturing Raw Materials Using Machine Vision

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Bachelor of Engineering (Electrical and Electronic)
Supervisor: Dr Andrew Maxwell
USQ **Sponsor:** Cement Australia Pty Ltd *Keywords:* Machine Vision, Probabilistic Neural Network.

1. Introduction

In the mining and manufacturing industry, there is a need for a non-extractive system which can identify raw materials as they are transported via conveying systems. Such a system would allow identification of raw materials as they are transported along common conveying systems preventing cross-contamination when the materials are delivered to the final storage location.

This project will use machine vision techniques identified during a review of the literature to identify cement manufacturing raw materials (Clinker, Gypsum and, Limestone). Classification of this raw material will be achieved by extracting statistical image colour features which will then be classified using a Probabilistic Neural Network (PNN).

2. Background

Work conducted by (Patel & Chatterjee, 2016), (Thurley, 2011) and many other works in literature primarily focused on classification or sizing of various Limestone grades. This project aims to contribute to the available literature by successfully classifying all three cement manufacturing raw materials.

3. Methodology

A stratified random sampling procedure was developed for each raw material to take 25 x 10kg samples for each material from the cement manufacturing process and stockpiles. These samples were placed on a purpose-built test bed designed to take 20 images of each sample using an IDS UI-5250CP-C_HQ for further processing.

The model depicted in figure 1 shows the images initially being filtered to reduce the effect of input noise. At this point, the images have been broken into their individual Red, Green and Blue (RGB) components and passed through the histogram function. From the resultant histogram pixel distribution, individual statistical features were extracted using weighted average, skewness and kurtosis statistical equations for each colour.

Finally, each of these nine features per image was entered as a vector and passed to the input layer of the PNN. The first 15 images taken from each sample will be used to train the PNN. The layout of the PNN consists of four layers also shown in Figure 1. The purpose of the PNN is to classify raw materials once it has been successfully trained. The output from this network will determine the classification probability of
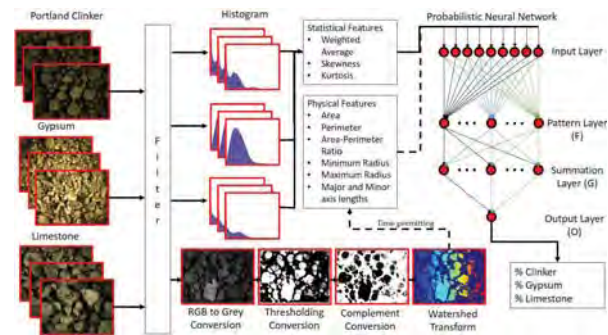

Figure 1 – Model process flow overview

the image in relation to each raw material. Once the PNN model has been optimised using the training set, the remaining five images per sample will be used to validate the model.

4. Key Outcomes

Through research of the literature, CMOS Global Shutter imaging technology was chosen allowing improved imaging of a moving conveying system. Also, a camera enclosure with controlled lighting was built minimising the effect of varying ambient lighting. The design of this enclosure also allowed test bed training images and live images to be taken over the conveying system for future model verification.

5. Further Work

Time permitting the initial image will be segmented using a watershed transform to extract the physical features (area, perimeter, area to perimeter ratio, minimum and maximum axis lengths).

6. Conclusions

Early results are indicating that identification of Cement Manufacturing Raw Materials will be possible. As the project has not reached a conclusion and a critical review of the results and validation of the model remains. Drawing a conclusion will be difficult.

Acknowledgements

I would like to thank Mr Mark Wright (Operations Manager) and Mr Andrew Woodward (Electrical Services Manager at Cement Australia Railton Operations for their ongoing support and supply of resources for this project. Also, I would like to thank Dr Andrew Maxwell for providing guidance and much-needed feedback. Most importantly I want to thank my family for their unconditional love and, support.

References

Patel, A. & Chatterjee, S., 2016. Computer vision based limestone rock-type classification using probabilistic neural network. *Geoscience Frontiers*, Volume 7, pp. 53-60

Thurley, M., 2011. Automated measurement of limestone particle size distributions using 3D range data. *Journal of Process Control,* Volume 21, pp. 254-262.

Interaction between Piles and Slopes

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(Honours) (Civil)

Supervisors: Dr Jim Shiau,
USQ

Keywords: Interaction between
high-rise piles and slopes.

1. Introduction

This is a research project on how piles and slopes interact with each other. This is a modification of the original topic of how piles and tunnels interact. This was changed as the model with tunnelling and piles was too complex to be created in such a small amount of time. If the study of slope and piles were not investigated, there would be devastating effects all over the world.

2. Background

Buildings are constructed in the most abnormal places. This is possible because of studies geology of the earth and the understanding of the earth at a certain location. A lot of the time, the earth needs help withstanding the force from the buildings. This can be achieved with foundations, reinforcement, stabilisation etc. This thesis will help structures near/on slopes be constructed better. This is because, the model being constructed will help better the understanding of how forces are distributed throughout the earth and what can be done to counteract these forces.

3. Methodology

Firstly, a deep understanding of ground movements had to be established. This then went onto creating a model for the tunnelling and pile interaction. After a few weeks it become obvious that such a model could not be constructed to a reasonable depth within the time limit given. It was decided it had to be changed. It changed to the interaction of slopes and piles. This model was a lot more achievable and has been almost constructed to the depth needed. 'Figure 1' shows the program FLAC 2D used to create a model which shows the distribution of loads from a force of a high-rise building and bolts on the slope to stabilise the earth.

4. Key Outcomes

Throughout this dissertation it has been discovered that the initial model was too complicated to complete on time. Therefore, a simpler model had to be constructed. The model now concentrates on the interaction between buildings and slopes. The main outcomes desired now are to understand the movement of the ground so that the forces can be counteracted before
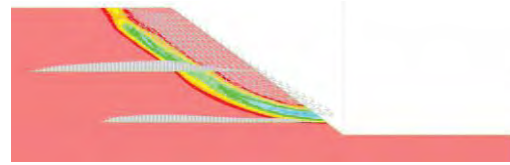

Figure 1 – distribution of loads.

devastating collapses happen. This model will help do this through a more graphical approach.

5. Further Work

A simple model has been constructed where some results can be given but the model needs to change some aspects and variables to give more results to make more sense of the results given. Also a case study may be also analysed if time permits. After the completion of the thesis the studies from can be continued on pile and tunnel interaction as this is more for a master's degree.

6. Conclusions

This thesis concludes that ground movement is extremely complicated and needs to be studied intensively to achieve good results for the implication to the real world. This thesis hopes to achieved a simplified but effective way to show where a construction can or cannot be constructed near a slope. Results have not been complete yet. In conclusion, the geology of the earth is very complex and need to be understood which is sometimes easier through a graphical approach.

References

UnderstandConstruction.com, 2016. *PILE FOUNDATIONS.* [Online]
Available at:
http://www.understandconstruction.com/pile-foundations.html
[Accessed 1st May 2016].

Yih, C. C., 2003. *FINITE ELEMENT STUDY OF TUNNEL-SOIL-PILE INTERACTION,* Sinapore: National University of Singapore .

Sams, M., 2016. *Numerical Investigation of Stability and Settlement of Tunnels in Undrained Clay ,* Toowoomba: University of Southern Queensland.

Modeling and Analysis for Conversion Efficiency Improvement of Nano-Structured GaAs Solar Cells by Reducing the Reflection Losses

Sponsor – School of Mechanical and Electrical Engineering

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Master of Engineering Science (Electrical and Electronics)

Supervisors: Dr Narottam Das, USQ

Keywords: solar cells and panels, conversion efficiency, reflection losses, sun light trapping

1. Introduction

The earth's resources are vast and are bountiful that helps towards the proper functioning of the human race. The earth's resources sometimes found out in the deep sea explorations or sometimes drilled from the chest of rocky earth, sometimes available deep under the earth buried thousand's feet below.

With the extreme and unthinkable usage of the conventional energy sources human mankind has been putting the earth's life and ecological balance in real danger. Likewise, sun is the biggest source of energy for the whole universe. Solar light is available on the maximum days except the cloudy and rainy days. Solar power is created by concerting the energy stored in the solar light into a more usable form. The development of photovoltaic (PV) that works on the principle of collecting the solar light energy and converting it to the direct current theory that is later on stored into the batteries and power banks to be used later on.

2. Background

The main purpose of the solar cells or technically called as photovoltaic cells is to convert the light falling on the solar cells into the electricity. The solar cell is thus a device that is a mix of chemical and physical properties mainly includes the voltage, current flow, and other electric flowing variables. The position of the solar panel needs to orient towards the sun in order to gain the maximum solar influx (Kostoff et. al, 2007).

3. Methodology

 The methodology will begin with fabricating a 2d Nano-scopic grating structure. To enhance the

Figure 1 - Different Nano-grating structure

transmission effect and improve the conversion rate over the solar substrate surface, 2D Nano scopic grating structure will be positioned on the solar substrate. Further, in order to get accurate integrated and diffractive optics simulations of the model solar cell, FDTD analysis method will be implemented. Substantially, refraction, internal reflection, transmission and scattering have a consequence over the grating surface as a result of the grating parameters. As shape and size of the Nano grating structure determines the subsequent amount of power generated, different shapes of the grating structures are analysed.

4. Key Outcomes

Triangular shaped nano grating structure when compared with rectangular and trapezoidal shaped nano grating structure has highest light absorption and lowest light reflection losses.

5. Further Work

In the near future, grating structure can be shaped in to semi circular, circular, octagonal and also cylindrical. Different semiconductor materials can also be used.

6. Conclusions

Triangular shaped nano grating structure which has the best absorption rate are encouraged to improve the conversion efficiency

Acknowledgements

References

Singha, R., Rangarib, V., Sanagapallia, S., Jayaramana, V., Mahendraa, S., Singha, V. (2004).Nano-structured CdTe, CdS and TiO2 for thin film solar cell applications. Solar Energy Materials& Solar Cells, 82, 315-330.

Analysis of Nonlinear Pulse Propagation and Wave-mixing Characteristics in Semiconductor Optical Amplifier

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Master of Engineering Science (Applied Telecommunications)

Supervisors:

Dr Narottam Das (USQ)

Keywords: Four-wave mixing, FD-BPM, Gain saturation, MNLSE, Nonlinear pulse propagation, SOA.

1. Introduction

Semiconductor optical amplifiers (SOAs) are the key component for optical pulse amplification and optical switching at a very high speed due to their small size, a low switching energy, non-linear characteristics and ability to integrate with other optical devices. The SOAs are not only limited to amplify the short optical pulses, SOAs are also used in many functional applications, such as wavelength conversion i.e., four wave mixing (FWM), optical switching and optical signal processing. For generation of FWM signal, two input pulses or signals are propagated into the SOA and obtained a new signal. The main aim of this project is to analyse the single pulse propagation and FWM characteristics in SOAs with different input pulse shapes.

2. Background

Recent report has been focussed on nonlinear pulse propagation in SOAs for wavelength conversion, sampling, switching for high speed communication systems. These characteristics varies with different parameters, such as, input pulse shapes, pulse widths, and input energy levels. Therefore, a detailed modelling and analysis is required for the short-pulses saturation properties is important in order to understand the fundamental limitations on these devices and improve their performance. The purpose of modelling an SOA is to relate the internal variables of the amplifier with external variables, such as the output signal power, saturation output power. Here, the main focus is on pulse propagation and FWM characteristics in SOAs. Compare the simulation results for (i) single pulse propagation, (ii) gain saturation characteristics, (iii) two pulses propagation such as FWM characteristics in SOAs. Based on the simulation results, propose a suitable design of SOAs for high-speed communication systems.

3. Methodology

The modified nonlinear Schrödinger equation (MNLSE) is used to simulate the pulse propagation characteristics in SOAs with different input pulse shapes. Finite-difference beam propagation method (FD-BPM) is used to solve the MNLSE for different input pulse shapes. The output pulse propagation results are obtained by injecting different input pulse shapes into the SOA. Later, FWM simulations results will be carried out by injecting two input pulses with different wavelengths. The simulation results will be carried with various input pulse shapes, pulse width, and input energy levels. Subsequently, the above simulations will be analysed and compared to propose a suitable design of SOAs for high-speed communication systems.

4. Expected Outcomes

Based on the simulation results with various situations, such as, input pulse shapes, pulse width, and input pulses energy levels; I will compare and analyse results to propose a suitable design of SOAs for efficient communication systems.

5. Project Progress

Up to date, I have completed the literature review for my project and now I am focussing on the basic simulations of pulse propagation, gain saturation and FWM characteristics with different input pulse shapes, energy level variation and other parameters. Continue the project work in next semester and complete the remaining part of the project.

6. Summary

The project work is on progress as I started the project in S2 2016. Presently, I am at initial stage of the project and continuously working on it to get the simulation results. So, I am presenting the estimated results in this presentation. Exact simulation results will be presented at the final presentation of my project.

7. Acknowledgements

My supervisor Dr Narottam Das is helping me a lot to progress on the project. I would be thankful to him for his valuable support and guidance so far.

References

Barua, S., et al., (2015). "Analysis of nonlinear pulse propagation characteristics in semiconductor optical amplifier for different input pulse shapes," International Journal of Electrical, Computer, Electronics and Communication Engineering 9(1): 16-20.

Das, N., et al., (2012). Four-wave mixing in semiconductor optical amplifiers for high-speed communications, in proc. of the 5th International Conference on Computers and Devices for Communication 2012 (CODEC2012), West Bengal, India.

Daniell (Zn-Cu) Cell Investigation for long term storage.

Sponsor – School of Mechanical and Electrical Engineering

Bharath Parikipandla

Master of Engineering Science (Power)

Supervisor: Mr Andreas Helwig, USQ

Keywords: Daniell Cell, Porous/Permeable Membrane/Separator, electrons, short, medium and long term energy storages.

1. Introduction and Background

Wherever renewable energy penetration is increasing, energy utilities globally are investigating the need for energy storage systems (ESS) (David Linden,Thomas B. Reddy, 1995). The autonomy period for these ESS can vary from a matter of hours for short term applications to much longer periods measured in days or even months. This research focusses on ESS management to for balancing renewable supply that is potentially useful for monthly storage, to balance load demand due to significant reduction of renewable energy production resulting from local weather conditions such as monsoon periods.

In this context, the aim of this project is to investigate on various components of zinc-copper Daniell Cell to improve the efficiency of the electrical storage system for medium and long term purposes. Historically, the Daniel Cell is used both as a reference cell for electro-chemistry studies, but also was the primary stationary batteries used for telegraphic systems.

2. Methodology

A detailed study will be undertaken on different types of storage system, depending on the conductivity of electrolyte, and published technical data on existing or similar battery types (i.e. storage capacities [kWh], depth of discharge capacity [DoD%], cycle life (charge/ discharge) and operational life (years)) of the Zn-Cu Daniell Cell. Testing of the selected separator materials, could determine future improvements of energy storage efficiencies for different renewable ESS (e.g. solar-thermal, pumped storage and mechanical).

Finally, conclusions cost analysis and simulation models are drawn from the test results. An in-depth study will be undertaken into different types of storage system, depending on the conductivity of electrolyte, and technical performance data of the battery Zn-Cu Daniell Cell. Testing on the selected separator / electrolyte material, could provide hints for future improvements of energy storage efficiencies in different renewable energy storage systems. Finally, conclusions cost analysis and simulation models are analysed as the test results.

3. Key Outcomes

From the above proposed process, to assess and quantify for the Daniell cell potential developments to make possible improvements in energy storage systems for medium and long energy storage.

4. Further Work

Testing phase of the project will be done in the Simulation Software and the most efficient cell configuration and electrolyte material will be chosen. A small Daniel cell shall be built, and after charge / discharge cycling, samples of the Zn and Cu will be investigated using a scanning electron microscope.

5. Conclusions

After completion on the project, a quantified Daniell cell of zinc and copper with gelled electrolyte made of sodium polyacrylyte or similar alternative materials for storing energy for long term use.

Acknowledgements

On behalf of my project I would like to thank this university for giving me this privilege of doing the real time research project. I would be grateful to my project supervisor Andreas Helwig for present and future support and his excellent hard work towards all his students. Lastly I will be thankful to all my mates for giving me good suggestions for opting this project.

References

David, L, Thomas B. Reddy. (1995). *HANDBOOK OF BATTERIES*. Edition 3.

Brian J.Starr, & VolodymyrV.Tarabara. (2016). *Coating porous membranes with a photocatalyst: ComparisonofLbL*

Self-assembly and plasma-enhanced CVD techniques. Available online at www.elsevier.com/locate/memsci

Energy usage in Coal Seam Gas production and delivery

Sponsor – School of Mechanical and Electrical Engineering

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Master of Engineering Science (Mechanical)

Supervisors: Associate Prof Guangnan Chen, USQ

	2013–14		Average annual growth	
	PJ	Share (per cent)	2013–14 (per cent)	5 years (per cent)
Transport	1 578.5	38.9	1.1	1.7
Manufacturing	1 014.0	25.0	-1.6	0.0
Mining	531.1	13.1	6.6	9.0
Residential	449.0	11.1	-1.4	0.3
Commercial	315.8	7.8	2.8	1.4
Agriculture	99.7	2.5	0.3	0.9
Construction	26.7	0.7	7.1	1.3
Other	45.4	1.1	-14.9	-8.6
Total	4 060.1	100.0	0.8	1.7

Keywords: Coal Seam Gas

1. Introduction

This dissertation is based on Coal Seam Gas production and delivery in Australia.

Coal seam gas (CSG) has been identified as a key energy source and as a primary growth sector for Queensland, forecast to provide significant economic benefit. This project is aimed to determine the energy usage in various processes of CGS production and delivery to the market and end users. Major energy uses in these processes and thus the net energy-balance of CSG will be determined. Relevant data from the literature and case studies will be collected and analyzed.

2. Background

This project aims to determine the energy usage of the processes used in CSG extraction and delivery. This will give a brief idea about how much energy is been used in each and every process, how much energy is used for domestic, industrial and international exports. CSG is a naturally occurring gas which is extracted from coal beds or sometimes found in rocks and shale both in low and high grade forms. This gas is extracted using different methods and supplied for further usage. The gas is also converted to LNG and exported.

There are almost 20 active CSG projects and 30 proposed projects in Queensland.

3. Methodology

The main methodology used is the calculation of net energy balance of CSG used the data. The total CSG produced in Australia is supplied for various purposes. Each process will use a certain amount of energy for its usage. The amount of energy used in each process will be calculated and estimation will be done accordingly.

4. Key Outcomes

The main outcome of this project is to identify the processes involved in production and delivery of CSG. The second most key outcome is the risks involved in the extraction and delivery process. The amount of CSG (in PJ) produced per year was calculated among domestic and international usage.

5. Further Work

- To check the data uncertainties and data gaps that needs to be filled.
- Calculate the net energy balance of CSG.
- Predict the impact on national energy usage.

6. Conclusions

CSG is the main source for power generation in Australia. As it is a naturally occurring gas it is safe to use. The net energy balance will be calculated and it will be checked with the pervious data for more information.

Acknowledgements

References

Australian Government Department of Industry and Science 2015, viewed 13 May 2016, <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aes/2015-australian-energy-statistics.pdf>

The influence of the contact temperature on the material removal under lubricant contact conditions

Sponsor – School of Mechanical and Electrical Engineering

Bhargavkumar Patel

Master of Engineering Science (Mechanical)

Supervisors: Assoc Prof Belal Yousif,
                 Associate Professor (Mechanical Engineering)

Keywords: Wear performance, Interface temperature, Polymers.

1. Introduction

In this project, wear performance of different polymers sliding against stainless steel at different operating parameters will be investigated. Different sliding speeds, applied loads and sliding durations will be considered in the experiments under lubricant contact conditions. The main concept of this project is to study influence of the interface temperature on the material removal form the soft part (polymers) during the sliding.

2. Background

Tribological study has become more dipper as industries facing different problem relating machine failure. In the practical application, friction study of different polymer against stainless steel has become crucial due to breakdown of machine parts. Hence, the project will be based on how this results will be help to the practical world. Moreover, there are lots of composite material which are currently used in the machining parts hence it is big field to study and investigate for best outcomes. In this project, we will try to find the combination of different polymer against stainless steel.

3. Methodology

The whole project will be held according to step by step process which is predetermined. Examine past studies, we will set the parameter which should be include in our project like different load, timing, sliding speed and lubricating conditions. Also, polymers and their composite will be decide to sliding against the stainless steel. Next, we will be develop our experimental steps to enhance the project work and after that experimental work will be done with different instrument like thermocouples with infrared thermometer, tribometer etcetera. Finally, we will collect the data from different combination of polymers with different parameters and investigate it for positive outcomes.

4. Key Outcomes

We will expect that the results will be useful for different machining parts design for better life and efficiency. Also, we will be excited to see how does internal temperature affects the wear performances in the different conditions.

5. Further Work

Currently project is in the literature review phase hence the project parameters and experimental steps will be decided on the basis of further study. Therefore, all the investigation and futuristic work will be defined on the basis of expected outcomes.

6. Conclusions

Final results will provide the following insight about:

1) Data sheet of wear performance with different internal temperature of polymers

2) It will help to select better material for parts manufacturing.

Acknowledgements

References

Nirmal, U., Yousif, B. F., Rilling, D., & Brevern, P. V. (2010). Effect of betelnut fibres treatment and contact conditions on adhesive wear and frictional performance of polyester composites. *Wear, 268*(11–12), 1354-1370. doi:http://dx.doi.org/10.1016/j.wear.2010.02.004

Shalwan, A., & Yousif, B. F. (2014). Influence of date palm fibre and graphite filler on mechanical and wear characteristics of epoxy composites. *Materials & Design, 59*, 264-273. doi:http://dx.doi.org/10.1016/j.matdes.2014.02.066

Yousif, B. F., & Nirmal, U. (2011). Wear and frictional performance of polymeric composites aged in various solutions. *Wear, 272*(1), 97-104. doi:http://dx.doi.org/10.1016/j.wear.2011.07.006

Analysis of the Potential for 100% renewable energy supply to Groot Eylandt
School of Mechanical and Electrical Engineering

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Bachelor of Engineering (Honours) (Electrical and Electronics)

Supervisors: Dr.Les Bowtell, USQ

Keywords: living off grid, renewable energy, carbon emission

1. Introduction

Mining Industries have a big impact on communities who are highly dependent on their operation and services. This research project is based on the GEMCO mine and the communities of Groote Eylandt who are highly dependent on the mine's operation for employment, their energy demand and social living from royalty income. Mines are notoriously vulnerable to nature and their sudden closure can impact the community. Sometimes it forcing them to relocate which becomes a big burden on the government to look after them at such a remote location. Findings of this research show how communities and local governments can utilise royalty income in renewable energy resources such as; solar power and bio gasification plant to make community independent from manning services.

2. Background

There is a substantial amount of research about renewable energy and its benefits. Also mine operations with beneficial and harmful impacts on communities in Australia and around the world. There is an insufficient amount of research about communities meeting their energy demands with 100% renewable energy resources. This research project is an analysis with the different power sources of renewable energy and its economical benefits to local communities in regards to meeting their energy demands with only renewable energy.

3. Methodology

Communities of Groote Eylandt received energy from GEMCO and all charges of energy is paid by GEBIE (Groote Eylandt and Bicker ton Island Enterprises). GEBIE receive funding from royalty income which is paid by the GEMCO mine. If this revenue is invested in renewable energy it will save and create new opportunities for communities to prepare them for the future when the mine closes its doors. This methodology is based on how to achieve the community's residential energy demands with renewable power sources. Detailed energy audits conducted for residential load profile. Based on the audit data and Homer energy softer a system model was analysis for communities to achieve this demand. There is also a possibility to create a bio gasification plant for methane gas capture. To increase efficiency of renewable energy and gives an additional source of energy in the cyclone season when solar production is minimum and demand is high.

4. Key Outcomes

This research is based on investigating transitioning from grid connections to 100% renewable and economical. During the research detail energy audit of the residential load conducted and purpose a renewable power system. The main objective was to achieve complete freedom from fossil fuels by relying on only renewable resources. This can be achieve but it's not economical for the community because of its geographical situation and weather pattern. 80% of energy can be produced with renewable power sources and the last 20% of its energy demand can be achieved with generators which can be operated by fossil fuel or methane gas which can be capture via a separate process.

5. Further Work

To further research for Bio gasification plant in the proposed model to achieve efficient use of renewable energy sources for communities.

6. Conclusions

To achieve 100% renewable energy for any residential demand can be achieved but is not economical. In conclusion it was found that 80% of its energy demand can be economically and sustainably produced from renewable sources. The use of fossil fuels is still there but has been reduced significantly to 20% benefiting the communities in the long term.

References

Sims, R. E. H., Rogner, H., & Gregory, K. (2003). Energy policy: Carbon emission and mitigation cost comparisons between fossil fuel, nuclear and renewable energy resources for electricity generation Elsevier. doi:10.1016/S0301-4215(02)00192-1

Keyes R (1992) Mine closures in Canada: Problems, prospects and policies. In: Neil C, Tykkylainen M and Bradbury J (eds) Coping with Closure: An International Comparison of Mine Town Experiences. London: Routledge, 27–43.

Relationship and other Advanced Contracting Process

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Patel Master of Engineering Science (Mechanical)

Supervisors: Assoc Prof Dr David Thorpe,

USQ Associate Supervisors: Dr. Steven

Goh.

Keywords: Relationship Contracting, Alliancing contracting, Surveying, Questionnaires.

1. Introduction

A contract is an agreement between two or more parties where an offer and acceptance is involved. This agreement is legally binding, and each of the parties involved has an obligation to adhere to the terms stipulated in the contract. Contract can be entered into through spoken word, writing and can also be implied. In the past, most of the contracts made among persons were oral.

2. Background

The major type of contracting used in general practice are cost reimbursement, fixed type contract, alliance contract and boot contract. In this research, researcher evaluate the study of relationship contracting process in oil and gas industries. The contractual form used in the oil and gas industry in the past was the concession, where the country that has deposits of oil and gas would give a private company the exclusive rights to extract, process and market the oil products.

3. Methodology

Methodology is crucial in any study, because it determines the data collection methods and techniques that are to be applied when doing analysis on the data gathered. Methodology involves data collection methods that will be used in the study include documentary analysis and anonymous questionnaires survey. and analysis technique involving excel chart result to discuss questionnaire which will be used for surveying in oil and gas industry.
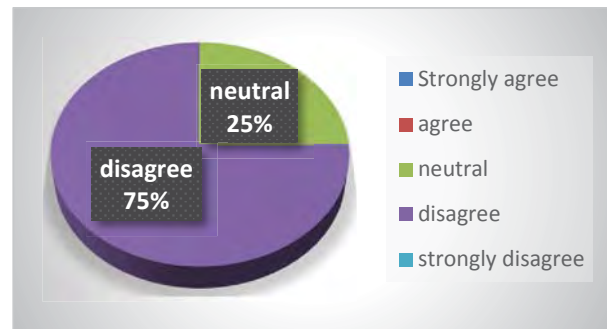

Figure-1: How familiar are you with Relationship contract and other form (alliance, partnering, schedule of rates, lump sum, cost plus) of contract process?

4. Key Outcomes

The tools of data collection that were used included documentary analysis, and questionnaires. Most of the useful findings in this study were derived from the documentary analysis, as it was established that relationship contracting is not that well understood by the respondents in the questionnaires, even though not enough participant had been responded.

5. Further Work

Evaluating relationship contracting method with large sample size of the questionnaires and conducting surveys in different mechanical industry are the further work in the future.

6. Conclusions

For this study, evaluation of relationship contracting process by the documentary analysis in oil and gas industry would have been more appropriate. This study has established that relationship contracting better than conventional contracting.

7. Acknowledgements

I would like to express the deepest thanks to my supervisor, Dr. David Thorpe for the guidance and support throughout the year. I would also like to thank my assistant professor, Dr. Steven Goh for the guiding me to contact oil and gas industries for conducting survey.

References

ACA, (1999). Relationship Contracting: Optimising Project Outcomes. 1st ed. North Sydney NSW 2060: Australian Constructors Association.

Cowan, B. and Davis, J. (2002). RELATIONSHIP CONTRACTING: WHAT IS IT AND WHERE IS IT GOING?. 1st ed.

Adoption of Advanced and Sustainable Engineering Materials by Small and Medium Enterprise

Sponsor: School of Mechanical and Electrical Engineering

Sohilkhan Pathan
Master of Engineering Science (Mechanical)
Supervisor: Assoc Prof David Thorpe, USQ
Keywords: materials, advanced, S&ME (small and medium enterprise)

1. Introduction

Nowadays advanced and sustainable (A&S) engineering materials are highly demand in manufacturing industries. However, there are some issues to adopt advanced materials by small and medium enterprises. The aim of this research is to determine the factors that influence the adoption of A&S engineering materials in S&ME. Also, to identify the factor that promote the adoption of A&S engineering materials in S&ME with find out the factors that limit. In addition, to determine the best approached in the implementation of the use of A&S engineering materials in the small and medium manufacturing enterprises.

2. Background

The use of the natural resources in the manufacturing industry has proven unsustainable in the recent years as a result of the limited nature of these resources. The objectives of this research to examined the current and past situation of using A&S engineering materials in the small and medium manufacturing enterprises. Its effects on environment, cost of product and life cycle of the product and so on.

2. Methodology

The first step is created questionnaire about 25 set of questions for survey then to approach 15 participants to conduct survey via online survey method and collect data with the follow USQ human Research ethics. The data collection tool that will be used on line questionnaire via survey monkey. Participants will be asking to answer the questions on behalf of their firm. survey questions are hope to take less than 30min to complete. After collect data, analysis method using statistical

(mathematical) will be use performance scale includes 1 to 5 scale and agree, disagree to find out the possible solutions by analysis collected data from participants. Survey will be non-identifiable so there is no any risk for participants.
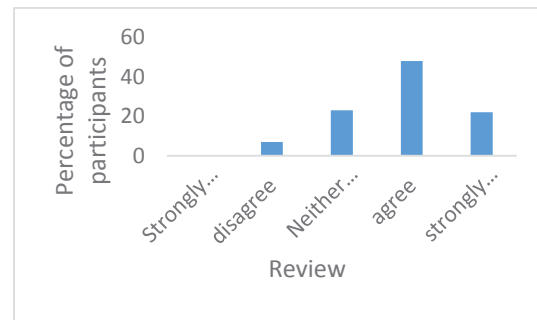

Figure 1 – using advanced material have a good future by S&M enterprises

4. Key Outcomes

Based on the systematic literature review and using statistical analyse method based collected data from participants, to find out the factors and limitation and determine the best approach in the implementation to adopt A&S engineering materials by S&ME.

5. Future work

Further work could be the to analyse the data using statistical (mathematical) method will be use performance scale includes 1 to 5 scale and agree, disagree to find out the possible solutions by analysis collected data from participants.

6. Conclusion

Small and Medium Enterprises need more technical skills to use advanced materials, minimize environment effects and cost and understanding product cycle to adopt advanced and sustainable engineering materials.

Acknowledgement

Reference

Ashrafi, N. (2014). A Review of Current Trend in Design for Sustainable Manufacturing. IOSRJMCE, 11(4), pp.53-58.

Relationship between road surfacing and crash rates and application to seal design

Sponsor – School of Civil Engineering and Surveying

David Pattison

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Joe Devine, USQ

Chris Molligodde, Roads and Maritime Services

Figure 1 - Sample Diagram

Keywords: Road surfacing, skid-resistance

1. Introduction

The Australian road network provides a vital link for industry, the economy and communities. Road transport enables the movement of goods and people for work and social activities. The volume of traffic on the road network continues to increase and is expected to double between 2010 and 2030.

To ensure the safety of all road users roads must be maintained to an acceptable standard. This includes maintenance of the pavement, surface drainage and related infrastructure.

2. Background

Seal design for resurfacing is based on evaluation of the existing surface conditions and traffic volumes to design a seal compatible with the existing surface. The seal design process does not consider other factors that could impact on performance and quality such as road geometry, crash history, surrounding environment and speed zone. This project will determine if any relationship exists between road surface and crash rates and how this affects seal design.

3. Methodology

Crash data has been collected for all reported accidents in the Roads and Maritime northern region for the past five years. Initial investigation shows that over 17,000 crashes have been recorded during this period.
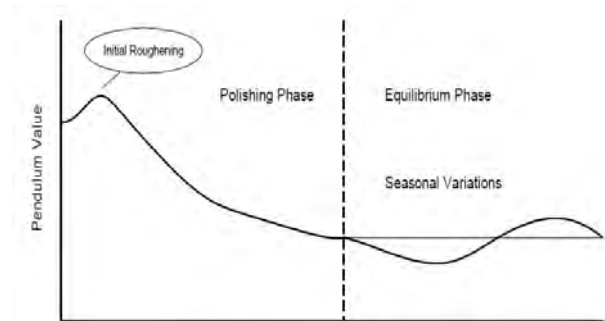
Crash data has been categories by type including time of crash, weather conditions, road environment and injury type. Road surfacing information has been determined for each record

4. Key Outcomes

The data collected to date comes from three different sources all using different referencing systems to identify the locations. The data has been spatially mapped to link the data to one referencing system. Categorisation of the data has been completed.

5. Further Work

Determine surface type at the time of the accident followed by detailed analysis of the data to determine relationships and trends, if any. If required, develop a tool for seal design that incorporates safety considerations. This would be based on the Australian Standard for seal design form but modified to include safety considerations.

6. Conclusions

At this stage it is too early to draw any conclusions.

Acknowledgements

I would like to thank my supervisors Joe Devine and Chris Molligodde for their assistance throughout this project.

References

Australian Asphalt Pavement Association (AAPA), 2014, Fundamentals of Bituminous Surfacing, Sydney.

Austroads, 2009, Guide to Pavement Technology Part 3: Pavement Surfacings', Austroads, Sydney.

The Impacts Construction Traffic has on Pavements Within Residential Subdivisions

School of Civil Engineering and Surveying

Adam Pease

Bachelor of Engineering

(Honours) (Civil)

Supervisors: Dr Soma Somasundaraswaran, USQ

Keywords: Heavy Vehicles, Pavement Failure, Residential Streets.

1. Introduction

A road hierarchy is essential to ensure the safety and appropriate conveyance of the public. Within residential subdivisions Local Access streets are one of the lower classed streets within this hierarchy and form the main focus of this research project. Flexible pavements consisting of unbound granular materials have been widely adopted in the construction of residential streets. These pavements include a wearing surface such as asphalt or bituminous seal and layers of granular base materials.

2. Background

It is common engineering knowledge that passenger vehicles have very little effect on the pavement structure, and heavy vehicles cause pavement failure from traffic loads. Current standards assume that during the typical 20-year design life of a local access street, it only experiences heavy vehicle traffic such as the weekly garbage truck and the odd removal truck. However, if you consider the first year during residential dwelling construction, the percentage of heavy vehicles will peak and cause a higher traffic load. Having a pavement fail 5-10 years prior to the intended design life, puts a strain on the local government.

3. Methodology

Conducting the testing in a controlled environment required a large amount of financial support. Therefore, the use of non-destructive testing on in-situ pavements was the most suitable method, Figure 1 highlights the general layout of a falling weight deflectometer. Appropriate test locations within the chosen residential streets were established and non-destructive tests conducted. With the aid of Circly, the data was then used to analyse the theoretical versus actual design equivalent standard axles.
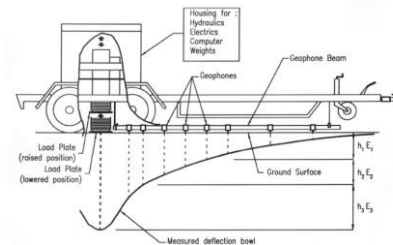

Figure 1 – Northern Pavement Consultants falling weight deflectometer diagram

4. Key Outcomes

Establish whether the residential pavement has exceeded or failed to meet the theoretical design calculations highlights that the issue is real. Based on this an alternative design technique has been created that accounts for construction traffic and enables the residential pavement to reach its intended design life.

5. Further Work

Due to time constraints it is recognised that further testing and analysis will be required to ensure the alternative pavement design method can be fully endorsed and enforced by the local government.

6. Conclusions

As a result of the initial increase in traffic loads caused by the heavy vehicles, it was found that the local access road pavements have had a reduction in design life. From early analysis the addition of a small percentage of cement to the road pavement has had a large increase in the pavements strength, which has enabled the pavement to withstand the initial peak in traffic loads.

Acknowledgements

References

Northern Pavement Consultants 2015, Auscan Crescent, Garbutt, Queensland, viewed 10th October 2015, Available at: http://www.npcqld.com.au/about_us.dyn

Geodesic Dome Structural Analysis and Design

Sponsor – Strata Group Consulting Engineers

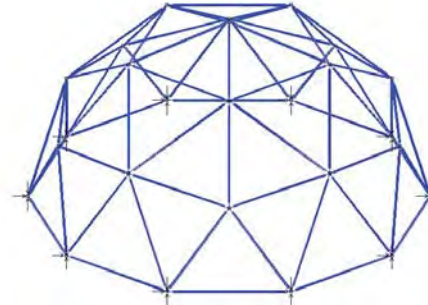### Zhuohao (Felix) Peng

Bachelor of Engineering
(Honours) (Civil)

Supervisors: Dr Sourish Banerjee, USQ

Figure 1 – Geodesic Dome Computational Model

Keywords: geodesic dome, structural analysis, design

1. Introduction

The form of dome has not been widely adopted in the building sector due to its complex shape and difficulty of modelling and analysis comparing to conventional structure. As an outstanding concept and architectural form, dome shaped structure remain underutilized despite of its high potential and exceptional performance in many ways.

The aim of this research is to develop a spreadsheet to carry out 3D space truss structural analysis on the geodesic dome using stiffness method. The loading considered on the structure will be based on per AS/NZS1170 requirement.

2. Background

Natural disaster resilient and cost effective structure and construction has been put under spotlight for decades. The financial and psychological burden of natural disasters have impacted all most every country in the world.

The increasing requirements from the new design codes has being challenging all the building professionals in the ways of strength, functionality, architecture and economy.

In the late of 1940s, Buckminster Fuller a well know architect, mathematician and engineer began to experiment with the geodesic geometry. He noticed that natural structures seemed to have better performance against naturally occurring disasters whereas in the conventional building forms.

3. Methodology

This project proposes to use spreadsheet to speed up the repetitive and tedious matrix operations of arithmetic when conducting stiffness method for structural analysis. The results will be put against with commercial structural analysis package for comparison and validation.

4. Key Outcomes

To demonstrate how stiffness method can be applied in spreadsheet to carry out structural analysis.

5. Further Work

Foundation design will be completed in the future, as well as the shop drawing. The algorithm in the spreadsheet can be further optimised to shortening the computational time.

6. Conclusions

This research validates the spreadsheet for future templates development.

Acknowledgements

I would like to thank Dr Sourish Banerjee for providing me assistance and guidance to help me to complete the project. Also I would like to thank my employer for supporting me with all the office resources and the project idea in the first place.

References

Hibbeler, RC 2011, *Structural Analysis*, 8th edn, Prentice Hall, Bangkok, Beijing, Hong Kong, Jakarta, Kuala Lumpur, Manila, New Delhi, Seoul, Singapore, Taipie, Tokyo.

Makowski, ZS 1984, *Analysis, design and construction of braced domes*, 1st edn, Nichols Publishing Company, New York.

Ranzi, G & Gilbert, RI 2015, *Structural Analysis - Principles, Methods and Modelling*, CRC Press, Taylor & Francis Group, Boca Raton, London, New York.

Adoption of Advanced and Sustainable Engineering Materials by Small and Medium Enterprises.

Sponsor – School of Mechanical and Electrical Engineering

Student Name:
Uday Kumar Raju PENUMACHA

Master of Engineering Science (Mechanical)

Supervisors: A/Prof. David Trope, USQ

Dr. Narottam Das, USQ

Keywords: Composite materials, Effectiveness, Sustainable.

Introduction

This project involves the critical evaluation on the mechanical properties of composite materials to analyse if they can be adopted by small and medium enterprises, in order to achieve sustainability. Critical analysis is performed on the existing sustainable material model in relation to a construction equipment model. The effectiveness and efficiency of sustainable engineering materials and its application in small and medium enterprises in attempt to increase the efficiency by using composite materials will also be discussed in this research.

1. Background

Performance increase in the present applications demands the requirement for new materials. Continuous wear and tear of the materials in SMES (Small and Medium Scale Enterprises) will affect the overall performance of the firms. Composites materials are the combination of two or more materials which exhibit unique properties (The Royal Society of Chemistry, 2016). By conducting the systematic of literature on problem solving issues and management strategies of construction equipment and employing composite materials we can develop a construction model with increased efficiency.

3. Methodology

Performing a critical analysis of an existing sustainable material model in relation to a construction equipment model will be carried in this research. Furthermore, the issues with the current materials used for small and medium enterprises is scrutinized in order to increase the efficiency by using composite materials. Moreover, whether the mechanical properties of materials are sustainable by using composite materials to change its mechanical properties is also evaluated.

Fig 1: Replacement of composite material with an existing one.

4. Key outcomes

The outcomes in this particular experimental study will comprehensive contribute to knowledge of sustainable engineering materials. Issues with the use and employment of current materials and also the advantages of using composites materials in such firms will also be evaluated. Analysing the mechanical properties of materials by using composite materials will contribute a lot to SMSE's.

5. Further Work

The study and research is yet to be performed, to further results & detailed performance of the composite materials for sustainability.

6. Conclusions

However, many applications have been included to withstand wear and tear of the materials in SMES the experiment will employ composite materials. Consequently, the composite materials will exhibit unresolved properties such as low weight, continues thermal sustainability, durability and low thermal conductivity experiments included in enhancing the mechanical properties of material in small and medium enterprises.

Acknowledgements

I would personally thank my supervisor A/Prof. David Trope, who was helpful to me from the beginning of the project. I would also like to thank Dr. Narottam Das, for his ideas and assistance.

References

Anon, 2016. *The Royal Society of Chemistry*. [online] Rsc.org. Available at: <http://www.rsc.org> [Accessed 7 Sep. 2016].

Sutherland, J., Rivera, J., Brown, K., Law, M., Hutchins., Jenkins, T. and Haapala, K., 2008. Challenges for the Manufacturing Enterprise to Achieve Sustainable Development. *Springer London*, [online] pp.15-18.
Availableat:http://link.springer.com/chapter/10.1007/9 78-1-84800-267-8_4> [Accessed 7 Sep. 2016].

Studying the effects of non-uniform stress distributions on soil heave

School of Civil Engineering and Surveying
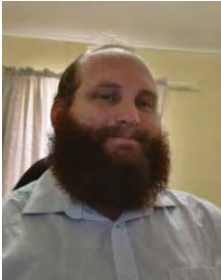
David Petersen

Bachelor of Engineering (Civil) and Bachelor of Science (Mathematics)

Supervisor: Dr Habib Alehossein, USQ

Keywords: Soil expansion, two-dimensional, swell overburden.

1. Introduction

Soil heave is a major contributor of structural damage every year globally. Volume changes in soil due to changes in moisture content will either exert a pressure onto a structure or cause displacement if the confining pressure on the soil is not large enough. Being able to predict the total swell potential and related swell pressure of a soil that a foundation is placed upon is important in limiting potential damage by selecting appropriate construction methods.

2. Background

There are currently many different ways to test soils and models used to predict swell potential. To date there is no one universally accepted test or model that is used but a number that have been accepted to give reasonable approximations. To achieve greater accuracy of predictions the cost and time required to test increase greatly and hence many assumptions and simplifications are made in current tests and models.

3. Methodology

For testing of samples oedometer swell overburden method was used to be able to compare one-dimensional results with two-dimensional results. Comparisons of critical parameters such as free swell percentage, swell pressure and swell index are made between the two tests. Figure 1 shows the oedometer test setup used and a two-dimensional test in progress using the custom made cell.

4. Key Outcomes

Swell overburden tests have been conducted and values for free swell percentage, swell pressure and swell index

Figure 1   (left) – Oedometer with standard cell loaded

(right) – Two-dimensional test in progress

have been obtained for the clay sample when full lateral restraint is applied. Initial tests using an axisymmetric two-dimensional non uniform loading approach have lower maximum swell percentage and then consolidation through movement of soil from under the loaded area.

5. Further Work

In depth analysis of results between the different tests. No comparison of predictions with methods from Australian standards due to time restrictions.

6. Conclusions

Key conclusions from current data are that maximum and final swell values along with swelling behaviour vary significantly between one-dimensional and two-dimensional tests. For more accurate modelling of swell aspects like lateral restraint and rate of moisture change between soil layers could studied further.

Acknowledgements

I would like to thank Dr. Kazem Ghabraie for his support and direction in designing this project, Daniel Eising for his assistance and technical support in the laboratory and USQ for the supply and manufacture of vital testing equipment.

References

Al-Shamrani, M. (2003). Experimental study of lateral restraint effects on potential heave of expansive soils. *Engineering Geology, 54*(1-2), 173-183.

Chen, F. H. (1988). *Foundations on expansive soils:* Developments in geotechnical engineering vol. 54. New York: Elsevier.

ASTM standard D4546-14. (2014). *Standard test methods for one-dimensional swell or collapse of soils.* http://www.astm.org

3D Hydrologic Features Mapping with Imaging Rover

School of Civil Engineering and Surveying

Declan Pettersson

Bachelor of Spatial Science
(Honours) (Surveying)

Supervisors: Dr Xiaoye Liu, USQ

Figure 1 – Image of Site and Hydrological Features

Keywords: Photogrammetry, Spatial Modelling, Hydrologic Features

1. Introduction

Toowoomba has experienced severe weather events and flooding in the past, however arguably the most notable event was the floods of 2011. Flood mapping can identify flood prone areas so that local authorities can mitigate the threat and reduce the potential damage. New spatial technologies are emerging which have the potential to create models of waterways to document the hydrologic features such as bridges, culverts and basins.

The Trimble V10 utilises twelve high definition cameras to document the site and create a 3D model, which can be analysed to provide solutions.

2. Background

Imaging Rovers, such as the Trimble V10, offer relatively quick and simple mapping solutions however they are new technology and their capabilities are yet to be tested in many areas. The project aims to test the capabilities of the Trimble V10 and determine whether it is suitable for the specified application.

3. Methodology

The project is largely practical based and thus a significant amount of time went into field work. The Trimble V10 was integrated with a GNSS receiver and base station to ensure accurate positioning. Numerous set-ups throughout the site with sufficient network geometry were performed to capture images of the entire site. The field data was then processed and the images were stitched together through the use of automatic tie-points, to ultimately create a seamless model of the site in order to create a spatially accurate point cloud.

4. Key Outcomes

The key outcome of the project is to create an accurate model from images that can be utilised to measure features and document the hydrologic features of waterways. At this stage I have created the model and I am still in the process of analysing the data and generating results.

5. Further Work

The tasks remaining are creating a point cloud from the image model and if time allows, running a rainfall simulation through the model. The simulation may not be feasible due to time constraints and may provide a good basis for future investigations

6. Conclusions

The key conclusion of the project will determine the potential of the Trimble V10 and identify whether it is suitable for the specified application. It will also provide insight as to what other spatial applications it may be suitable for.

Acknowledgements

I would like to thank Xiaoye Liu for her continued support and guidance and the University of Southern Queensland for supplying the equipment which was necessary for the success of the project. I would also like to extend thanks to Luke Czaban for offering his knowledge, time and guidance in regards to the operation of the equipment and processing of the data.

References

Evans, J. T. (2015). Evaluation of Photogrammetric Measurements Obtained Using Imaging Rovers and Imaging Theodolites (Undergraduate Dissertation, University of Southern Queensland, Toowoomba). Retrieved from https://eprints.usq.edu.au/29203/1/ Evans_J_Liu.pdf

The Effect of Railway Track Resurfacing on Lateral Track Resistance

School of Civil Engineering and Surveying

Ashley Poulton

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Habib Alehossein, USQ

Keywords: Railway, Lateral Track Resistance, Single Sleeper Push Test

1. Introduction

This project investigates the effect of resurfacing on the lateral resistance of railway track. Mathematical analysis and field testing was used to determine the lateral resistance of sleepers pre and post resurfacing. A finite element (FE) model is then used to predict the buckling behaviour of track pre and post resurfacing.

2. Background

Lateral track resistance is important to prevent track shift, track buckling and train derailments. It is mainly achieved by the lateral resistance of sleepers to movement in the ballast bed, and is highly dependent on sleeper and ballast conditions. A track maintenance process called resurfacing is required on a routine basis to restore defective rail alignment. An unavoidable and undesirable side effect of this process is the disturbance of the interlocking ballast particles within the ballast bed. This process immediately weakens the lateral resistance of the track, which is regained over time through cumulative traffic loading. Queensland Rail is undergoing a programme to install new low profile concrete sleepers to replace timber sleepers on their network. This project addresses the current knowledge gap in understanding how the lateral resistance of this new sleeper design is affected by track resurfacing and the track's buckling resistance post resurfacing.

3. Methodology

Mathematical models identified during the literature review for peak lateral resistance of sleepers were used to predict the expected pre and post resurfacing values. The most reliable way to measure the actual lateral resistance of sleepers is to perform the Single Sleeper Push Test (SSPT). A SSPT test device was designed, manufactured, trialled and then applied in field testing. The SSPT device enabled the non-linear lateral resistance of the sleeper, pre and post resurfacing, to be captured with the results shown in Figure 1.
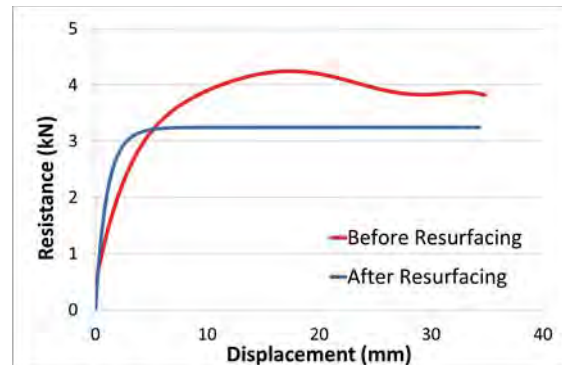

Figure 1: SSPT results pre and post resurfacing.

A beam FE model representing an idealised section of track will be developed, with the lateral resistances obtained from field testing used as boundary conditions. Non-linear analyses will be run to compare the buckling resistance of the track pre and post resurfacing, in the presence of a track misalignment and a compressive rail force due to thermal expansion.

4. Key Outcomes

A SSPT device was developed and used to field test sleepers pre and post resurfacing. The lateral resistance curves were obtained for both conditions. Resurfacing was found to reduce peak lateral resistance by 23%, resulting in good agreement with earlier modelling.

5. Further Work

The FE analyses to assess the buckling resistance of the track pre and post resurfacing is to be completed. Further investigation opportunities include comparison of cumulative rail traffic loading versus dynamic track stabilisation for the recovery of lateral track resistance.

6. Conclusions

The lateral resistance of low profile concrete sleepers is reduced immediately after track resurfacing by 23%. Controls such as temporary speed restrictions or dynamic track stabilisation should be considered to manage the increased risk of track buckling, particularly in warmer months.

Acknowledgements

References

Kish, A (2011). *On the Fundamentals of Lateral Track Resistance*, Technical Report, Kandrew Inc. Consulting Services.

US Department of Transportation (2013). *Track Buckling Prevention: Theory, Safety Concepts and Applications*, Office of Research and Development, Washington D.C.

Synchronization of Multiple DVB-T USB Receivers for use in Common Radio Astronomy Applications

School of Mechanical and Electrical Engineering

Timothy Price

Bachelor of Engineering (Electrical and Electronic)

Supervisor: Dr John Leis

School of Mechanical and Electrical Engineering

Keywords: "Software Defined Radio", Synchronization, Astronomy

1. Introduction

In recent years DVB-T USB receivers have come on to the market which can be used as inexpensive SDR's (software designed radios). This project involves the research, design and implementation of methods of synchronizing the operation of multiple DVB-T USB SDR's. Once accomplished, common radio astronomy functions are performed to prove the synchronization.

2. Background

There are a wide range of USB receivers on the market capable of working as SDR's. Some projects such as time of arrival estimators and beamforming systems require multiple phase coherent channels. The receivers that are capable of these operations market for over $800 AUD. The project shows that through the use of a hardware switching arrangement, phase coherence can be achieved with multiple DVB-T USB's that sell for approximately $10 each.

3. Methodology

The first section of the methodology includes researching methods of synchronization, conceptual design and testing. A procedure using RF switching hardware (as seen simplified in Figure 1) and correlation was eventually designed to synchronize the devices. The second part of the methodology contains the research, design and implementation of the two radio telescopes as well as the underpinning theory required to apply radio interferometry with the achieved synchronization.
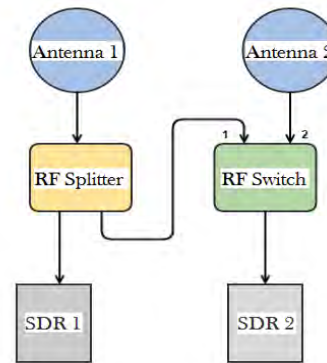

Figure 1 – Synchronization Switching Hardware

4. Key Outcomes

The switching arrangement designed for the project was successfully constructed and implemented to synchronize the samples received from two DVB-T USB receivers. The first radio telescope has been constructed and successfully detected 21cm hydrogen line emissions from our galaxy.

5. Further Work

Construction of the second radio telescope is underway and is expected to be completed in the very near future. Once constructed, synchronization can be applied to the signals from both antennas and radio interferometry can be attempted.

6. Conclusions

An identified limitation to these devices is the maximum sample rate of about 2.6 Mbps which can put a limit on some operations. Regardless of this limitation the project shows that it is possible to accomplish a wide array of projects using equipment that was once considered too expensive for non-professionals to use.

Acknowledgements

I would like to thank my supervisor Dr John Leis for the support, suggestions and guidance throughout the project.

References

Fernandes-Prades, C., Arribas, J.. & Closas, P.(2013). *Turning a television into a gnss receiver*, *in* 'Proceedings of ION GNSS+, Tennessee', CTTC.

L.Wilson, T., Rohlfs, K. & Huttemeister, S. (2013), *Tools of Radio Astronomy* (6th ed.), Springer

Development of Stormwater Asset Management Plan

For Local Council

Sponsor – Sunshine Coast Council

Andrew Priest

Bachelor of Engineering
(Honours) (Civil)
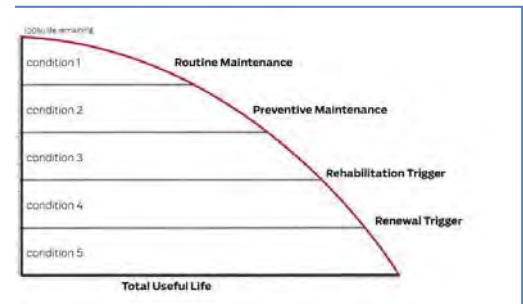
Supervisors: Dr Nateque Mahmood, USQ

Keywords: Stormwater management, Advanced Asset management, predictive modelling.

Figure 1: Typical Degradation curve (IPWEA,2015)

1. Introduction

The main purpose of the research project is to report on the development of the improved Stormwater Asset Management Plan and to research on various models and systems. The research will cover such areas as asset identification, current condition assessment procedures, risk and criticality and the development of predictive modelling to ascertain future failures in a stormwater network.

2. Background

Sunshine Coast Council has a large stormwater asset base. The majority of the stormwater assets are ageing and previous underfunding and temporary maintenance schedules have added to the problem. Many local councils have in place a 'core' asset plan but no advanced system to analyse individual assets and implement an improvement plan (AM) and hopefully the research will assist local government in advanced AM.

3. Methodology

The methodology includes an analysis of current assets and how they are managed. From this further research into current procedures on how the assets are captured and then a condition assessment of a number of networks to provide data and information for implementing an advanced asset management system. Data from the condition assessment will be modelled using age versus condition input to predict life expectancy of the assets.

4. Key Outcomes

Current core AM plans has identified deficiencies in how assets are assessed for condition and age. Data collection and networks have been captured and some basic modelling has been undertaken. Formulating risk and criticality in assessment has been undertaken and these are developing well into the model.

5. Further work

The next step is to identify levels of service, life-cycle costs, and renewal and maintenance strategies. The model will then be applied to the field networks and the results will be analysed.

6. Conclusions

Further research still needs to be undertaken before any substantial conclusions can be made. The key message from this research is that local councils need to be more proactive with managing their assets

Acknowledgements

I would like to thank Dr Nateque Mahmood for his guidance and also my employer SCC.

References

IIMM 2015, *International Infrastructure Management Manual* – International Edition 2015, version 5.0, National Asset Management Support Group(NAMS LTD), Wellington, New Zealand.

Institute of Public Works Engineering Australasia, 2015, *Condition Assessment & Asset Performance Guidelines Practice Notes v2*. Sydney: NAMS.AU, IPWEA.

Hudson, W., Haas, R. and Uddin, W. 1997, *Infrastructure management*. New York: McGraw-Hill.

FRACTURE BEHAVIOUR OF FIBRE/POLYMER COMPOSITES BASED ON COIR FIBRES

Student Name: Rahul Rajan
Master of Engineering Science (Mechanical)

Supervisor: Dr. Belal Yousif
School of Mechanical and Electrical Engineering University Of Southern Queensland

Keyword: close comparison between the glass and coir based epoxy based composite-polymer to the fibre proportion ranging from 0%-6% of 4 samples-NaoH treatment of fibre-mould preparation and carried to the impact and tensile test-SEM inspection for the fibre topology.

1. Introduction

Utilizing environment inviting procedures or techniques likewise pay some great outcomes for the present day world. Particularly, in development field the normal fibre strands like coir is one of the best advancements in building pieces. It acts about as a support material in the composite sector. Use of these reliable filaments which act in a manner that their interfacial grip with the engineered network as remarkable as that and delamination to the composite too.

2. Background

There are many researches about and ponders have been under scrutiny for characteristic fibre as a trade for manufactured fibres. Because of the upgraded mechanical properties of the natural fibre materials than the synthetic fibres. The impact of these common strands are broadly utilized among the worldwide commercial ventures. The Fibre strengthen polymer composite (FRCP) are one kind among the composite materials that coordinate with the glass and carbon as a simulated fibre in such a manner to give quality to the piece. The natural filaments are supposed to be less costly than the synthetic strands. However, there are numerous elements impact these normal strands and expected to check. This project effectively attempts to explore those mechanical break conduct of the fibre. In addition, this research will closely attempt to cover the separation between the engineered and natural fibre using different techniques and test.

3. Methodology

Actually, there are a number of methodologies which need to check the properties of the materials. The better outcome result for the mechanical, thermal and water absorption properties have to be detailed using the treatment of the fibre composites with NaOH solution for different concentrations sample between epoxy-resin and the fibres. The Scanning Electron Microscope (SEM) produces the image of each and every samples ranging from 0% to 6% fibre proportion. In such a way, the focused beam of electrons transmitted from the SEM can analyses the sample's compositions and surface topology. Moreover, the Impact test and tensile test provides a reasonable comparison between the natural fibre and the glass fibre in terms of their mechanical properties.

4. Key Outcomes

There is a conviction that the result from this project would be a replacement of natural fibres instead of the synthetic fibre in the field of craft and innovations. After a thorough inspection along its mechanical properties, the best outcome will be decided

5. Further Work

The research regarding this project is still under progress. The technical side of making the composite sheets and cutting them for the tensile and impact test are finalised. However, due to some technical error, the further tests such as impact, tensile and the Scanning electron microscope are yet to do in some days.

6. Conclusions

Coir based epoxy is a natural fibre that has believed to be a replacement for the synthetic fibre. Technically, there are many hurdles have to be crossed for this result. Once, it is possible to do so. It would be a major revolution in the field of construction and structure as it throws a less economical operation compared to the any other fibre composites. Moreover, the coir fibre is highly reliable and compactible with its strand quality.

Acknowledgements

References

- Wikipidia. 2006. *Composite material*. [ONLINE] Available at:https://en.wikipedia.org/wiki/Composite_material. [Accessed 8 August 2016].
- M. A. Maleque. 2013. *Development and Characterization of Coir Fibre Reinforced Composite Brake Friction Materials*. [ONLINE] Available at: http://link.springer.com/article/10.1007/s13369-012-0454-4. [Accessed 9 August 2016].

Vendor Management with respect to clean Energy (Wind)
Sponsor: School of Mechanical and Electrical Engineering

Student Name: Arvind Ravichandran

Degree: Master of Engineering Science (Power)
Supervisor: Dr Narottam Das
Co-supervisor: Dr Nateque Mahmood
Keywords: Mechanical Failures Impact on WT (Wind Turbines).

1. Introduction

It is well established that the power plants based on coal and other fossil fuels have been a major contributor of Carbon di Oxide creating the greenhouse effect that depletes the ozone layers and creates devastating climatic changes around the world.

2. Background

Given the importance of renewable energy, it is imperative to promote clean energy sources like wind energy through Wind Turbines (WT). This research is focused on mechanical failures and the effect of comprehensive vendor management approach to reduce mechanical failures of clean energy equipment like wind turbines .

3. Methodology

The research included both quantitative and qualitative methodologies and is conducted in four phases which are listed below in a table format.

Table I: Various phases and results.

Phase	Activity	Result
1	Data Collection from OEMs	Wind Farms identified
2	Data collection from Wind Farms to identify major cause of failure	Components identified
3	Agree with OEMs for pilot	In the process
4	Data collection after deploying vendor management agreement	Yet to start

4. Key Outcomes

Two major wind farms identified to run the pilot in order to measure the results of deploying a comprehensive vendor management agreement. Additionally, three major components that frequently fail have been identified.

5. Further Work

Discussion with chosen OEMs are ongoing to get an agreement on the pilot project to be run based on which the study will continue with data collection to assess the impact of vendor management agreement.

6. Conclusions

The key conclusion of the project is that by having a comprehensive vendor management agreement with OEMs, the impact due to mechanical failures can be reduced thereby making WT more productive.
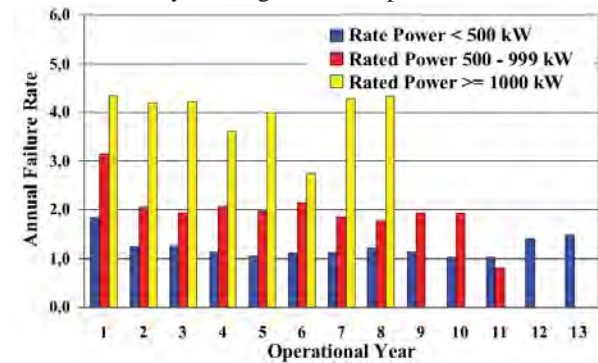

Figure 1. Number of Incidents per Wind Turbine (WT).

Acknowledgements

References

1. Sheng, S and Veers, P, Conference Paper NREL 2011, pp. 3.
2. Sarkar, A and Kumar, Behra, International Journal of Scientific and Research Publications, Volume 2, Issue 2, February 2012, pp. 2.
3. Sheng, S and Veers, P, Conference Paper NREL 2011, pp.12.

3D modelling for surveying projects using Unmanned Arial Vehicles (UAVs) and Laser scanning

Sponsor – UAS Pacific

Bradley Redding

Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Ms Zarah Gharineiat, USQ

Keywords: Photogrammetry, 3D Modelling,

1. Introduction

3D models that have been created from photogrammetry have some evident limitations. To create better, more complete 3D models, it is necessary to understand and reduce these limitations. The project aims to look at the effect of camera orientation (portrait and landscape) and its effect on the overall accuracy of the project.

2. Background

It is important that we better understand both the effects of different camera orientations as well as their limitations and possible uses for different situations. However, this also enables us to gain a better understanding of high resolution photogrammetry which will allow surveyors the ability to better choose the right tool for the right job.

As a surveyor, accuracy, precision and the overall reliability of the data is paramount. Another key element is the product delivered to the client must be complete, even small amounts of missing data may require a large amount of work, hence incurred cost.

3. Methodology

The main analysis was conducted using mean distance from the comparison surface to the model. Where individual points can be selected and compared to each other. Other direct comparisons of software generated quality reports were created. Figure 1 is one of the data sets captured and analysed.

4. Key Outcomes

To determine the effect of portrait and landscape camera orientations, theoretically portrait photography has a higher accuracy demonstrated in the diagram on the right, however the actual results are yet to be determined. The latest version of Pix4d (processing software) has drastically changed the output results from the model and may have a significant effect on the overall outcome of the project.
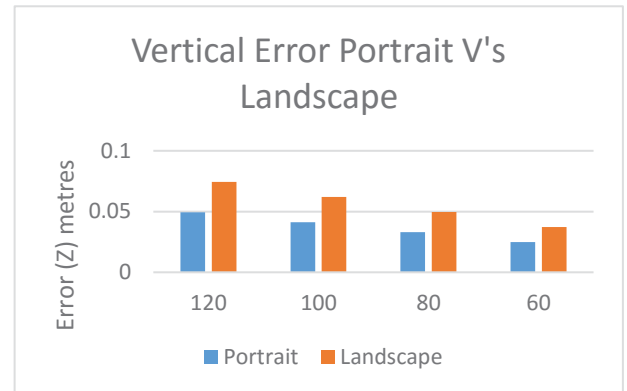

Figure 1 - Sample Diagram

5. Further Work

The project is still in the analysis stage and requires much more work in that region. The project had the potential to delve further into the use of oblique UAV photogrammetry when combined with normal UAV photogrammetry.

6. Conclusions

At this stage the effect of portrait verses landscape is non-conclusive, however with further analysis will produce conclusive results.

Acknowledgements

I would like to thank Zarah Gharineiat for the continued support throughout the project. Luke Czaban for technical support during processing and analysis support as well as Geoff Barker for supplying the Unmanned system used to capture the data.

References

TECHNOLOGY, A. (2015) "Processing UAV Projects."

Uysal, M., A. S. Toprak and N. Polat (2015). "DEM generation with UAV Photogrammetry and accuracy analysis in Sahitler hill." Measurement **73**: 539-543.

ENG4903 Professional Practice 2, University of Southern Queensland, Toowoomba, Australia.

Improvement of Production of Double-Disc Planters

Norseman Machinery Imports Pty Ltd

Andrew Reeson

Bachelor of Engineering (Mechanical)

Supervisors: Dr Ray Malpress

Keywords: Agriculture, Machinery, Manufacturing

Introduction

Norseman Machinery is an agricultural manufacturing company based in Edgeroi, New South Wales and Toowoomba, Queensland. Their main product is the Techniplant, a double disc precision planter used for row crop and broadacre farming. Double Disc Precision Planters are the most precise planter type available and are used where plant spacing, seed depth and yield optimisation are critical factors.

Background

Norseman is a farmer owned business and does not employ any engineers. Their products have been developed through the replication of existing machines, and trial and error. No engineering or holistic overview has been applied in their development and therefore, many issues have seeped into the design, wasting time and money. This project aims to redesign the current product and the production process involved in order to reduce cost and complexity whilst improving quality and reliability.

Methodology

Interviews were conducted with the staff at Norseman to gather their thoughts on aspects of the design and production that could be improved. This information was then compiled and used to guide the rest of the project. A new workshop layout was drafted and implemented, before a production plan was also devised and submitted to management. New component designs were drawn and FEA conducted. 3D printed prototyped were made and tested on existing machines.

Key Outcomes

The redesigned workshop layout allowed for the storage of 28 more pallets, created a dedicated stores area, reduced picking time and allowed better access to the component assembly area. Once fully implemented, the production plan should significantly reduce the amount of downtime caused by incorrect stock levels. The improved design is stronger, simpler, cheaper and more reliable.

Further Work

The production plan is yet to be fully implemented and the new design is still being drawn up. The design for the entire unit will not be finished this year and will have to be finished early next year.

Conclusions

By combining years of practical experience, knowledge from my degree and problem solving skills, I have made significant improvements to the productivity of Norseman and quality of their products.

Acknowledgements

Thanks to Norseman for paying me to do this and to Terry Byrne for printing prototypes.

Relay Operated Alternator Governing System

School of Mechanical and Electrical Engineering

Kendric Rendle-Short

Bachelor of Engineering (Honours) (Mechanical)

Supervisor: Mr Chris Snook, USQ

Keywords: Fuel efficiency, auto-electrical, mechanical

1. Introduction

The limited future of fossil fuels, as well as increasing concern for the environment and rising petrol costs, means that methods of increasing fuel efficiency are becoming a priority in the automotive industry. One such method is to 'switch off' the alternator during acceleration, so that the engine can deliver more power to the wheels, while forcing the alternator to use the engine's power only when decelerating.

2. Background

Several car manufacturers already employ alternator governing systems, using various methods to detect acceleration conditions and switch off the alternator at the appropriate time. Such systems have improved fuel efficiency by 1-10%. However, there are currently no aftermarket systems available for consumers to fit to their cars. This project aims to fill this technological gap by developing a low cost, stand-alone, versatile system to switch the alternator off during acceleration, and examine the effectiveness of such a device.

3. Methodology

This project involved researching, designing and building a prototype alternator governing system, following the objectives of a simple, low cost and versatile design. Once built, the device was installed in a Toyota Landcruiser, a Ford Laser, and a Hyundai Getz. Average fuel consumption with and without the device was recorded for comparison.

The most detailed measurements were taken of the Ford Laser, with weekly recordings of distance travelled, battery load tests, and average fuel consumption, to achieve more accurate results.

Figure 1 - Prototype of Alternator Governing Device

4. Key Outcomes

At the time of writing, a prototype alternator governing unit had been built at a cost of $55. The prototype device is shown in Figure 1. The device was installed in the Landcruiser and the Laser, and the effects measured. An improvement of 0.7% was recorded in the Landcruiser, due to the design of its electrical system. In the Laser, the device gave an improvement in average fuel consumption of 5.4%. Based on the data recorded in the Ford Laser and current fuel prices, this equated to an average yearly saving of $89, and 74 litres per vehicle. No increase in battery wear had been detected in the measurements.

5. Further Work

The electrical system of the Hyundai Getz is incompatible with the alternator governing device, so analysis of that car cannot be completed. Moving forward, there is the potential for the device's design to be streamlined to reduce size and cost.

6. Conclusions

The outcome of a low cost, aftermarket system was achieved, with noticeable improvements to fuel efficiency in small cars.

Acknowledgements

References

Surampudi, B., Redfield, J., & Ostrowski, G. J. (2008). *Mild Regenerative Braking to Enhance Fuel Economy via Lowered Engine Load Due to Alternator*. http://dx.doi.org/10.4271/2008-01-2560

Yoshida, L. T. & Poland, R. L. (1992). *Method and apparatus for managing alternator loads on engines*. Google Patents.

Improving the transition of a successful tender from Estimating to Project Management phases

Sponsor – FK Gardner & Sons Pty Ltd

Joseph Richardson

Bachelor of Construction (Honours)

Supervisors:

Mr Paul Tilley, Lecturer – USQ School of Civil Engineering and Surveying

Mr Scott Carter, Group Manager (Systems) – FK Gardner & Sons

Keywords: Knowledge Management, Knowledge Transfer, Construction

1. Introduction

At FK Gardner & Sons Construction (FKG), there are procedures in place that relate to the transfer of knowledge and information between teams, however they are generally not followed. This project looks at improving the processes surrounding this transfer of project-specific knowledge to project delivery teams.

2. Background

In the lifecycle of a construction project at FKG, the only time that the project "changes hands", is between the Estimating and project management teams. This transition involves the vital transfer of project-specific knowledge between teams. If that vital information is incorrectly, or only partially transferred between the teams, it can have an adverse effect on project outcomes, through financial and/or time losses due to gaps in project knowledge from the delivery team. This has been identified as a key area for improvement by FKG Group management.

3. Methodology

The Estimating team generally will acquire a large body of project-specific knowledge gained throughout the tender period. To determine which of this knowledge should be passed directly to the project delivery team, a semi-structured interview was completed with 6 members of FKG's estimating team. A further 15 project delivery team members undertook a survey to determine their requirements. Thirteen of the fifteen respondents

considered that the quality of information provided by the estimating team, has either a "huge" or "considerable" impact on project commencement and success:
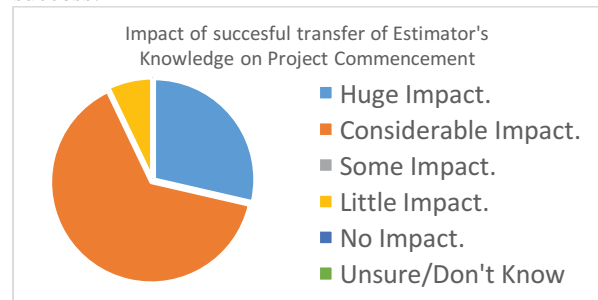

Figure 1: Results of Project Team Survey Regarding Estimating Team's Project Knowledge

These results were applied in the re-design of the handover procedural documentation.

4. Key Outcomes

Key outcomes are as follows:

- Understand relevant literature (knowledge management & transfer, lean construction, value stream mapping)
- Determine the current use of the existing procedures
- Generate improvements that can be implemented into the system and tested
- To compare the proposed improvements with outputs typically given using the current systems.

5. Further Work

Remaining work includes finalisation of process improvements, further research into existing proprietary systems, and testing of proposed procedural change.

6. Conclusions

The Estimating Handover Meeting is the point at which improvements must be implemented. Guidelines to be implemented for gathering and filing of estimator's knowledge

Acknowledgements

I would like to thank Paul Tilley and Scott Carter for their never-ending support, assistance, and the occasional inspiration to perform better.

References

Anumba, CJ, Egbu, C & Carrillo, P 2008, Knowledge Management in Construction, Wiley.
Emmitt, S & Gorse, C 2006, Communication in Construction Teams, Taylor & Francis

Analysis of Road Crashes at Roundabouts in Toowoomba
School of Civil Engineering and Surveying

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Bachelor of Engineering   (Honours) (Civil)

Supervisors: Dr Soma Somasundaraswaran, USQ

Keywords: Roundabout, Road Crash, Geometric Properties

1. Introduction

The use of roundabouts is widespread in Toowoomba, the largest regional city in Australia, yet crashes at these roundabouts contribute a substantial amount to the total crashes. Therefore, the purpose of this study was to analyse the road crash data from roundabouts in Toowoomba with the aim of evaluating the safety performance at each roundabout to re-examine the geometric features of the poorer performing roundabouts that may be modified to reduce the severity or frequency of road crashes.

2. Background

The city of Toowoomba has a significant number of roundabouts and more are being constructed each year. With the number of roundabouts increasing, it is important to ensure that both the existing roundabouts and any new roundabouts being designed and constructed are as safe as possible for the road user. In particular, the geometric properties of roundabouts that can significantly affect roundabout safety need to be considered with care and attention.

3. Methodology

Preliminary analysis of the road crash data for Toowoomba roundabouts was undertaken to identify any trends in the crashes. The roundabouts were then ranked based on their safety performance using performance measure methods identified in the Highway Safety Manual. A road safety audit is to be undertaken on the top ten worst performing roundabouts to identify possible geometric factors that can be improved. Remedial measures can then be proposed for the top ten roundabouts and the effect of the improvements can be quantified using Crash Modification Factors (CMFs).

4. Key Outcomes

The most common type of road crash at the roundabouts in Toowoomba are angle crashes, Figure 1. Roundabouts are generally considered a safer alternative intersection because of the reduction in head-on crashes. However, the angle crashes can be just as severe if high speeds are involved. It has been identified from the literature that the most significant geometric properties of roundabouts are those influencing the speed vehicles approach, manoeuvre and exit the roundabout. The geometric properties that affect the speed the most are the entry geometry and the driver's sight distance.
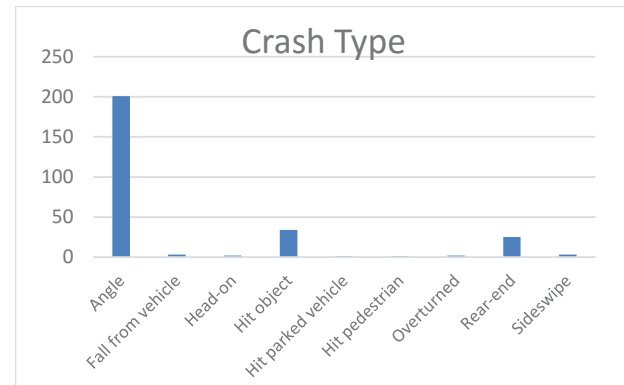

Figure 1 – Crash Frequency of different types of crashes at Toowoomba roundabouts

The aim of the road safety audit is to identify other geometric properties that have significant impact on the safety of the roundabout.

5. Further Work

Further work still to be undertaken includes the Road Safety Audits and proposing remedial measures to improve geometric properties of the roundabouts to increase safety.

6. Conclusions

This project aims to identify geometric features of the top ten worst performing roundabouts in Toowoomba that can be improved to reduce the frequency and severity of road crashes.

Acknowledgements

References

Austroads. (2015). *Guide to Road Design Part 8 - Treatment of Crash Locations* (2nd ed.). Sydney: Austroads Ltd. Retrieved February 12, 2016, from https://www.onlinepublications.austroads.com.au/items/AGRS08-15

Queensland Government. (2016). Road Crash Locations. Queensland: Department of Main Roads. Retrieved February 12, 2016, from https://data.qld.gov.au/dataset/crash-data-from-queensland-roads/resource/e88943c0-5968-4972-a15f-38e120d72ec0

Austroads. (2015). Guide to Road Design Part 4B - Roundabouts (3rd ed.). Austroads Ltd. Retrieved February 15, 2016, from https://www.onlinepublications.austroads.com.au/items/AGRD04B-15

The Role Building Information Modelling and Visualisation in Residential Construction

Simon Richardson

Bachelor of Engineering

(Honours) (Civil)

Supervisors: Dr Vasantha Abeysekera, USQ

Keywords: Visualisation, BIM, Residential Construction.

1. Introduction

Building Information Modelling (BIM) and the visualisation that can be produced with it is promoted as an essential and inevitable technology that will be an integral part of the construction industry. Although there is much documentation on how BIM can improve the quality and efficiency of the industry its primarily focused on high value developments and large infrastructure projects.

There is little information on how the technology will benefit the smaller scale projects. In particular, the construction of detached dwellings. This project researched the requirements of the residential construction industry and identifies the features of BIM that will be of benefit to the industry.

2. Background

BIM and visualisation is proven to benefit larger projects. Due to the size of these projects there can be more resources allocated to the design phase where BIM can improve the efficiency of the construction process. Residential construction has much lower margins and less efficiencies to be gained from improved coordination and planning. It is recognised that the construction industry is a slow to change. Therefore, the benefits of implementing BIM must target the 'real world' issues for the residential construction industry in order to be adopted.

To identify these issues, the first objective was to investigate the perceived problems in residential construction sector from the perspective of the builder. The second objective was to determine what level and features of BIM and what visualisation techniques can rectify or reduce the effects of these issues and how.

3. Methodology

An interview was designed that brought to light issues faced by builders in the residential construction industry. Interviews were then conducted with randomly selected Toowoomba builders. The results were compared and common issues identified. The issues presented in the interviews were then determined to be structural or unique to that builder. The issues were identified that BIM and visualisation could address. Software packages were identified that could address the issues and issues that are not able to be resolved with BIM are highlighted. Findings are provided to the interviewees and their feedback noted.

4. Key Outcomes

The key outcomes will be solutions that BIM and visualisation can provide to issues that are prevalent in the residential construction industry.

5. Further Work

Further research into what programs are available that can achieve this or what modifications are required to resolve the issues identified without current solutions.

6. Conclusions

This project aims to identify the key issues in the residential construction industry that could be resolved with BIM and visualisation techniques. The outcome is a list of issues and requirements not currently being addressed for the industry. It provides recommendations on what BIM technologies may be able to resolve these problems.

Acknowledgements

References

Hampson, K & Brandon, P (2004), *Construction 2020: a vision for the property and construction industry*, Cooperative Research Center, Brisbane, Queensland.

Alabdulqader, A, Panuwatwanich, K & Doh, J-H (2013), *Current use of building information modelling within Australian AEC industry*, Proceedings of the13th East Asia-Pacific Conference on Structural Engineering and Construction Hokkaido University, <http://www98.griffith.edu.au/dspace/handle/10072/57078>.
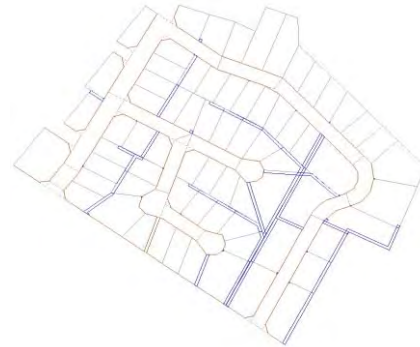
The effects of control point shape and distribution in the creation of a Numeric Cadastral Data Base, NCDB, in an urban area of Alice Springs NT

Sponsor – Department of Lands Planning and Environment NT (DLPE)

David (Tom) Roberts

Bachelor of Spatial Science (Honours) (Surveying)

Supervisors: Dr Glenn Campbell, USQ

Roland Maddocks, DLPE

Keywords: Numeric Cadastral Data Base, Cadastral Adjustment, GeoCadastre, Co-ordinated Reference Mark

1. Introduction
For centuries information defining a property's boundary has been held in the form of a document consisting of directions and distances. With modern surveying instruments and advancement's in processing power the possibility of moving towards a coordinated cadastre is becoming a reality. Such a cadastre can be defined as a Numeric Cadastral Data Base (NCDB).

2. Background
A Numeric Cadastral Data Base is created by inputting the information from the original cadastral survey plan into a software package and adjusting the area in conjunction with the original survey marks on the ground. Little work has been done at looking at the effect of shape and control point distribution on such adjustments.

3. Methodology
An uncoordinated area has been surveyed using methods put forward by the DLPE to investigate the creation of a NCDB. From the subject area 48 parcels have been selected for further analysis on the cadastral adjustment within the software package GeoCadastre. A manual reinstatement of the area was conducted and used as a base file to compare the position of 147 parcel corners against NCDB adjustments using different control configurations.

Diagram 1 – Test Area

4. Key Outcomes
Key outcomes include reporting on the processes in developing a Numeric Cadastral Data Base. Identifying the effects of control point shape and distribution in the least squares adjustment within the NCDB creation program GeoCadastre. Determine the expected accuracies of the Numeric Cadastral Data Base relative to the original position of the boundary corners after all necessary adjustments are made.

5. Further Work
An analysis of the different adjustments will be conducted by comparing the position of the final parcel corners to the base file from the manual reinstatement.

6. Conclusions
Recommendations will be made on selecting different control configurations when creating a NCDB to generate the closest resemblance of the actual boundary corners.

Acknowledgements
I would like to thank Roland Maddocks and Paul Montefiore from the DLPE, my supervisor Glenn Campbell and my family, friends and employer for their support throughout the term of the project.

References
Elfick, M 1997, *Coordinating a Metes and Bounds Cadastral System,* Dept. Civil Engineering and Surveying University of Newcastle, Australia

Maddocks, R & West, R unpub, *Coordination of the Northern Territory Cadastre,* First Trans-Tasman Surveyors Conference 1997

Application of Google and MODIS data to assess the health of the Mitchell Grasslands, through web-based GIS

School of Civil Engineering and Surveying

Thomas Robertson

Bachelor of Spatial Science (Honours)

(Surveying)

Supervisor: Dr Kithsiri Perera *Keywords:*

NDVI, KML, Mitchell Grasslands

1. Introduction

The Mitchell Grasslands lie in North-Western Queensland and represent a significant proportion of Queensland's cattle grazing pasture, supporting many livelihoods and communities. The use of satellite data and imagery to assess the health of the grasslands in terms of primary production is being investigated and compared to other existing methods. Using Google Earth, and web-based GIS, freely available data will be available for use for a broader audience.

2. Background

Vegetation Indices including NDVI and EVI give a measure of pasture 'greenness'. These are based upon the difference in the detection of red and near infrared radiation, from the Terra and Aqua satellites as a part of the MODIS program. 16 years of continuous rolling 16-day averaged images and data have been accessed. The current Queensland industry standard for estimating pasture production and health is the AussieGRASS model which takes into account many sources of data to generate monthly and annual simulated pasture growth rates.

3. Methodology

By selecting seasonal images sourced from MODIS vegetation index data, a time series of images can be generated for a particular location. Then, using historical meteorological data and AussieGrass results and interpretation, correlation can be drawn showing the timing delay and sensitivity of the vegetation index to various stimuli. An example of the Aussis Grass model results can be seen in Figure 1.

4. Key Outcomes

At moderate resolution, MODIS vegetation index data makes is able to produce a satisfactory time-series showing the magnitude of changes in response to the seasons.

Figure 1 – AussieGrass Pasture Growth July 2016 Anomaly
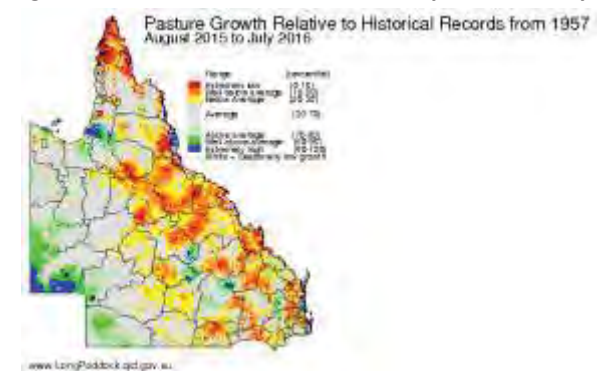
5. Further Work

Increased confidence in the results can be gained by completing more work in validating the MODIS vegetation index data against the AussieGrass data. Also, by integrating the relevant KML files into a web domain, the generation of Google Earth KML using a script or HTML will be improved.

6. Conclusions

The use of vegetation index data appears to be appropriate for use in estimating pasture health on the Mitchell Grasslands. In particular for moderate and large scale applications such as looking at region- or state-wide implications of weather patterns.

Acknowledgements

References

DSITI. (2016). Retrieved from Australian Grassland And Rangeland Assessment by Spatial Simulation:
https://www.longpaddock.qld.gov.au/about/researchprojects/aussiegrass/index.html
LPDAAC. (2016). Retrieved from Land Processes Distributed Active Achive Center - MODIS Products Table:
https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table
Perera, K., & Apan, A. (2009). Analysing Biomass Fluctuations in Mitchell Grassland, Australia, in wet and Dry Rainy Months Using MODIS Data. Surveying and Spatial Sciences Institute Biennial International Conference. Adelaide, Australia.

High Performance Optical Absolute Position Sensor for Harsh Environments

School of Mechanical and Electrical Engineering and Russell Mineral Equipment

Jake Roney

Bachelor of Engineering (Honours)

Supervisors:
Mr Chris Snook, USQ

Mr Andrew Tuxford, Russell Mineral Equipment

Keywords: Optics, Sensor, Position

1. Introduction

Russell Mineral Equipment (RME) is a leader in mill relining systems and produce many components to carry out these processes. This project seeks to analyse the performance of the 'Thunderbolt' recoilless jackhammer series which RME design and manufacture. To do so, the project will attach an optical position sensor to the hammer block to determine the velocity and power of the jackhammer which indicates the level of performance.

2. Background

The implementation of the sensor is beneficial by the hammer no longer needing to be taken out of service for the performance analysis to be conducted, but instead can be done automatically during use. Unlike what this project seeks to implement, the current similar designs in industry cannot stand the harsh working conditions and speeds reached by the RME 'Thunderbolt' hammers. This project will challenge me by allowing me to implement my mechanical engineering knowledge and by forcing me to expand my knowledge into electronic systems.

3. Methodology

The project contains various components and I will therefore implement a methodology which breaks the project into segments. Firstly, I analysed the hammer shaft to determine what makes it work and then designed the surrounding components to suit the shaft, as well as, a barcode which is used to determine the position of the hammer. Secondly, I selected and designed the optical position sensor. Thirdly, the programming of the microcontroller must be done. Lastly, a prototype can be created for testing.
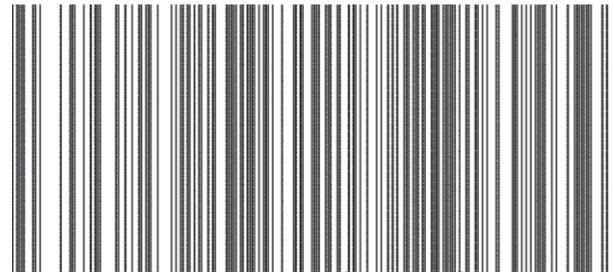

Figure 1: Barcode created by using a Maximal Length Sequence.

4. Key Outcomes

I have created a Maximal Length Sequence (MLS) for the positon barcode shown in Figure 1. This is interesting as there are only 256 bits in this sequence which contain 256 unique 8 bit combinations. I have also conducted a significant literature review to determine the most effective solution for each component of this project.

5. Further Work

To complete the design, the microcontroller for the position sensor must be programmed to display the velocity of the hammer relative to time. Also, the physical positioning of the sensor relative to the light source must be determined. After these, an prototype can be created for further testing.

6. Conclusions

It is evident from this project that an optical position sensor could effectively be implemented into the series of RME 'Thunderbolt' recoilless hammers. This sensor will allow the performance of the hammers to be accurately analysed without removing the hammer from operation.

Acknowledgements

References

Parker 2103, *Intellinder Absolute Position Sensor,* Parker Hannifin Corporation, Benton, AR, viewed 30 March 2016

Taos, *Design Considerations for an Absolute Steering Angle Encoder Demo,* Texas Advanced Optoelectric Solutions, viewed 30 March 2016

Investigation of Low Voltage Regulation Opportunities on the Distribution Network

Sponsor – School of Mechanical and Electrical Engineering

Shaun Rosendale

Bachelor of Engineering

(Honours) (Power)

Supervisors: Mr Andreas Helwig, USQ
    Dr Narottam Das, USQ
    Mrs Tereses Milford, Energex

Keywords: Low Voltage Regulator

Figure 1 – LV Regulator installed

1. Introduction
As the electricity distribution networks need to change due to the ever increasing distributed generation being installed, there is a need for the low voltage (LV) network to be able to handle the bi-directional energy flow.

This project investigates the use of a 150kVA padmounted In-line Power Regulator on the LV network to assist in maintaining the quality of supply along an LV feeder.

2. Background
The electrical network was originally designed for power to flow from generators, through transmission networks, through distribution networks and then to customers. This has changed in recent times due the installation of solar PV. The low voltage network has become an extremely important part of the electricity network partly because of the large scale introduction of residential solar PV installations. This is due to the inverters being set to operate in a voltage bandwidth, and if the electricity network's voltage exceeds this then the inverter will trip off. This leaves customers unhappy and the electricity distributor needing to augment the network. The augmentation works can cost hundreds of thousands of dollars.

3. Methodology
The possibility of using a LV regulator was first assessed by creating a model of the network and testing the model based on readings that had been taken from the network. The model was used to determine a suitable location of the LV regulator and once this was determined a project could be created to design and construct the LV regulator. A photo of the LV regulator installed is shown in Figure 1. Recordings were taken of the LV area both before and after the installation to assist in analysing the benefit of the LV regulator

4. Key Outcomes
There have been two LV regulators installed with voltage recorders installed at a number of sites along the feeder.

Data is just coming in and being assessed however initial data analysis shows that the LV regulator at the first site is maintaining power quality in the LV feeder.

5. Further Work
Analysis of the data from the recently installed regulators is ongoing.

6. Conclusions
The introduction of a standalone LV regulator as a tool that can be used to rectify power quality issues will be beneficial and cost saving to the distribution company. Future work is to explore feedback loops to optimise regulator set point for voltage performance of the LV feeders and to explore the relationship between PV infeed and regulator voltage set point to maximise PV.

Acknowledgements

References
Hadjsaid, N., Sabonnadiere, J. 2011, *Electrical Distribution Networks*, ISTE, Hoboken, N.J; London;.

Investigating design and construction issues for precast concrete bridge over Bookookoorara Creek

School of Civil Engineering and Surveying
NSW Roads and Maritime Services

Alexander Rosnell

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Weena Lokuge, USQ

Mr Peter Young, Roads and Maritime Services

Keywords: Bridge, precast, constructability, safety

1. Introduction

Bridges are an integral part of the road network that provide passage for vehicles over otherwise impassable terrain such as waterways. This project involved construction of a new type of modular concrete bridge and identifying areas of design refinement for future construction.

2. Background

Local government is responsible for 10,000 bridges on the NSW road network, 50% of which are timber bridges. Of this timber bridges, 30% are in poor condition and require substantial maintenance or replacement. NSW Roads and Maritime Services has developed a precast concrete bridge design called Country Bridge Solutions to aid in the replacement of these deteriorating bridges. The bridge design is intended to be quick, easy and cost effective to construct.

3. Methodology

This project involved the construction of a three span 30m precast concrete bridge over Bookookoorara Creek in Tenterfield Shire LGA. Construction records were kept and analysed to identify areas which could be modified to reduce construction time, improve safety and decrease cost. Concepts to improve these areas were developed and analysed to determine a recommended concept for detailed design by others.

Figure 1 - New and old bridges

4. Key Outcomes

This project identified 21 areas that may be improved. Concepts were developed and analysed for each of these areas, and modifications were proposed that ranged from alteration of reinforcement spacing to systemic changes to the bearing and pre-casting process. Implementation of the recommended options is expected to improve the simplicity of the system in addition to meeting the project objectives.

5. Further Work

It is recommended that the concepts recommended for progression by this report be considered for inclusion in the final bridge design.

6. Conclusions

The bridge construction was largely successful and, with the consideration of the issues raised by this project, may provide a suitable option, for replacement of aging bridge assets.

Acknowledgements

References

Griffith, A., & Sidwell, A. (1995) *Constructability in Building and Engineering Projects*, London, UK: MacMillan Press.

Roads and Maritime Services (2016) *Country Bridge Solutions Modular Bridge Overarching GuideEd. 1 v1*. RMS Publication

Analysis of Steady State Vs Dynamic Modelling of Groundwater Mounding in Development Areas in WA

Sponsor – School of Civil Engineering and Surveying

Luke Rusconi Bachelor of

Engineering (Civil)

Supervisors: Dr Elad Dafny, USQ

Keywords: Groundwater, Mounding, Modelling

1. Introduction

In Western Australia, it has been common practice in the land development industry to ensure that finished lot levels have sufficient separation to groundwater levels to allow the practical and economic construction of dwellings as well as to protect the amenity of the dwellings and provide recreational areas and gardens that are not water logged and fit for use. To achieve this there are two standard methodologies used within the industry being the filling of lots to gain separation and/or the provision of adequate subsoil drainage to lower and control groundwater. There are various models and methodologies used throughout the industry to assist in the design of drainage systems and earthwork levels, these include steady state models such as the Hooghoudt equation as well as dynamic software models such as MODFLOW.

2. Background

Given the economic and environmental costs, there is a strong focus on minimising the amount of fill required on development sites. It is critical that engineers use the most relevant and accurate methods for the calculation of groundwater mounding and ultimately the determination of the required fill level. This project will review a selection of the methods available to engineers for calculation of the mounding and will compare and make comment on the variances and relevance of each method.

3. Methodology

Modelling was under taken on a 2 layered theoretical site. Variations between steady state models and a dynamic model are to be assessed and tested for sensitivities in various situations.
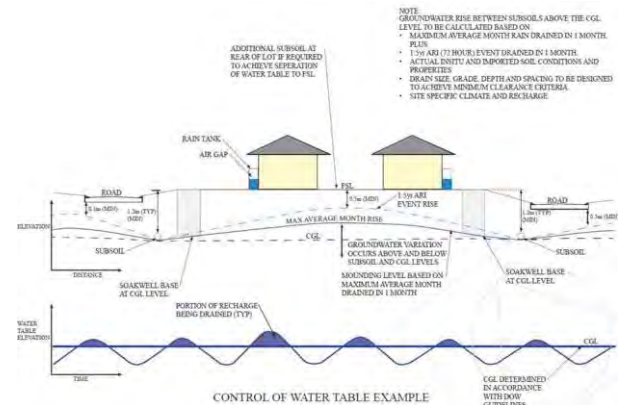

Figure 8 – Groundwater mounding requirement (Calibre Consulting (Aust) Pty Ltd)

4. Key Outcomes

Modelling has shown that while the various steady state methodologies used are comparable, they are significantly more conservative than the results obtained from the transient model.

5. Further Work

Further analysis is required to see if the standard inputs to the steady state equations can be modified to consistently produce results comparable to the transient model.

6. Conclusions

The requirements of the IPWEA guidelines for calculating groundwater modelling are too conservative for steady state modelling. The required storm event input needs to be adjusted to represent a more realistic set of results.

Acknowledgements

I would like to thank Dr Elad Dafny who is my supervisor for this project who has been extremely helpful. Western Australia State Manager of Calibre Consulting (Aust) Pty Ltd has also been extremely helpful in providing industry experience.

References

Ritzema, H. P. 1994, *Drainage Principles and Applications*, ILRI Publication 16, Wageningen, The Netherlands.

Land Development Steering Group 2016, *Draft Specification Separation distances for groundwater controlled urban development,* IPWEA

Shared Zones as a Solution to Grade and Space Restrictive Residential Streets

Sponsor – School of Civil Engineering and Surveying

Stephen Russell

Bachelor of Engineering (Civil)

Supervisors: Mr Trevor Drysdale, USQ

Keywords: Shared space, roading, local government

Figure 1 – Locking Street Shared Zone

1. Introduction

Nelson City Council located in the "Top of the South" Island of New Zealand has a restrictive topography that limits development to the costal fringe. Over time this has forced developments along the hinterland regions of the area creating medium to highly populated residential streets over steep grades and narrow road reserves. "Shared Zones" have been presented as an option to cost effectively provide a refreshed and functional street environment.

2. Background

As population in the Nelson region continues to grow, solutions for these restrictive spaces need to be considered. The literature has extensively covered the way in which urban and CBD shared space should operate, however there is a gap in the knowledge in the Australasian space in regards to residential shared space.

3. Methodology

A literature review determining best practice in this space has been undertaken. From the outcomes of this review an assessment of functionality of the existing zones has been undertaken through qualitative surveys of residents in the street and council officers involved with the upgrades. Figure 1 shows the threshold treatment on one of the existing zones. A design and cost benefit analysis has then been undertaken on two options. One adhering to the principles of shared space and the other on a land development manual compliant upgrade.

4. Key Outcomes

From research into best practice shared spaces there is no single best approach. Instead the guidance document will have a greater focus on how to best meet the individual conditions of the site. Prescriptive rules and regulations are of lesser importance than taking an active approach to best fitting the project to the environment in which it is located.

Cost benefit the advantage of the shared space is apparent. Trade-offs in terms of reducing parking space and negative public opinion need to be managed to ensure the treatment type is appropriate.

5. Further Work

The guidance document will be completed in draft format however may take some time to bring into practice. Internal peer review of the document will be necessary and then approval by Council committee likely.

6. Conclusions

Shared Zones are a suitable solution to the grade and space restrictive residential streets in the Nelson City Council area. Their implementation should not be automatic and their use should be restricted to those areas that can be enhanced through achieving the objectives developed in this research.

Acknowledgements

References

Reid, S. Kocak, N & Hunt, L. (2009). Shared Space Project – Stage 1:.Appraisal of Shared Space, Department of Transport, London UK.

Collarte, N, (2012). *Rethinking a residential Street in Somerville,* Cambridge, USA.

Low Cost Passive Radar Through Software Defined Radio
Sponsor – Naval Technical Bureau, Department of Defence

Mathew Ryan

Bachelor of Engineering (Honours)

(Electrical & Electronic)

Supervisors: Dr Andrew Maxwell, USQ

Mr Liam Price, Naval Technical Bureau

Keywords: Radar, Software Defined Radio, Digital Video Broadcast - Terrestrial.

1. Introduction

Passive radars utilise existing terrestrial radio signals, such as those produced by radio or television stations, to track objects within their range. This project aims to determine the suitability of low cost USB TV tuners as hardware receivers for a Software Defined Radio (SDR) based passive radar receiver. Subsequently determining its effectiveness in producing inverse synthetic aperture radar images using data collected from Digital Television signals.

2. Background

The concept of tracking moving objects with radio waves was first proposed in the late 19th centaury, and following the development of traditional monostatic radar in the early part of the 20th centaury, a proof of concept for passive radar was achieved in the Daventry experiment, conducted in the United Kingdom in the mid 1930's (Kuschel & O'Hagan n.d.). Since this initial confirmation, Militaries the world over have been using passive radar as a part of electronic warfare. The evolution of SDR has enabled greater access to the technologies required to implement passive radar, with the greatest limitation being the cost of the required hardware. The availability of low cost hardware was therefore investigated to determine its suitability and subsequently the availability of passive radar to a wider audience.

3. Methodology

Research was conducted into the available SDR receivers, and comparison of specifications was made against the low cost receiver used in the project. Hardware was developed based around the Realtek RTL2832U chipset to coherently receive radio signals for target identification. The complex ambiguity function was implemented to interpret sampled data
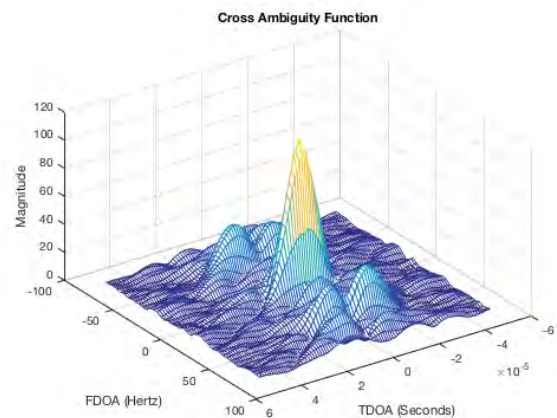

Figure 1: Passive Radar Target Data

windows, with the output of these windows to be compared to the requirements for an inverse synthetic aperture radar input, thus determining the suitability of the device.

4. Key Outcomes

A functional hardware platform has been developed to determine the suitability of the low cost receiver as a passive radar receiver. Software interpretation of the received data has identified that although the hardware is capable, a real time implementation of data processing is not yet possible, impeding the ability to determine the suitability of the receiver as an inverse synthetic aperture receiver.

5. Further Work

Further work to be completed beyond the scope of the project includes analysis and improvement of the receiver hardware to reduce the noise floor, and the addition of directivity to the received radar information.

6. Conclusions

The results of testing show that the hardware is capable of receiving and producing the requisite data. Software processing of the received data does not occur in real time and is impeding the ability to determine the overall suitability of the hardware.

Acknowledgements

References

Kuschel, H. & O'Hagan, D. (n.d.), *Passive radar from history to future*, in 'Radar Symposium (IRS)', Vol. 2010 11th International, pp. 1–4.

Terrestrial Laser Scanning, Asset management in remote Aboriginal communities

Rory Ryan

Bachelor of Spatial Sciences (Surveying)

Supervisors: Dr Xiaoye Liu, USQ

Keywords: Terrestrial Laser Scanner, Abstract Space, Asset Management, Australian Indigenous Cultures

1. Introduction

The aim of this project was to identify current assets in remote aboriginal communities, map these assets using the latest laser scanning technology and provide data sets of the assets in a format that could improve planning, the negotiation process and general decision making of all parties involved in the development of resources on aboriginal land.

2. Background

Planning and asset management in Aboriginal communities has not always been in the best interest of the community themselves. In the past there has been a lack of planning and negotiation between the communities and those making the decisions possibly due to lack of information. This project will identify assets within aboriginal communities and map those assets using three dimensional terrestrial laser and '*more than abstract space*' (Roth 2009) techniques. The asset data can be used in planning and management of resources.

3. Methodology

The methodology included a combination of research and data collection within an Aboriginal community using TLS.

The research undertaken looked at current Aboriginal land rights legislation and identified the importance of customs, traditions and the right to 'negotiate' when identifying assets and determining land use in aboriginal communities.

Traditional cadastre data and practices currently used in remote aboriginal communities of the NT were then compared against mapping of '*more than abstract*

Figure 1 – Pre field scan location plan, Ski-Beach NT

space' (Roth 2009) and current capabilities of TLS in asset management.

A comparison assessment of spatial data was undertaken using criteria informed by the land rights legislation and cultural values of the individual stakeholders within the community: e.g. consideration of traditional cultural practices.

Field and office component involved mapping portions of a remote indigenous community using TLS and subsequent process of asset data.

4. Key Outcomes

Identified, captured and extracted a combination of assets used in the process of data management. Compared TLS captured data to traditional survey methods adopted in setting out the local cadastre.

5. Further Work

Further work would include the identification of Aboriginal assets, mapping these assets using '*more than abstract space*' (Roth 2009). Possible further work could involve investigating the relationship of mapping Aboriginal assets and land rights.

6. Conclusions

That TLS technology is developing and an ideal tool to be used in the development and management of resources in Aboriginal communities.

Acknowledgements

References

Roth, R. (2009). The Challenges of mapping complex indigenous spatiality: from abstract space to dwelling space. *cultural geographies* 2009, 16: 207-227.

Evaluation of the Trimble V10 Imaging Rover

Sponsor – School of Civil Engineering and Surveying

Tim Ryan

Bachelor of Spatial Sciences (Honours) (Surveying)

Supervisors: Ms Zahra Gharineiat, USQ
Ass Prof Peter Gibbings, USQ
Mr Brian Hammonds, NSW
Technical Director, RPS Group

Keywords: V10, Terrestrial Photogrammetry, Trimble Vision.

1. Introduction

Technological developments are revolutionising the process of measuring and describing the built and natural environment. The V10 has been presented as one such development. It incorporates 'Vision Technology' and twelve digital cameras to create 12 individual pictures to be processed through 'Trimble Business Centre' Software to develop a 60 megapixel full site panoramic capture. The ability to quickly capture detailed and comprehensive data from a safe distance with minimal site impact gives it significant advantage over alternatives, but only if accuracy and precision are adequate. If they are, the V10 could truly revolutionise many aspects of the industry.

2. Background

Surveyors seek to produce excellent results with minimal time, labour and capital outlay. The V10 promises significant time savings over traditional methods. It can be operated by one person where others use two. Where in the past a worker would have to tread a potentially unsafe site the V10 can be operated at a distance. Traditional methods captured data about specific predetermined points but the V10 captures virtually all data such that required points can be determined post hoc. All this could be of great advantage providing it can be achieved with adequate accuracy and precision. The aim of this project is to determine if its accuracy and precision is indeed adequate in comparison with alternative systems.

3. Methodology

Literature pertaining to the process of Terrestrial Photogrammetry was reviewed and alternatives to the

Figure 1 – Project Site

V10 (hardware and software) for comparison were determined. A simple survey (Figure 1) was conducted using four systems, one of which was a traditional, tried, tested and accepted process to form the basis for comparison with the other three.

4. Key Outcomes

Data collection so far highlights the uniquely comprehensive nature of the data collected and the significant time savings. Relative accuracy and precision are yet to be tested as the project continues.

5. Further Work

Data processing is pending, to be followed by statistical analysis of the comparative results. Future research may well seek to replicate the results on more complex structures for confirmation of conclusions.

6. Conclusions

The V10 has the potential to make a significant contribution in many aspects of spatial analysis if its accuracy and precision are adequate.

Acknowledgements

I would like to thank Peter Gibbings and Zahra Gharineiat for support and supervision. Brian Hammonds has been of huge assistance in refinement of methodology and training in the use of the V10. RPS group have been very generous with access to hardware and software. Russel Box at UPG provided software licenses and general industry discussion.

References

Trimble Navigation Limited. (2016, July 20). *Trimble V10 Imaging Rover*. Retrieved from Trimble: http://www.trimble.com/Survey/Trimble-V10-Imaging-Rover.aspx

Design analysis of the bearing component of the hip joint prosthesis to improve distribution of forces and frictional wear.

Sponsor: School of Mechanical and Electrical Engineering.

Kizito Saika

Bachelor of Engineering

(Honours) (Mechanical)

Supervisor: Dr Steven Goh (USQ).

Keywords: Stress Distribution, Prosthetic Hip Joint wear, Hip Joint Implant Tribology, Prosthetic Materials.

Figure 1 – Effect of wear debris, Varshney, (2016).

1. Introduction.

This is a design analysis project aimed at reducing wear of the hip joint components by improvement of distribution of forces. Though there have been celebrated achievements in the total hip arthroplasty (THA) procedure that have brought much relief, challenges associated with wear , hip joint stresses and adverse biological response have greatly affected the longevity of the implants.

2. Background

Prosthetic wear is a problem that has overshadowed the tremendous gains in the THA and has resulted in implant loosening that required revision surgery. THA has been known to be confined to the older patients but has recently crept downwards to include those in the twenties. This has increased demand and quality of the implants. The project analyses the forces that are active at the hip joint articular surfaces and by use of computer simulation, finite element analysis (FEA) was performed on the model were upon material and lubrication regime were recommended.

3. Methodology.

The techniques involved literature review to establish the successes and failures, the hip joint materials involved and their lubrication regimes were evaluated to establish the best candidate that is biocompatible in the event there is wear. PTC Creo simulation was used in the analysis of the hip joint loads and contact stresses to come up with a modified model that promises implant longevity.
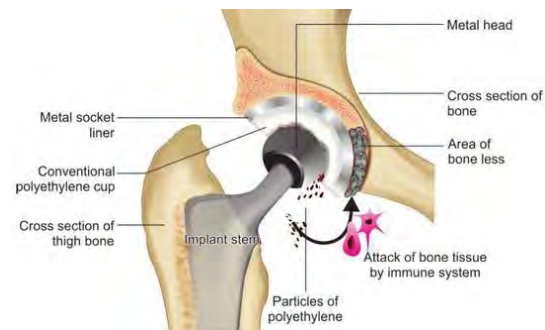
4. Key Outcomes

The computer models are still under evaluation however the early results show reduced stresses. Further knowledge about contact area size, stresses and wear would be available after analysis.

5. Further Work

The recommended design and selected material are to be incorporated into construction of the proto type bearing that will have to be rigorously tested.

6. Conclusions

It is quite promising the design can achieve low stresses, therefore coupling this development with the information gained in the literature review, the longevity of the hip implant is achievable.

Acknowledgements

I would like to express my gratitude to my supervisor, Dr. Steven Goh senior lecturer at the University of Southern Queensland for his guidance throughout my project. Most importantly, my wife deserves special mention for unwavering support and help without which this project may have been impossible. I would also like to acknowledge my colleague, Mr. Richard Sambamo for his encouragement throughout this project.

References

Hosseinzadeh, H. R. S., Eazi, A. & Shashi, A. S. (2012). *The Bearing Surfaces in Total Hip Arthroplasty Options Material Characteristics and Selection.pdf.*

Varshney, M. K. (2016). *Surgical and Functional Anatomy.*

ASSESSING THE IMPACTS OF LAND USE CHANGES ON ENVIRONMENTAL QUALITY IN TOOWOOMBA REGION USING REMOTE SENSING AND GIS

Sponsor – Kurdistan Regional Government (HCDP Program)

Choman Salih

Master of Engineering Science (Surveying)

Supervisors: Dr Kithsiri Perera,

Prof. Armando Apan

Keywords: GIS, Remote Sensing, Environmental Quality, Land Use Change

Figure 1 - Map of environmental quality in Toowoomba region

1. Introduction

Human's activities like population growth, economic situation prospects and agriculture are some of the factors that affect how land is used. These activities are both destructive as well as constructive in regard to modifications occurring on the land. Land use and Land cover maps (LULC) are generally the most important kind of maps in the study of temporal variations of an area. Accordingly, this study aims to assess the impacts of land use changes on environmental quality in the TRC area using remote sensing and Geographical Information System (GIS) technology.

2. Background

In South-East Queensland, approximately 60% of native vegetation has been cleared since 1975 which has resulted in an increase of pasture land by 50% (Le Brocque et al. 2003). However, long term land use/ land cover changes and its impacts on the environment is not reported in the literature. So, this study will address the temporal land use/land cover changes and their immediate impacts on the environment in Toowoomba region.

3. Methodology

In this study, Landsat images of Toowoomba region for the years 1994 and 2016 were used to produce land use/land cover, vegetation, surface wetness, and slope maps. These maps have been used in the assessment of land use changes. These maps were then used as an input in the GIS-Based Multi-Criteria Decision Analysis (MCDA) as reported by Store & Kangas 2001. A map of environmental 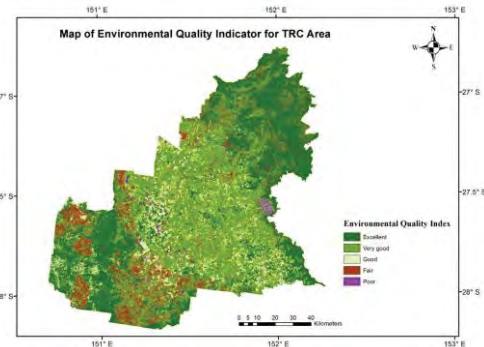quality classes was designed as a result of MCDA (figure 1). Erdas Imagine and ArcMap are the main software that have been used in this study.

4. Key Outcomes

The main findings are a significant increase in deforestation and the conversion of natural / grazing vegetation into agricultural land. Cropland areas have increased by 158% whereas irrigated agricultural lands have decreased by 77%. This has certainly affected the wetlands in the TRC area, and the maps have confirmed these findings. According to the produced maps, these changes have mainly occurred in the central part of the study area where the slope map shows lowest elevation and slope variations.

Conclusions

Being flat and arable, the central part of Toowoomba region has seen a significant increase in agricultural activities that has led to a remarkable vegetation clearing in the past 22 years.

Acknowledgements

References

Le Brocque, AF, Zammit, C and Reardon-Smith, K 2003, 'Richness, complexity & condition of remnants in the eastern Darling Downs, Queensland 'in Ecological Society of Australia Annual Conference 2003 (ESA 2003), 8-10 Dec 2003.

Store, R & Kangas, J 2001, Integrating spatial multi-criteria evaluation and expert knowledge for GIS-based habitat suitability modelling. Landscape and urban planning, vol 55, no. 2, pp. 79-93.

An assessment of dam construction effect on hydrological connectivity: A case study of Sardi River, Nepal.

Sponsor – School of Civil Engineering and Surveying

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Supervisor: Dr Md. Jahangir Alam, USQ

School of Civil Engineering and Surveying

Keywords: hydrological connectivity, floodplain, fish migration

1. Introduction

The construction of dams will cause a massive variation to the natural flow characteristics in the river as most of the water is diverted for consumptive uses and the downstream floodplain is inundated only with the riparian release most times of the year. The floodplain vegetation and the fish species in the river are the ones directly affected by these controlled flows.

2. Background

Study of hydrological connectivity is highly important at this stage as a large number of large and small scale hydropower projects are currently underway in Nepal and a necessity for sustainable development is one of the major challenges. This research examines the effects of dam on floodplain vegetation and fish species in the study basin.

3. Methodology

The research is carried out with the help of a simulated river model using HECRAS to examine the variation in pre-dam and post dam conditions. The significance of hydrological alterations to the existing vegetation type and important fish species is analysed.

4. Key Outcomes

A significant variation in hydrological parameters noticed from the simulation. Through identification of wetlands, a compensation flow for inundation was hypothesized and an economical analysis was carried
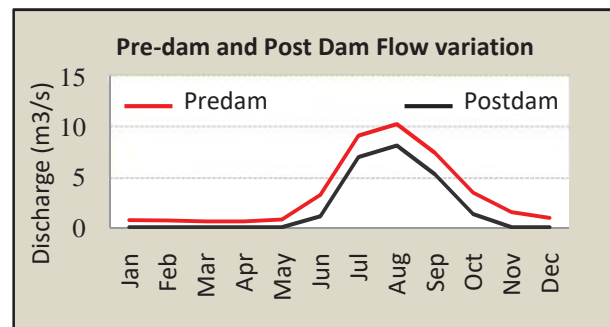

Figure 1 – Flow variation

out for maintaining such flow. The suitability of the changed hydrological parameters to important fish species in the study area was analysed. The figure above shows the variation in the flow before and after the dam based on which the simulation was carried out.

5. Further Work

Precisely evaluating the extent of damage requires detailed data of behaviour of vegetation or fish species and their location within the floodplain as their response to altered flows are different. Extensive laboratory tests are carried out for a target species of greater value.

6. Conclusions

Altered flow parameters were found out from the simulation. Reduction in floodplain cover was calculated and its damage to riverine system was studied. Certain important fish species were studied based on their response and endurance to changed flows. However, detail field based ecological study and data is essential to understand sensitivity and response of each species to flow alterations.

Acknowledgements

References

McCully, P. (1996). *Rivers no more: the environmental effects of dams*: Zed Books.

Anisfeld, S. C. (2011). *Water resources*: Island Press.

Adhesive wear and Frictional behaviour of metals against stainless steel counter face under dry contact conditions

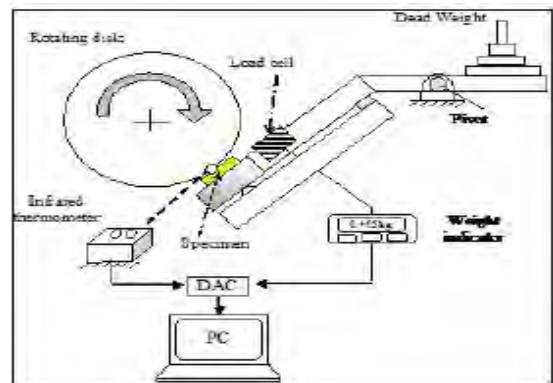**Aswin Therkayil Sathyan**

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USQ, Toowoomba

Figure1: Block on ring machine configuration

Keywords: Dry adhesive wear, wear mechanism, Metal sliding

1. Introduction

Nowadays, wear and friction are the major concerns in the field of industry and machine parts and are related to the life of machines. This project focusses on the adhesive wear and frictional behaviour of metals against stainless steel counter face under dry contact conditions. The experiment will be done under various parameters and the surface morphology of the worn metals will ne examined

2. Background

. It is extremely important to know how metals behave under different operating parameters. This project helps to identify the operating parameters which influence the wear and friction behaviour of different metals. By identifying these, knowledge about metal behaviour under sliding conditions can be enhanced and can decide on type of metals that can be used for specific purposes.

3. Methodology

Experiments will be conducted for different metals under different operating loads, speed and time under dry state condition Block on ring apparatus will be used for the experiment. The surface morphology of the worn metals will be analysed using scanning electron microscope. The amount of wear in each operating condition is noted. Graphs and diagrams will be plotted for different metals and counter faces at different operation parameters.

4. Key Outcomes

The mechanical properties of different metals such as mild steel, aluminium and copper are identified. The influence of counter face type on wear behaviour of the selected metals such as aluminium, stainless steel and mild steel are to be identified. Stress analysis and influence of temperature on specific wear rate and friction behaviour are also examined.

5. Further Work

More metals and counter faces will be included for the experiment if time allows. The influence of temperature on specific wear rate and friction behaviour are to be examined More research has to be done on other type of materials in order to make a general conclusion.

6. Conclusions

The specific wear rate and frictional behaviour of different metals are studied and the worn surfaces before and after the test are examined. Operating parameters will have a significant influence in wear and frictional behaviour of metals.

Acknowledgements

References

1. Alotaibi, J., Yousif, B., & Yusaf, T. (2014). Wear behaviour and mechanism of different metals sliding against stainless steel counterface. *Journal of Engineering Triblology, Proceedings of institution of mechanical engineers Part J*, 5

Thinking beyond the Iron Triangle-: A new way of evaluating construction project performance

Sponsor – School of Civil Engineering and Surveying

Aldo Savian

Bachelor of Engineering (Honours) Civil

Supervisors: Dr Nateque Mahmood, USQ

Keywords: Time, Cost, Specification, Iron Triangle, Quality, Success, Performance.

1. Introduction

The ability to determine if a construction project has been successful is difficult as there are varying perspectives on the notion of success. In many situations, the way to verify if a project has achieved it goals is to use three simple core elements, being cost, time and specification. These three important aspects are known within the construction industry as the "Iron Triangle". However, the achievements of projects, especially large scale construction ventures, take into consideration so many other facets that it is certainly confusing to accept that the iron triangle provides a comprehensive and detailed explanation of the parameters of success.

2. Background

The expression "Iron Triangle" is used throughout many industries and commonly represents the link between three important performance aspects that make up a successful project; this being; time, cost and specification (Atkinson 1999). Therefore, the determination of a model that provides a distinctive expression of project success is definitely required, as shown below
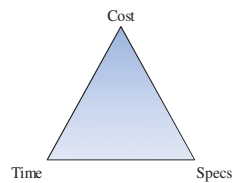
The Iron Triangle
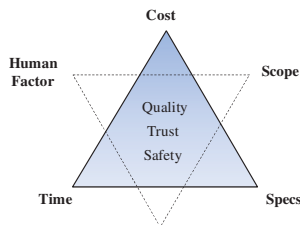
An Alternative Iron Triangle

3. Methodology

To achieve the research objectives for this study, a number of processes will be conducted. These methods will include; 1. Collecting data from various source open and closed sources for example, USQ Library databases e.g. Scopus, Compendux, etc., Google Scholar, Conference Proceedings, and interviewing approximately 10-15 Project Managers (representatives from Tier 1-3 level), who are working within the construction industry.

4. Key Outcomes

The key outcome of this research study is to determine if the concept of the "Iron Triangle" metaphor, depicting time, cost and specification, is an appropriate example in measuring the performance of a construction project being successful. This will lead into thinking beyond this notion and consider a new way of evaluating project success.

5. Further Work

It is envisaged that the developed "Iron Triangle" concept will be provided and thinking beyond this notions will be the main aim of the research project. Therefore, further work can be performed in the way of conducting further in-depth research surveys in an attempt to provide a broader aspect of the model and its effect on the performance of construction projects.

6. Conclusions

In conclusion of this project, a number of important aspects have been provided to stir-up the imagination and to think beyond the traditional methods of the "iron triangle, being time, cost and specification.

Acknowledgements

References

Atkinson, R 1999, Project management: cost, time and quality, two best guesses and a phenomenon, it is time to accept other success criteria, *International Journal of Project Management*, vol. 17, no. 6, pp. 337-42.

Investigation and Modelling of a Simple Peripheral Drag type VAWT utilising 120^0 internal angle blade sections

Sponsor – e.g. School of Civil Engineering and Surveying

Mr Kristan Sedgman
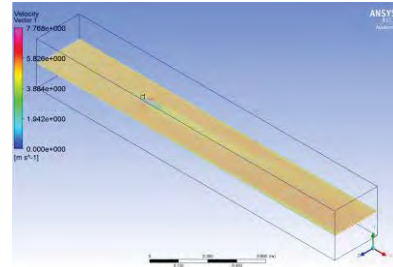
Bachelor of Engineering (Honours) (Mechanical)

Supervisors: Mr Andreas Helwig, USQ

Dr Ray Malpress, USQ

Figure 1: ANSYS Fluent simulation of a partial circular section in a wind tunnel.

Keywords: VAWT, Wind Tunnel, Modelling

1.Introduction

This project was initiated by an interest in assisting remote and rural communities provide themselves with renewable off-grid electricity. Vertical Axis Wind Turbines offer a simple solution to this need, with less complex design requirements, and numerical modelling can reduce development time. It would also allow assessment of a design before incurring construction costs.

My project involves numerical modelling of simple turbine blade shapes. Numerical models of the blades were generated through sequential angular steps. The results of these simulations were validated by wind tunnel testing of scale blade models. Any differences between the CFD model data and the wind tunnel test results were analysed to attempt to improve the CFD model.

CFD data for common sizes of PVC pipe could then be generated and incorporated into an optimising numerical design modelling package program.

1.   Background

One study regarding the link between access to electricity at home and the effect this can have on a child's study patterns(Daka & Ballet, 2011) highlighted the potential that these technologies have to change individual lives and whole communities. Simple turbine designs are required to make this possible for low income communities. This project investigates the optimising of material usage in blade construction, inspired by work (Zhou & Rempfer, 2013) indicating

that lift effects may be present on simple circular section blades.

2.   Methodology

The project used ANSYS fluent (fig.1), wind tunnel testing including microcontroller based measurements, design and 3D printing of test apparatus, and will use the MATLAB Simulink package for turbine modelling.

3.   Key Outcomes

One finding from the CFD results is that only minor lift effects are encountered by the 120^0, indicating that Zhou and Rempfer's results were not only attributable to the shape of individual blade sections.

4.   Further Work

Some wind tunnel testing still needs to take place to validate the initial numerical models, requiring more detailed numerical analytical techniques, particularly interaction between blade wakes. Also the Simulink programming is yet to be accomplished, it is hoped that an optimum angle for the blades can still be determined.

5.   Conclusions

This project shows that the correlation between CFD results and real performance of a turbine blade is affected by the quality of the CFD model.

Acknowledgements

References

Daka, K. R., & Ballet, J. (2011). Children's education and home electrification: A case study in northwestern Madagascar. *Energy Policy, 39*(5), 2866-2874. doi:http://dx.doi.org/10.1016/j.enpol.2011.02.060

HAWT versus VAWT: Small VAWTs find a clear niche. (2003). *Refocus, 4*(4), 44-46. doi:http://dx.doi.org/10.1016/S1471-0846(03)00433-5

Zhou, T., & Rempfer, D. (2013). Numerical study of detailed flow field and performance of Savonius wind turbines. *Renewable Energy, 51*, 373-381. doi:http://dx.doi.org/10.1016/j.renene.2012.09.046

Relationship and other Advanced Contracting Processes

Sponsor – School of Civil Engineering and Surveying

Ankit Senjalia

Master of Engineering Science (Structural)

Supervisors: A/Prof. David Thorpe,

Dr Nateque Mahmood

Keywords: Contracts, Project, relationship, modern.

1. Introduction

The project aim mainly investigates study of the relationship contracting process or other advanced contracting processes, contract selection, management of relationship and alliance contracts and benefits in using selected contract types.

2. Background

Relationship contracting and Early contractor Involvement type of contracts are now been practiced from the past few years. Based on the type of project, the contracting process is selected and the work is progressed. In the large volume project like infrastructure projects, Public private partnerships are used to initiate and complete the project (Davis & Love, 2011).
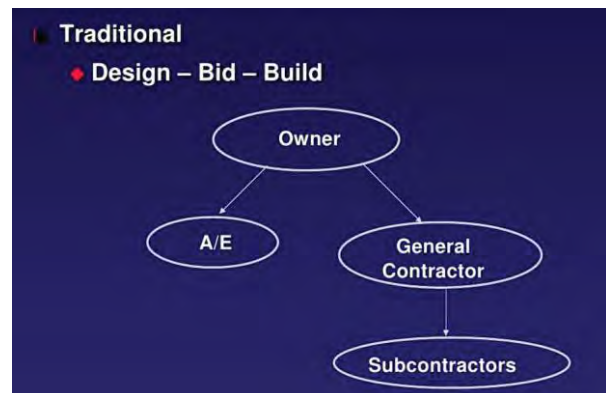
3. Methodology

Evaluate the drawbacks and benefits of the type on contracts that are frequently used by government organisation and private sector. Do a review on the findings of the present methods used for selecting a certain type of contract. For example: Traditional contracting process. (given figure)

4. Key Outcomes

Develop a comparison table between the types of advanced contracting processes adopted and their relationship in both private and government sectors.

5. Further Work

Investigate the background information on the recent completed infrastructure projects in locations in the Toowoomba region. Improve the comparison model by adding new points that can be useful under infrastructure projects or any other type of construction works.

6. Conclusions

Suggest a process that can be used to select specific type of advanced contracting process based on the required project of certain volume and expectations.

Acknowledgements

References

Davis, P., & Love, P. (2011). Alliance contracting: adding value through relationship development. *Engineering, Construction and Architectural Management, 18*(5), 444-461. doi:10.1108/09699981111165167

STATCOM's performance under abnormal network conditions

School of Mechanical and Electrical Engineering

Ronesh Shankar

Bachelor of Engineering

(Honours) (Power)
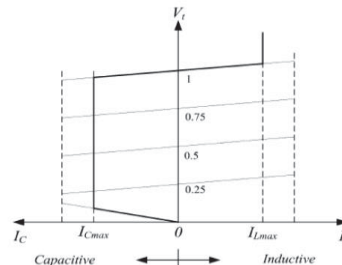
Supervisors: Assoc Prof Tony Ahfock, USQ

Figure 1 – Typical V-I Characteristics of STATCOM

Keywords: STATCOM, Performance, Simulink

1. Introduction

STATCOM is a reactive power compensator that is based on the use of IGBT's which can mimic reactors and capacitors electronically. STATCOM is part of the Flexible AC Transmission System (FACTS) devices that is used to facilitate the power control, enhance the power transfer capacity, decrease line losses and generation costs and improve the stability and security of the power system.

2. Background

STATCOM has been is use in the power system for nearly two decades but there is still active research done to understand its behaviour. Even though a lot of research has been conducted about STATCOM's behaviour under normal network conditions, a lot is still unknown about STATCOM's behaviour under abnormal network conditions.

3. Methodology

A phase STATCOM model was used from the Matlab Simulink library. This model was modified for four different simulation models: 1. STATCOM on an open loop without any faults; 2. STATCOM on an open loop with a fault; 3. STATCOM on a closed loop without any faults; 4. STATCOM on a closed loop with a fault. A phase to phase and phase to ground fault was introduced as part of the simulation. The STATCOM is connected to BUS 2 to control voltage deviation. The performance of the STATCOM was analysed with respect to the V-I characteristic of the modelled STATCOM as shown by figure 1.

4. Key Outcomes

The STATCOM successfully controlled the voltage on BUS 2 for any voltage drops along the network without any faults. When a fault is introduced, the STATCOM does react to bring the voltage to 1 per unit (pu) but is unsuccessful due to the capacitor size.

5. Further Work

Further calculations are required to determine if the STATCOM is working within its V-I characteristic when under fault conditions.

6. Conclusions

STATCOM's provides a simple solution to voltage deviations in an electrical network. It can absorb and generate reactive power with faster response time and has the ability to damp any large disturbances on the power system,

Acknowledgements

I would like to take this opportunity to thank my supervisor Assos Prof Tony Ahfock for his assistance and guidance. I would also like to thank my wife and kids for support and understanding.

References

Hingorani, NG & Laszlo Gyungi 2000, Understanding Facts Devices, IEEE Press.

Shahnia, F, Rajakaruna, S & Ghosh, A 2015, Static Compensators (STATCOMs) in Power Systems.

Masood, T, Aggarwal, RK, Qureshi, SA & Khan, RAJ 2010, 'STATCOM Model against SVC Control Model Performance Analyses Technique

An investigation on the influence of elevated temperature on the behavior of fibre composites

School of Mechanical and Electrical Engineering

Sukrant Sharma

Master of Engineering Science (Mechanical)

Supervisors: Dr Allan Manalo, USQ

Mr Ging Maranan, USQ

Figure 1 – Effect of elevated temperature on Flexural Strength of Specimens with different fibre orientations

Keywords: Fibre composites, Elevated temperature, GFRP

1. Introduction

The increasing use of fibre composite materials for structural and aerospace applications requires them to withstand exposure to harsh environmental conditions. One such environmental factor is the elevated temperature under in which the composite material is required to function. This project aims to investigate the effect of elevated temperature on the mechanical properties of fibre composite laminates.

2. Background

Fibre composite materials for engineering applications are routinely exposed to elevated temperatures and are required to retain their mechanical properties. However, the effect of elevated temperature on the flexural and inter-laminar shear properties of fibre composite laminates in the longitudinal and transverse directions have not been investigated yet. This is the research question that this study is trying to address.

3. Methodology

Glass fibre reinforced polymer (GFRP) laminates in two different fibre orientations (longitudinal and transverse) were subjected to flexural and shear loading at 7 different temperatures (RT ,40°C ,70°C ,100°C ,120°C,150°C,200°C). The specimens were tested for 4 different span-to-thickness ratios. The data gathered was analysed to establish the effect of elevated temperature, fibre orientation and span-to-thickne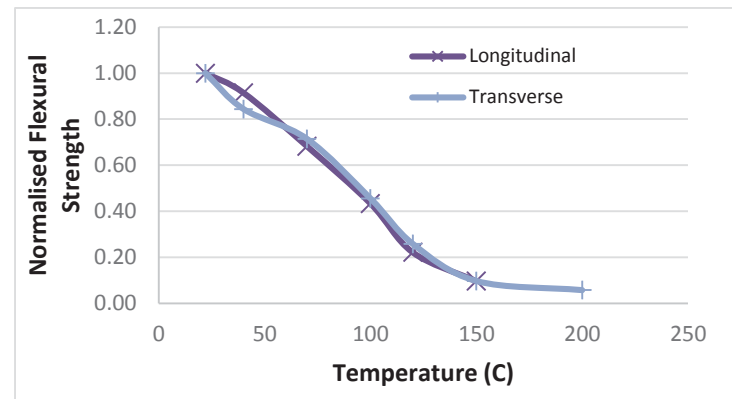ss ratio on the flexural strength and inter-laminar shear strength of the composite. The failed specimens were microscopically observed to identify failure modes.

4. Key Outcomes

It was found that there is a general decrease in flexural and inter-laminar shear strength with increasing temperatures. Elevated temperature affects the flexural strength of laminates in a similar fashion for both fibre orientations. (Fig. 1)

5. Further Work and Conclusion

An empirical equation will be developed to predict the behaviour of laminates under elevated temperatures.

Elevated temperature negatively affects the mechanical properties of composites. Longitudinal fibre orientation in composites gives better mechanical properties.

Acknowledgements

I would like to thank and acknowledge Dr. Allan Manalo and Ginghis Maranan for their support and guidance throughout the project. I would also like to acknowledge the CEEFC for allowing the use of their facilities for this project.

References

Maranan, G.B., Manalo, A.C., Karunasena, W., Benmokrane, B.,& Lutze, D.(2014). Flexural behaviour of glass fibre reinforced polymer bars subjected to elevated temperature.*In Proceedings of the 23rd Australasian Conference on the Mechanics of Structures and Materials,*187-192.

Bai, Y., Keller, T.,&Vallée, T.(2008). Modelling of stiffness of FRP composites under elevated and high temperatures. *Composites Science and Technology*, 68(15), 3099-3106.

Thermal Performance of a Roof-Integrated Solar Micro-Concentrating Collector

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Master of Engineering Science (Mechanical)

Supervisor: Dr Ruth Mossad, USQ

Keywords: Heat loss evaluation, CFD Analysis, Design optimisation.

1. Introduction

This project comprises of CFD analysis on a computational model of a commercially available MCT module for accurately quantifying its operational heat losses. A well-founded understanding of the mechanisms of heat losses will help us form the basis of minimising the losses, eventually leading us to an optimised design of the MCT system. The analysis is done using the software package, ANSYS.

2. Background

There is an increased interest in employing Solar Micro-concentrating collectors(MCT) for medium scale applications such as hot water and air-conditioning for domestic, commercial and institutional buildings. But a comprehensive research on how to achieve their best possible thermal performance by cutting down thermal losses has not been carried out yet. The aim of the project is to investigate and validate the ways to achieve an improved thermal performance and optimised design of a Micro-concentrating collector.

3. Methodology

1) Developed a computational model of MCT consisting of Fresnel reflectors, absorber tubes, secondary reflector, glazed canopy and attachments using ANSYS software.

2) Using ANSYS FLUENT the airflow and heat transfer inside the cavity were simulated.

3) Evaluation of convective and radiative heat losses from the absorber tubes and the cavity and obtain the flow velocities and temperature distribution patterns.

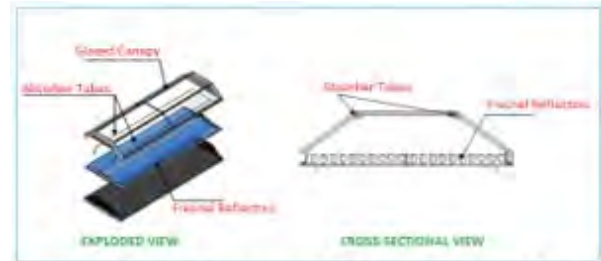4) Estimating the thermal efficiency and optimum operating parameters for the solar collector.

Fig.1: Configuration of the MCT Module (Sultana et al., 2012)

4. Key Outcomes

An accurate 3D modelling of the MCT module and the meshing of the cavity has been carried out. The boundary conditions describing the operating parameters of the MCT module have been identified. These 2 stages precede the simulation and analysis phases of the project where the temperature distribution patterns and flow visualisation have to be obtained.

5. Further Work

The simulation phase of the project is ongoing and is expected to produce the initial results of temperature distribution and flow velocities at different regions inside the cavity of the MCT. Heat losses from individual components have to be determined which will further our knowledge in design optimisation of the MCT. Modified computational models have to be analysed to ensure consistency in the results.

6. Conclusions

Evaluation of heat losses from individual components of the MCT is a major step towards achieving improved thermal performance and optimised design. An accurate computational modelling and CFD analysis is essential in these processes.

Acknowledgements

References

Sultana, T., Morrison, G. L., & Rosengarten, G. (2012). Thermal performance of a novel rooftop solar micro-concentrating collector. Solar Energy, 86(7), 1992. doi:10.1016/j.solener.2012.04.002.

Kalogirou, S. A. (2004). Solar thermal collectors and applications. Progress in Energy and Combustion Science, 30(3), 231-295. doi:10.1016/j.pecs.2004.02.001

A Comparison of the accuracy of RTK GNSS derived Topographic data verses Photogrammetric derived Topographic data collected from Unmanned Aerial System (UAS)

Sponsor – School of Civil Engineering and Surveying

Figure 1.
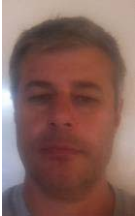
Student Name: Chris Sharp

Bachelor of Spatial Science (Surveying)

Supervisors: Dr. Dev Raj Paudyal

Keywords: UAS, RTK, GPS

1. Introduction

Surveyors have been completing topographic GNSS surveys for many years. During this time there have been vast technological improvement resulting in changes to both the methods and processes used to gather this data, while also resulting in substantial improved accuracy. The objective of this research project is to obtain quantative data to compare the accuracy of topographic measurements derived from traditional RTK GNSS surveying techniques and compare those to topographic measurements derived from photogrammetric techniques collected via a UAS.

2. Background

Advances in RTK GNSS and UAS technologies have given rise to spatial scientists being able to take measurements on a large scale in a much shorter time frame. In addition to this it has opened up more opportunities to the profession with surveyors being able to obtain data in areas which would have been nearly impossible to access as well as the economic benefits.

3. Methodology

The initial topic arose through experience with several existing and prospective clients making enquiries about the measurements of their properties. When asked about the possibilities of UAV surveying I found that the accuracies stated by many manufacturers were somewhat ambiguous.

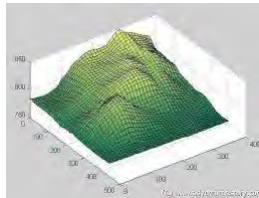I will be measuring two different landscapes with land based RTK GNSS techniques and

UAS's to gather data to produce a Digital Elevation Model (DEM). A DEM can be represented as a raster (a grid of squares, also known as a height map when representing elevation) or as a vector-based triangular irregular network (TIN).

4. Key Outcomes

The project is designed to provide information on the use of UAV photogrammetry for Land measurement to required accuracies. Comparison to GNSS measurement to demonstrate that UAS derived photogrammetry is a viable alternative. Confirmation that accurate vertical measurements can be achieved from a remote source other than being on the ground. The initiation of this technology offers benefits in reducing cost and increasing land value while being non-intrusive in relation to crop and stock.

5. Further Work

More work needs to be completed on tables and presentation of the dissertation.

6. Conclusions

My aim is to have readers be informed of the feasibility and limitations of the study. Due to UAS availability the data analysis is not quite completed.

Acknowledgements

I would like to thank my supervisor Dr. Dev Raj Paudyal who has been very helpful on the analytical aspects of this project. I would also like to thank my colleague Remy Dehaan who supplied the UAS and software.

References

Gibbings, P., & Zahl, M. (2014, in press). When to consider RTK GNSS for a Cadastral Survey. *Spatial Science Queensland, Winter* (July)

I. Balenovic, H. Marjanovic, D. Vuletic, etc. Quality assessment of high density digital surface model over different land cover classes. PERIODICUM BIOLOGORUM. VOL. 117, No 4, 459–470, 2015.

Janssen, V., & Haasdyk, J. (2011). *Assessment of Network RTK Performance using CORSnet-NSW* Paper presented at the International Global Navigation Satellite Systems Society (IGNSS) Symposium 2011, University of New South Wales, Sydney, NSW, Australia

Stabilisation of Black Cotton Soil using Lime, Sodium Silicate and Fly Ash

School of Civil Engineering and Surveying

Jack Sharpe

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Andreas Nataatmadja, USQ

Keywords: Black Cotton Soil, Stabilisation, Pavement Engineering

1. Introduction

The overall aim of this particular project is to determine whether the use of stabilisation agents such as sodium silicate, fly ash and lime will in fact improve the poor soil characteristics of black cotton soils. Therefore the relevant technical information must be provided from this investigation to determine the feasibility of each option. The following objectives has been identified:

- Determine CBR values of existing material with and without the addition of stabilising agents.
- Determine the effect on compaction that the stabilising agents may have.
- Collate data and compare the results of each option to determine the most viable and effective solution.
- Identify the effectiveness and usefulness to industry.

2.Background

The properties of black cotton soils render them nigh on useless as a foundation for engineering projects, in particular pavements. Their high clay content causes an increase in the liquid limit and plasticity of the soils, which causes them to swell and shrink.

The use of sodium silicate as a stabilisation agent can increase CBR values in some cases increasing up to sixteen times that of the original material.

Fly ash is commonly used throughout the world to stabilise material and it is also a relatively easy material to work with, with four main factors that have to be taken into consideration, these being the soil properties, delay time, moisture content at the time of compaction and the addition ratios.

Lime is the most widely used stabilisation agent in the world. It is simple to make, and has proven results in greatly improving the characteristics of subgrade materials.

3. Methodology

All soil testing will be done according to test methods Q102B: Subsidiary Moisture Content of Soil – Microwave Oven Drying, Q104A: Liquid Limit of Soil, Q105: Plastic Limit and Plasticity Index of Soil. From here the initial CBR value, CBR swell and linear shrinkage of the soil will be determine in accordance of Q106: Linear Shrinkage of Soil, Q113: California Bearing Ratio of Soil – Standard. Literature shows the 3-5 percent lime is required for heavy clays, and four percent of fly ash is required. Sodium silicate percentage will be varied.

4. Key Outcomes

OMC and gradings of heavy clay have been identified. OMC and density of stabilised samples determined using Q142A. This shows an improvement in strength with stabilisation.

5. Further Work

CBR testing to be finalised after samples finish soaking.

6. Conclusions

Initial testing conducted on black cotton soils highlight the unsuitability of the material as use for a subgrade in pavement construction. Stabilisation shows vast improvements in strength, plasticity and swell of the material, however pavements could still possibly expect a smaller life cycle.

Acknowledgements

References

Little, 2009, *Recommended Practice for Stabilisation of Subgrade Soils and Base Materials,* viewed 10th July 2016,from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w144.pdf

Mehta 2014, Analysis of Engineering Properties of Black Cotton Soil &

Stabilization Using By Lime. *Journal of Engineering Research and Applications,* 4**,** 25-32.

Fabrication and property characterization of silkworm silk reinforced epoxy composites

Sponsor - School of Mechanical and Electrical Engineering

Ali Shehab

Bachelor of Engineering
(Honours) (Mechanical)

Supervisor: Dr Mainul Islam, USQ

Keywords: Silkworm silk, Epoxy, Fabrication, Strength

Figure 1 – Tensile test

1. Introduction

Nowadays, everyone has a sufficient knowledge about problem of global warming and its effect on the climate, such as the Atlantic hurricanes in 2005 (Aalst 2006). That's why engineers should try to limit the reasons of global warming. One of these ways is to employ more environmental friendly technologies. Manufacturers are using synthetic fibres because of their high specific modulus and strength. Natural fibres have started to attract a great deal of attention looking at their specific properties and abundance to reduce the emission of greenhouse gases (Faruk et. al 2014). This project is to study the strength of the silkworm silk epoxy fibre composite.

2. Background

This project is important because it searches for the strength of the composite, which will help in replacing many synthetic fibres that share the same strength. This will also help manufacturing companies, as the natural fibres are cheaper and more sustainable, even from the environmental view-point using natural fibres is better than the synthetic fibres as they are naturally produced.

3. Methodology

In this project silkworm silk epoxy composite is fabricated and tested to see what is the best formation to give higher strength. The tests that are conducted on the composites are tensile (fig 1) and flexural tests. The ratios between silk and epoxy would be 1:4 1:3 and 2:5.

4. Key Outcome

Doing these tests we would know the best ratio to give the highest strength. In testing these different combinations; a relation between the ratio and the strength of the composite will appear; this relation will help the manufacturer to produce the material in the strength that they need. Knowing the strength will led to knowing where a similar synthetic composite are being used and replace them with more environmentally composites

5. Further Work

In this experiment only 5 to 7 samples were tested, increasing the number of sample would increase the accuracy of the result. This project is done on three different ratios that give a reasonable idea on the strength; more ratios could be tested to find if there is a better ratio to give a more accurate strength; Keeping in mind that in changing the silk or the epoxy could give different results.

6. Conclusions

One of the key conclusions would be finding the best ratio to give the highest strength. Then we can change a synthetic fibre with a natural one.

Acknowledgements

I would like to thank my supervisor Dr Mainul Islam and all the staff that helped me in completing this project that will add to the contraption of this university in the materials study in Queensland.

References

Aalst, MKV 2006,'The impacts of climate change on the risk of natural disasters', Disasters, vol. 30, pp. 5-18.

Faruk, O, Bledzki, AK, Fink, HP, Sain, M 2014,'Progress Report on Natural Fiber Reinforced Composites', Macromol. Mater. Eng, vol. 299, pp. 9–26.

3D Cell Position Extraction from Electron Tomography Images

Sponsor – School of Mechanical and Electrical Engineering
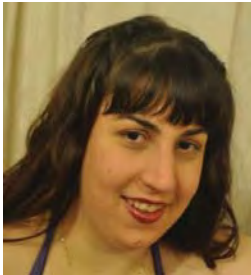
Anita Shephard

Bachelor of Engineering (Honours) Electrical and Electronics)
Bachelor of Science

Supervisor: Dr John Leis, USQ

Keywords: Electron Tomography, Autocorrelation, SNR

1. Introduction

Electron tomography is a medical imaging technique when multiple electron micrographs of a biological sample from different angles and taking the 2D images to make a 3D model of the sample. This project investigates several template matching algorithms to test their effectiveness in detecting virus cells in an electron tomogram.

2. Background

The current methods used in industry to analyse medical images are labour intensive and very time consuming. Methods used to find macromolecular structures in 3D are error-prone. Current methods used for processing images are done by hand and can take days to process. Computers are now able to render objects in 3D relatively quickly. This makes pattern recognition algorithms in 2D and 3D possible and allows these algorithms to be applied to electron tomograms.

3. Methodology

A model of the target object is created which forms the template. The template is cross-correlated with the electron tomogram and the areas where the cross correlation coefficients are high indicates that the area is possibly the target object. Once the template has been generated the temple needs to rotated around the three spatial axes (Euler angles) so the target object can be found in all possible orientations. If the angular spacing of the rotation is too large the target object may not be found because the object is smaller than the wedge created from the rotation angle. The maxima obtained by using cross-correlation functions in Fourier space give approximate location and orientation of the target object. Increasing the resolution of the electron tomogram by 2 nm would improve the quality of the image to the point where medium sized virus complexes could be differentiated.

4. Key Outcomes

Different templates were used to determine if the run-time could be decreased with 3D shape matching. The orientation-invariance is necessary because the orientation of the target object is unknown. Scale-invariance is desired because the scale of the images may vary.

5. Further Work

Correlation methods will be used to develop methods and algorithms to lower the noise and improve the signal to noise ratio. Boundary localization using adaptive shape and texture discovery algorithm will be used to detect the boundary of the cell membrane. The Bilateral Edge Detection Algorithm is used to supress noise by acting like a band stop filter that filters out the unwanted noisy frequencies. This algorithm is suitable for images with a low signal to noise ratio because it can enhance edge detection by extracting the desired features.

6. Conclusions

The algorithms tested were able to detect some of the target images with varying levels of noise. Using correlation of the signals some noise in the images was able to be removed and the SNR increased.

Acknowledgements

References

Frangakis, AS & Forster, F 2004, 'Computational exploration of structural information from cryo-electron tomograms', *Curr Opin Struct Biol*, vol. 14, no. 3, pp. 325-331,

Hrabe, T, Chen, Y, Pfeffer, S, Cuellar, LK, Mangold, AV & Forster, F 2012, 'PyTom: a python-based toolbox for localization of macromolecules in cryo-electron tomograms and subtomogram analysis', *J Struct Biol*, vol. 178, no. 2, pp. 177-188

Leis, AP, Beck, M, Gruska, M, Best, C, Hegerl, R, Baumeister, W & Leis, JW 2006, 'Cryo-electron tomography of biological specimens', *IEEE Signal Processing Magazine*, vol. 23, no. 3, pp. 95-103,

Home Based Solar Powered Generation, Storage and Localised Grids

Sponsor – School of Mechanical and Electrical Engineering

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Bachelor of Engineering (Honours)
Bachelor of Science

Supervisor: Assoc Prof Paul Wen, USQ

Keywords: Solar power, batteries

1. Introduction

The aim of the project is to design an optimal solar powered battery storage system for an average house in the Toowoomba region, QLD. There are multiple reasons a consumer would invest in a solar powered battery storage system such as to reduce energy costs, provide back up during a power outage and going off grid for environmental purposes (Ergon Energy, 2016). Going off grid will be the primary aim and the calculations and analysis will be based around this premise in this project.

2. Background

Home energy storage solutions consist of a solar panel that converts solar energy into DC electricity through the use of the photoelectric effect. The DC electricity is then converted into AC through an inverter which is used to power home appliances. Any excess DC electricity is used to charge the battery and once the battery is fully charged the excess electricity is then supplied to the electrical grid. The project is intended to provide an optimal solution for an average house in the Toowoomba region.

3. Methodology

The research was undertaken by initially determining the energy usage of an Ergon Energy customer and analysing the data in MATLAB. From the data, batteries and solar panels that met the requirements for the particular house were determined. An economic analysis will be undertaken to determine the most cost effective configuration.

4. Key Outcomes

Key outcomes that have been achieved are determining the energy usage of an Ergon Energy customer, the power of solar panels and the capacity of batteries. Further outcomes that will be determined are the most cost effective configuration for each of three typical houses (small, medium and large). A further intended outcome will be to develop a method of determining the optimal systems for consumers in different areas.
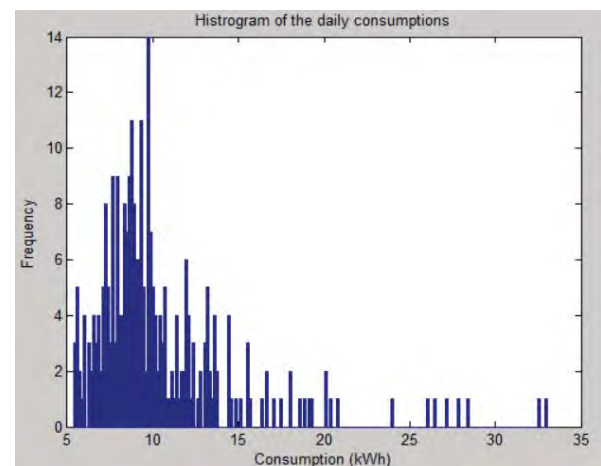

Figure 1: Histogram of daily consumption

5. Further Work

The remaining work that needs to be done is the modelling and economic analysis to determine the most cost effective energy storage configurations for three typical houses.

6. Conclusions

The key conclusions of the research will be a method of determining the optimal and economical solar powered battery storage system configurations for various houses.

Acknowledgements

References

Cupertino, A. F. et al. A (2012). A Grid Connected Photovoltaic System with a Maximum Power Point Tracker using Passivity Based Control applied in a Boost Converter.

Hao, Q, Jianhui, Z, Jih-Sheng, L & Wensong, Y 2011, 'A high-efficiency grid-tie battery energy storage system', *Power Electronics, IEEE Transactions on*, vol. 26, no. 3, pp. 886-896,

Study of effects of coarse grain contents on Atterberg's limits and expansiveness of the clays

Sponsor – School of Civil Engineering and Surveying

Suman Shrestha

Bachelor of Engineering (Civil)

Supervisor: Dr Buddhi Wahalathantri

Keywords: Expansive soil, Atterberg's limit, Swelling potential & pressure

1. Introduction

Expansive soil is the one that experiences significant volume change associated with changes in water contents. Volume change is an important variable usually considered in the design and construction of building foundations, pavement (roads), embankments and retaining structures. The main aim of the research is to experimentally investigate engineering properties of an expansive soil (Kaolin) with and without addition of a non-expansive coarse material following the consolidation phase.

2. Background

Due to expansive soil, the distressed infrastructure problems have resulted in billions of dollars of repair costs annually (Nelson and Miller, 1992). Therefore geotechnical researchers have developed many measures to reduce the expansiveness of soils such as treatment of expansive soil with a wide variety of additives. The current study seeks to improve expansive properties of soil by addition of coarse non-expansive soil (sand).

3. Methodology

A total of four properties namely, liquid limit, plastic limit, swelling potential and swelling pressure are investigated with and without addition of different percentages of sand. The cone penetration method is used to determine the liquid limit and expansive characteristics (swelling potential and pressure) are determined using the Oedometer test. A modified swell test using the Oedometer is performed to investigate different swelling characteristics. The soil specimen is first moderately compacted and then consolidated at 1000kPa under partially saturated condition. The sample is then unloaded to a seating pressure of 7kPa to measure

Figure 1. One dimensional Oedometer

the natural swell that may result due to the unloading cycle. Under 7kPa pressure, sample is then saturated to measure the expansiveness that may cause due to wetting.

4. Key Outcomes

Current results indicate significant reduction in swelling potential of clay when mixed with 50% of sand. Also, a significant reduction in Atterberg's limit is evident with addition of coarse material.

5. Further Work

Repeat testings and analysis of expansive characteristics with other percentages of sand mixtures.

6. Conclusions

Current results indicate that addition of non-expansive coarse material reduces both swelling potential and swelling pressure as well as Atterberg's limits which is consistent with the literature findings.

Acknowledgements

References

Jones, L. D., & Jefferson, I. (n.d.). Expansive Soils, Institution of Civil Engineers Manual Series

Nelson, J. D., & Miller, D. J. (1992). *Expansive Soils: Problems and Practice in Foundation and Pavement Engineering.* New York, NY: John Wiley & Sons, Inc.

To design a manually operated pole lifter to erect fire-meshes in the case of an emergency, which can be operated by one or two individuals without the aid of heavy machinery.

Charan Deep Singh
Master of Engineering Science (Mechanical)

Supervisor: Dr Ahmad Sharifian, USQ`

Keywords: Bushfires, pole erection, fire-screens,

Introduction

A firebrand shower plays the leading role in spreading a wildfire, and previous research has shown that wire meshes can act as a protective barrier against a wildfire attack on a shelter or a household. It, therefore, makes it necessary to erect poles that can support these screens in fierce weather conditions. Conventionally, the erection of such poles is done with the help of heavy machinery which cannot be readily made available on site in case of a fire. This project deals with the design of a pole erection system that is quick and reliable to operate in a state of emergency, and requires a minimum number of humans.

Background

The average annual toll in Australia for the aggregate numbers of buildings destroyed by bushfires since 1926 is 84 buildings per year(McAneney, Chen & Pitman 2009). Active defence methods to contain the fire include spraying water and chemicals from the ground or from the air. However flying embers can be barred from striking houses if a suitable screen is placed at an appropriate distance from the house. Erecting such screens on a short notice can be quite a challenge. An effort will be made here to meet these requirements and provide a defensive measure against the deadly wildfires that are caused by both natural and manmade reasons.

Methodology

Existing mechanical, electrical and manual methods of pole lifting will be explored and a feasible method of operation that utilises minimum human effort and is quick and reliable to operate will be finalised. Analyses will be performed on the effect of high temperatures and strong wind force on the structural and operational stability of the pole and pole lifter. The vulnerabilities of the proposed system to a firebrand shower will also be assessed. The design will be simulated with the help of ANSYS Mechanical and ANSYS Fluent.

Expected Outcomes

A comprehensive design that would help to erect fire screens around a household and mitigate the effect of flying embers.

References

McAneney, J, Chen, K & Pitman, A 2009, '100-years of Australian bushfire property losses: Is the risk significant and is it increasing?', *Journal of Environmental Management*, vol. 90, no. 8, pp. 2819-22.

"Increase the Tractor performance"

Sponsor – R Jeff Esdaile, Agricultural Consultant

Jasbir Singh

Master of Engineering Science (Agricultural)

Supervisors: Assoc. Prof Guangnan Chen, USQ School of Civil Engineering and Surveying
Keywords: Improvement of performance of two wheeler Tractor.

1. Introduction

With ever increasing costs involved in agricultural production, a two wheeler tractor seed drill has been developed for use by small holder farmers in developing countries or undeveloped countries. It has been tested or observed in the field, and it is at present fitted with simple tyne and disc openers as the method for seed placement. However, a two-wheel tractor operating a 2 row seed drill under conservation agriculture (CA) conditions often has extreme difficulty in pulling the implement through the soil. This could be due to several factors, possibly including insufficient tire weight of the combination, or incorrect tire size or configuration etc.

2. Background

A background research and review of literatures are studied to past research on two wheeler tractor. There is not much research is done on two wheeler tractor. Research shows that the power of 2WD Tractor is 1.6 times less than 4WD tractor. A research was also conducted on performance of 2WD tractor on different type of soils and conditions.

3. Methodology

A two wheeler tractor is designed which was placed at P9 laboratory of NCEA at University of Southern Queensland, Toowoomba (Australia). For this project, I used and analysis following methods to enhance the pulling power and traction of tractor.

1. Alternative wheel and tire arrangements

I have used alternative wheel and tire arrangements to increase the pulling power of traction by increasing traction.

2. Different Weight combinations

Traction is also directly proportional to weight of tractor. The different weight combinations of weights have been used to improve the pulling power of tractor. HP-K Series Force gauge has been used to measure the draft or pull of the tractor.

2. Key Outcomes

A two wheeler tractor has developed with seed drill, as well as a pair of single disc and double disc openers which have desirable drawbar pull. During the data analysis and observations, the effect on traction by modification in tractor design was also examined.

3. Further Work

A slip of wheels was neglected during experiments due to lack of time and equipment. A better data and traction would be achieved with proper instruments and sufficient time by considering slip.

4. Conclusions

The Traction of two wheeler tractor is increased with 50 kg weight at front and 12×12-inch wheel size. The drawbar power is increased by 20% on low gear.

7. Acknowledgements

I would like to thank my sponsor Dr. R J Esdaile and Prof. Guangnan Chen who helped me on each and every state with their great knowledge. They provide me necessary facilities and guidance in carrying out design and experiments. I would also thankful to Farmer Garry at Pittsworth, Australia for providing some equipment and land to perform experiments.

8. References

Clark RL. Tractor performance in two and four-wheel drive. Trans Am Soc Agri Eng 1984:8–11.

Alvi SAA, Pandya AC. Testing of walking tractor. The Harvester, Indian Institute of Technology, Kharagpur, (W.B.) India 1968;10(1):59.

Narang Suresh and Varshney A.C 1995, Evaluation oF a 6.71 kW power tiller for draft and drawbar power on tar roads, Viewed by 11 October 2015, < http://www.sciencedirect.com/science/article/pii /0022489895000089>

P. Biondia, F. Marazitib 1998, Drawbar Pull Performance of Tractors Based on Italian Type-approval HP-K series force gauge, viewed by 15 September 2015,<http://hilary8689.sell.curiousexpeditions.org/pz5 b7d458-hp-k-series-force-gauge.html>

Quality Assurance in Rail Track Resurfacing using a GPS System

Patrick Sinnott

Bachelor of Engineering (Honours) (Mechatronics)

Supervisor: Dr John Billingsley

Keywords: GPS, Rail, Quality Assurance.

1. Introduction

This project is a research into the process of rail track resurfacing and the possibility of implementing some improvements. The main area of focus is the resurfacing of curved track and the identification of curve features such as the start, transition and main curve. A GPS receiver is proposed to help with the location of the features. The research starts with some background knowledge on rail curves and their interaction with rail traffic. This is followed with some knowledge of GPS systems and how they work and can be adapted for this purpose

2 Backgrounds

The exact point where a rail curve starts is an important starting point for the maintenance of a curve. This information is often missing in some rural areas. The main focus of this research is to devise a simple method of helping the operator with this problem. The trajectory of the repaired curve will also be plotted and compared with the original design specifications to give a rating of the success of the repair work.

3. Methodology

The methodology employed in this project was

- Get a full understanding of curve geometry and GPS systems.
- Select some methods of tracking a trajectory and compare results and accuracy
- Run some on track trials
- Create a software package to match the results and provide reports
- Liaise with Queensland Rail personnel for feedback on the effeteness of the outcome

5. Further Work

The next generation of collision avoidance equipment on QR track machines will have advanced tracking ability. This can be adopted to intergrade with the software developed here. The possibility of integrating other stand-alone GPS devices such as the speedometer, driver vigilance system, and train control radio, into one system can be further researched.

6. Conclusion

A GPS system can be developed to allow the operator to identify the exact location of the machine and therefor produce a reliable and accurate track repair. The results of the repair can be plotted and compared with the design specifications, allowing the accuracy of the process to be identified.

Acknowledgement

References

Queensland Rail (2014) *Civil Engineering Track Standard* (Version 3.2)

Elion, N., Kaliabetsog, G. (2014) '*A new simple and accurate transition curve for use in road and railway alignment design*', European Transport Research Review

Global Positioning Directorate Systems Engineering and Integration (2013), *Interface Specification IS-GPS-705D: Navstar GPS Space Segment/User segment L5 Interface,* US Department of Defence

Management of Engineering Assets

Sponsor –School of Mechanical and Electrical Engineering

Student Name: Manpreet Singh Sivia

Master of engineering Sciences (Electrical and Electronics)

Supervisors: Dr David Thrope (Staff
Member), USQ

Mr.Mark Phythian(Staff
member), USQ

Keywords: Technological assets, Dwindling,
Quantative

1. Introduction

This project is related to the management of the
technological assets in a particular industry of the
Australia. This includes the identification of the
technological assets used in that industry and developing
effective management technique which will help in
proper utilization of the assets.

2. Background

This project is important because assets management is
essential to have long term benefits from assets. This
project will refine the existing techniques used in the
management of technological assets by providing
suitable conclusion.

3. Methodology

The methodology for this project is largely based on
the approaches used by the previous researchers. The
key method is action research which consists of the
identification of the assets and obtaining technical data
related to them. The research includes qualitative case
study approach for collecting primary and secondary
data.

4. Key Outcomes

The methodology mentioned above in the project will
focus on the assets which need to be improved for the
successful completion of the project.

5. Further Work

I had just finished the literature review of my project and
just working on the other specifications of the project
which are required for the successful completion of my
project.

6. Conclusions

The conclusions of my project will depend on my future
research related to the project. I am still working on my
project. So, it is very difficult to predict conclusion of
the project.

Acknowledgements

I would like to thankful to my supervisors Dr. David
and Mr Mark who are guiding me in this project. They
are quite helpful and providing me every kind of
support which are required in this project.

References

Bolton, R. N., Lemon,K.N, & Verhoef ,P.C(2004). The
theoretical underpinnings of the customer asset
management: A framework and propositions for
future research. *Journal of the Academy of
Marketing Science,*32(3),271-292.

Berger,P.D., Bolton,R,N., Bowman, D.,Briggs,E.,
Kumar, V.,Parasuraman,A.,& Terry ,C.(2002).
Marketing Actions and the value of the customer
Assets a Framework for customer Asset
Management. *Journal of Service Research* ,5(1), 39-
54.

Datta,N. , Elliot,A.J., Perkins,M.L., & Deeth,
H.C.(2002). Ultra-high-temperature(UHT)
treatment of milk:comparison of direct and indirect
modes of heatin. *Australian Journal of Diary
Technology*, 57(3), 211

Towards two-dimensional infiltration measurement in complex and variable soil environments

Sponsor – National Centre for Engineering in Agriculture

Ned Skehan

Bachelor of (Honours) (Agricultural)

Dr John Bennett, USQ

Keywords: Infiltration, soil, variability.

1. Introduction

The measurement of the infiltration rate in soil science has traditionally been a reasonable, but qualitative assessment of the physical characteristics of the soil. Monitoring how the infiltration rate changes over time gives insight into how the physical characteristics such as soil structure, changes. Quantifying this change is useful when assessing how mine site rehabilitation soils settle in the years following the burial of mining waste rock.

2. Background

The actual technique for measuring the infiltration rate is traditionally done as a point measurement, which is statistically unreliable for an average reading when the environment has a high level of variability within its physical characteristics. It is proposed that Electrical Resistivity Tomography (ERT) has the capability to quantify the infiltration variability that exists in complex soil environments which contains features including mining waste rock, textural variations, and structural anomalies such as varying degrees of compaction.

3. Methodology

The experimental design has the ERT probes at 25cm spacings under a slow drip irrigation event on a sandy soil to avoid a ponded head. The irrigation occurs underneath an enclosed structure to negate the effects of evaporation and transpiration as a pathway to water loss. It is hypothesised that the development of a successful measurement method would open up future research opportunities in the adaption of this technique to current hydrological models such as Hydrus to provide more accurate variability inputs so that the hydrology of locally variable soil environments may be better understood.

4. Key Outcomes

There are two stages of key outcomes within this project, the development of the measurement protocol that enables a time lapse measurement to occur with the appropriate corrections, and the validation of the developed protocol using an anthropogenic soil profile with infiltration obstacles at recorded locations. The pseudo section of the developed protocol of the ERT machine is graphically displayed in figure 1.
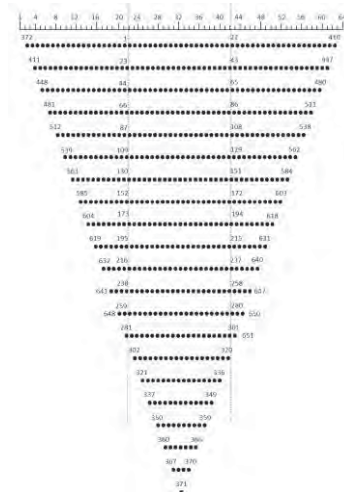

Figure 1 – Pseudo section of ERT protocol

5. Further Work

The experimental validation of the developed protocols is currently underway, and after analysis of preliminary data sets, it is looking to be a viable option for quantifying infiltration variability. There is more work to be done in identifying the limitations and additional applications of this technology in the field of soil science.

6. Conclusions

It can be concluded that ERT technology has viable applications in the area of soil science research, one of which is potentially capturing 2D variability of the soil physical characteristics.

Acknowledgements

References

French, H., & Binley, A. (2004). Snowmelt infiltration: monitoring temporal and spatial variability using time-lapse electrical resistivity. *Journal of Hydrology, 297*(1–4), 174-186.

Herman, R. (2001). An Introduction to Electrical Resistivity in Geophysics. *American Journal of Physics, 69*(9), 943 – 952.

Identifying best practice pavement design for an unsealed road network to achieve sustainability improvements

School of Civil Engineering and Surveying

Benjamin Smith

Bachelor of Engineering (Civil)

Supervisor: Assoc. Prof. David Thorpe

Keywords: granular stabilisation, unsealed pavements, resilience

1. Introduction

Unsealed road design, construction, and maintenance is historically poor in embracing best practice. Many smaller municipal government authorities and larger State road authorities rely on standards devised for sealed pavement design. Where these standards are employed on an unsealed road, premature deterioration of the pavement can result. It is therefore critical to provide an unsealed pavement design which is fit for purpose, and in line with current best practice utilising locally available materials sustainably.

2. Background

Two prime factors contribute to the deterioration of unsealed roads within the study area; increasing heavy vehicle volumes and poor drainage. Diminishing capital available for road maintenance necessitates rehabilitating unsealed pavements in the most fiscally and environmentally responsible way. Pavement stabilisation is one such method to improve the strength and resilience of a pavement using locally available materials.

3. Methodology

To facilitate the completion of this dissertation both qualitative and quantitative research methodologies were employed:

- Comprehensive Literature review

- Material Data acquisition

- Data Analysis and Modelling

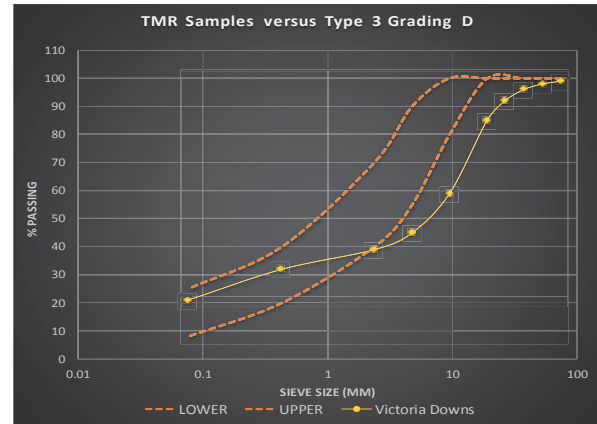- Tabulate Results and stipulate 'best practice' implementation.

Figure 1: Comparison between Western Queensland soil sample and MRTS05 Type 3 (D) grading envelope.

4. Key Outcomes

The principal outcome of the project was identification and classification of natural pavement materials from licensed gravel pits and roadside borrow pits. With reference to the literature the design of theoretically ideal pavement blends to achieve greater wearing resistance in service were developed.

5. Further Work

Conducting an economic analysis for implementing pavement blending as opposed to traditional re-sheeting maintenance programs. There is potential to conduct an in-service trial of the pavement blends identified.

6. Conclusions

In conducting this research project, it has been made particularly clear that the natural materials used for road construction in western Queensland are structurally poor and in need of modification by blending with more suitable materials.

Acknowledgements

References

AUSTROADS (2009), AGPT06-09 Part 6: Guide to Pavement Technology – *Unsealed Pavements.* Austroads Incorporated. Sydney.

Paige-Green, P. (2007) *New perspectives of unsealed roads in South Africa.* Road and Transport Research, 16 (3), pp. 56-62.

Utilisation of Rice Husk Ash and Fly Ash as a Partial Replacement for Cement in Self-Consolidating Concrete

School of Civil Engineering and Surveying

Cameron Smith

Bachelor of Engineering
(Honours) (Civil)

Supervisors: Assoc. Prof Yan Zhuge, USQ

Dr Igor Chaves, UoN

Keywords: Rice Husk Ash, self-consolidating concrete

1. Introduction

In order to promote sustainable construction and development it is essential to focus on strategies that improve the management of waste and resources. Due to its high amorphous (reactive) silica content, Rice Husk Ash (RHA) has been determined as an effective Pozzolanic material for the production of concrete.

The aim of this research is to determine the optimum quantity of RHA, an agricultural waste product, and Fly Ash that can be incorporated as supplementary cementitious materials for partial replacement of Portland cement in self-consolidating concrete (SCC). The utilisation of SCC provides a more versatile construction material than a regular concrete mix. Because SCC can flow and consolidate under its own weight, it is able to pass through extensive layers of reinforcement and settle more effectively without the need for vibration.

2. Background

Through determining whether RHA can be incorporated into a SCC mix design this research aims to provide suitable evidence in support of utilising RHA more widely as a construction material. Findings from this study have the potential to not only lower costs and the environmental impact of current methods but also utilise the Pozzolanic effects of RHA to increase the chemical and physical properties of SCC.

3. Methodology

In order to achieve the project objectives, this project involved three primary stages:

Stage 1: Burn Rice Husk in a controlled environment at temperatures between 600 - 650 °C to attain a product high in amorphous (reactive) silica

Figure 1 – Comparison of burnt & unburnt RHA

Stage 2: Development of SCC mix design, casting of associated compressive and flexural strength samples

Stage 3: Perform compressive and flexural strength tests on concrete samples and analyse results

4. Key Outcomes

The key outcome identified to date was that an XRD analysis of RHA confirmed the ash met requirements for use as a Pozzolanic material

5. Further Work

Completion of Stage 3 is yet to occur, once this is complete a detailed analysis may be provided

6. Conclusions

Analysis of the compressive and flexural strength testing will provide a clear understanding as to what percentage of RHA can be included in a 20% Fly ash SCC mix design before the concrete's physical properties are negatively affected.

Acknowledgements

I would like to thank both my supervisors for their support and assistance throughout each stage of my project, and also Alexis Tacey from the USQ Arts department for her assistance in procuring the RHA

References

Khatri, S, 2014, 'Impact of Admixture and Rice Husk Ash in Concrete Mix Design', *Journal of Mechanical and Civil Engineering*, vol. 11, p. 13-17, viewed 29 October 2015, <ISSN: 2278-1684>

Padma Rao, P, Pradhan Kumar, A, Bhaskar, Singh, B, 2014, 'A Study on Use of Rice Husk Ash in Concrete', *International Journal of Education and Applied Research*, p. 75-81, viewed 29 October 2015, <ISSN: 2348-0033>

Battery SMART charge controller / combined co-gen grid connected inverter Design and Simulation
School of Mechanical and Electrical Engineering

Morgan Smith

Bachelor of Engineering (Honours) (Power)

Supervisors: Dr. Narottam Das, USQ
Mr. Andreas Helwig, USQ

Keywords: BESS; charge controller; inverter.

1. Introduction
This project is both a case study of a battery energy storage systems (BESS) application in south-east Queensland (SEQ), and a battery controller and inverter design. To extend the existing knowledge of BESS implementation, a BESS combined with a grid-tied wind and solar photovoltaic (PV) system was analysed for its economic viability in SEQ. A smart, economically-mediated BESS charge controller was designed to supervise the power converter operations that link residential power production and BESS to the residential load and grid.

2. Background
BESS provide the capacity to *store* excess residential energy production or charge from the grid during 'time of day' low tariffs. In turn, they *provide* energy during low local generation or 'time of day' high tariffs. BESS have been extensively used in the off-grid market, but are now an option for the grid-tied market. However, predictions of BESS uptake vary greatly for domestic application. For this project, SEQ with its consistent solar resources and rising electricity tariffs is used as a test case for BESS technical and economic viability.

3. Methodology
System economics were assessed in the HOMER (Hybrid Optimisation of Microgrid Electric Renewables) software simulation. System design included development of insolation, wind, temperature, load, tariff, and BESS control models. Cost quantification was defined by product research; economic factors were also regarded.

To address dynamic aspects of the controller, Simulink (or SIMSCAPE) will be employed to simulate the system. Simulation aims to demonstrate the system transient response to events such as PV shading or sudden loading.
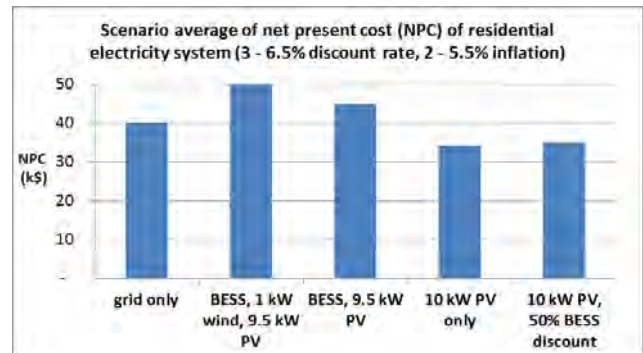

Figure 1 - System configuration costs

4. Key Outcomes
The first key outcome to date is the development and application of the context-specific models. HOMER modelling suggests that BESS and wind power are not presently economically feasible options in the specified context. The other key achievement is the development of a charge controller algorithm.

5. Further Work
The key remaining task is dynamic simulation modelling of the system. Separate components have been modelled but the design of a primary control system for the topology is being undertaken. This will include the integration of the smart controller algorithm with the control system and circuit.

6. Conclusions
The BESS systems' economic case needs capital cost reductions before they are economically viable in SEQ, noting that tariff costs are still rising to reduce this gap. Currently, the installation of extra PV panels, even at the low feed-in tariff rate, has a better return. Future analysis should be conducted on a case-by-case basis: each residence is context-specific; costs and technology change over time.

Acknowledgements

References
Keyhani, A. (2011). *Design of Smart Power Grid Renewable Energy Systems*. Hoboken, New Jersey, USA: John Wiley & Sons, Inc.

Khaligh, A., & Onar, O. C. (2010). *Energy harvesting: solar, wind, and ocean energy conversion systems* (A. Emadi Ed.). Boca Raton, FL, USA: CRC Press.

Sichilalu, S. M., & Xia, X. (2015). Optimal power dispatch of a grid-tied-battery-photovoltaic system supplying heat pump water heaters. *Energy Conversion and Management*, 102, 81-91.

Wearable Technology and Gesture Recognition for Live Creative Performance Augmentation

School of Mechanical and Electrical Engineering

Sathya R. Smith

Bachelor of Engineering (Honours) (Electrical & Electronic)

Supervisor: Dr Andrew Maxwell, USQ

Keywords: Gesture Recognition (GR), IMU, MIDI, Arduino

1. Introduction

Physical gestures are an important aspect of human communication. Since the beginning of the digital millennium, development of sensor-based gesture recognition (GR) systems has gained massive traction and is progressing rapidly. A key application of this technology is for use in stage performances, where control of visual and audio systems using bodily movements is desired. In completing this project, the aim is to develop a simple, but highly functional general purpose GR system.

2. Background

Performers are consistently searching for new methods of increasing their creative potential and productivity by trying to incorporate technology into their acts. Commercial GR systems tend to be expensive and complex as they contain specialised electronic components and may require extensive tutorial in order for the performer to make good use of the system.

3. Methodology

The project required extensive review of literature in order to appreciate current GR systems, as well as to review potential methods of system development. The methodological workflow of the system can be seen in figure 1. The system required the development of both hardware and software elements, with an emphasis on the use of low cost and/or open source components and platforms such as Arduino. OpenSCAD was utilised for design of hardware enclosures, while Arduino IDE and MATLAB were used for implementing recognition algorithms, and analysing data respectively.

4. Key Outcomes

The key outcome of the project was to develop a low cost method of capture gestural movement and
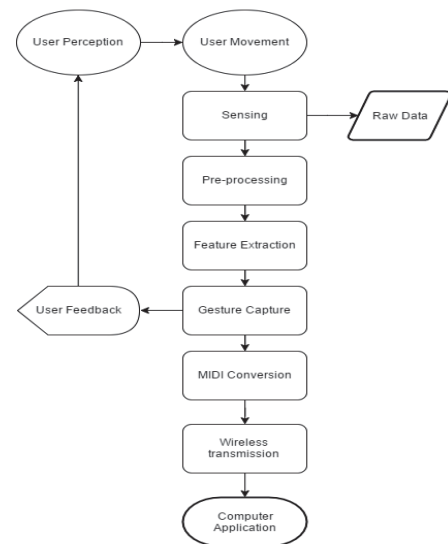

Figure 1 - GR System Workflow

processing this movement using components worn by the performer in order to create a MIDI output that can be applied to various performance systems.

5. Further Work

The work to be completed over the final weeks of the project period will involve extensive system refining and testing, as well as production of documentation for the project.

6. Conclusions

The creation of a simple, low cost and suitably functional GR system for artistic expression is highly feasible, but will require much dedication in the remaining time permitted.

Acknowledgements

References

Xu, R., Zhou, S., & Li, W. (2012). MEMS Accelerometer Based Nonspecific-User Hand Gesture Recognition. *IEEE Sensors J.*, *12*(5), 1166-1173. http://dx.doi.org/10.1109/jsen.2011.2166953

LaViola, J. (1999). *A Survey of Hand Posture and Gesture Recognition Techniques and Technology*. Department of Computer Science, Brown University, Providence, RI.

The Impact of Natural Fibre Reinforcements on the Interfacial Adhesion of Epoxy with Metals.

Jayanth Kumar. Srelam
Master of Engineering Science (Mechanical)

Supervisor: Assoc. Prof. Belal Yousif

Keywords: Adhesive Material, Jute Fibre, Metal Corrosion

1. Introduction

In general epoxy is mainly reinforced with synthetic fibres such as glass fibres. But in the present research project natural fabrics will be used as a main reinforce material. In the current project the study involves a potential of using natural fibres to reinforce epoxy for adhesion with metals purposes

2. Back ground

Epoxy is well known Adhesive materials for metals and in industries this Epoxy materials are mainly used for reparation of corrosion for metal in different engineering applications. (Dalmoro, Alemán et al. 2015)However in the present research deals with the natural fibres as a reinforcement material. (Miyauchi, Takita et al. 2016).due to the loss of strength in the present adhesive materials the research will be very much helpful to find the efficient material to use as a reinforcement material.

3. Methodology

In this research an investigation will be made by using natural fibres and glass fibres. Different fibre lengths and content will be investigated for the better adhesive materials for metals. The project involves various tests to find the strength of the jute material.

4. Key outcomes

in this project the expected key outcomes are natural fibre such as jute can be used as a reparation of metal corrosion and works more efficient than the glass fibre.

5. Progress to date

Currently working on literature review and data gathering. Tests will be made after further research of fibres

6. Summery

The expected outcomes of the present research to successfully use the Jute and other natural fibres for reparation of metal corrosion and compared the results with glass fibres.

7. Acknowledgements

I would like to thank Assoc Prof. Belal Yousif for knowing me about this project and guiding me in better understanding of this research.

Bibliography

Dalmoro, V., et al. (2015). "The influence of organophosphonic acid and conducting polymer on the adhesion and protection of epoxy coating on aluminium alloy." Progress in Organic Coatings **88**: 181-190.

Miyauchi, K., et al. (2016). "A study of adhesion on stainless steel in an epoxy/dicyandiamide coating system: Influence of glass transition temperature on wet adhesion." Progress in Organic Coatings **99**: 302-307.

Waste utilization in sugar industry – Biofuel from cellulosic material using microwave pre-treatment

School of Mechanical and Electrical Engineering

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Master of Engineering Science

(Electrical and Electronics)

Supervisors: Dr. Ihsan Hamawand, NCEA, USQ

Mr Paul Kamel, NCEA, USQ

Keywords: Bagasse, Biofuel, Microwave, pre-treatment

1. Introduction

An alternate source for replacing fossil fuels is ethanol, which is eco-friendly. The bagasse obtained as a residual waste from the sugarcane industry is a lignocellulosic material which can be used in the production of biofuel (Ethanol). The fermentation of the bagasse with yeast results in production of ethanol, this potential of ethanol production can be improved by pre-treating the bagasse with chemical or other methods, and resulting in the breakdown of the complex structure of the lignin. The obtained ethanol is a good source of energy which can be used to produce electricity, heat, etc.

2. Background

Ethanol is a non-fossil, clear, colourless liquid which can be found in alcoholic drinks, it is highly inflammable and this property of the ethanol makes it useful for the production of electricity or as a source of heat. In dry form it contains about 43% of cellulose. Conversion of the cellulose to monosaccharides is challenging, which is due to the chemical, structural factor. Hence any form of pre-treatment can be used to overcome this challenge.

3. Methodology

The pre-treatment method used in this case is a microwave assisted chemical treatment. The bagasse is grinded and sieved to a particle size of 150-350 μm. The samples are mixed with 300ml of dilute sulphuric acid, then treated with microwave for 5, 10, and 15 minutes. The microwave used has a frequency of 2.45GHz and power of 700W to 800W. The exposed samples are kept in oven for the same amount of the treatment time for 150°C. Then the samples are filtered to cease the further exposure to acid, the filtered samples then rinsed with water and dried in oven at 100°C for 24 hours. Then about 3 grams of sample is mixed with 300ml water and 3 grams of baker's yeast is added, then the fermentation is carried out for 10 days. The CO_2 produced during the fermentation collected and the fermented liquid analysed.

4. Key Outcomes

The preliminary experiments with pure sugar were carried out in the lab and the results of the CO_2 obtained from the fermentation (ethanol %) were convincing to that of the theoretical values calculated.

5. Further Work

The pre-treatment will be carried out shortly in the lab, and the experiment with the pre-treated sample will be analysed. Scanning electron microscope (SEM) will be used to visualize the effect of the pre-treatment, also the CO_2 collected and the result of GC will be considered.

6. Conclusions

The result of this study will infer that the microwave assisted chemical pre-treatment and improves the ethanol production comparing to the untreated ones. As microwave is inexpensive method and are energy efficient, this will be one of the suitable methods of pre-treating bagasse.

Acknowledgements

References

- Chen, W.H., Tu, Y.J. and Sheen, H.K., 2011. Disruption of sugarcane bagasse lignocellulosic structure by means of dilute sulfuric acid pretreatment with microwave-assisted heating. *Applied Energy*, *88*(8), pp.2726-2734.
- Lu, X., Xi, B., Zhang, Y. and Angelidaki, I., 2011. Microwave pretreatment of rape straw for bioethanol production: focus on energy efficiency. *Bioresource technology*, *102*(17), pp.7937-7940.

Analysis of scour potential of culvert during extreme flood events using numerical simulation

School of Civil Engineering and Surveying

Haren Stainwall

Bachelor of Engineering

(Honours) (Civil)

Supervisors: Dr Buddhi Wahalathantri, USQ
Prof Karu Karunasena, USQ
Dr Weena Lokuge, USQ

Keywords: ANSYS, Culverts, Flood events.

1. Introduction

Recent Queensland flood events, especially the 2011 and 2013 events resulted with severe damage to culverts across the state, indicating a gap in knowledge.

This research investigates the forces resulting from water flow and associated scour around a culvert during these extreme weather events. The ANSYS Finite Element Analysis (FEA) suite is used to identify critical areas of culverts to improve future culvert structures.

2. Background

The 2011 and 2013 Queensland flood events repeatedly caused culvert failures, indicating possible problems in culvert design, construction and maintenance processes. For an example, 192 culverts out of 330 in the Lockyer Valley Regional Council area were damaged during the 2011 flood event. The region was again hit with a significant flood event in 2013 which resulted in damage to 100 culverts with a further 92 requiring full replacement many of these structures were new having being replaced after the 2011 flood event. Scour, undermining and cracking in culvert structures have been identified as common failure mechanisms.

3. Methodology

This research mainly focussed on a selected case study area in the Left Hand Branch Region. One of the culvert structure along the Left Hand Branch Road (LHBR) is selected for the analysis work. A FEA model of this culvert is created using ANSYS to simulate the effect of major flood events on the culvert and to study the associated drag and lift forces around the culvert and scour potential under worst possible case. These forces associated with flood waters are then compared against the AS 5100.2-2004 bridge loadings. The effect of different geometry, including culvert depths and lengths as well as downstream scour protection mechanisms are
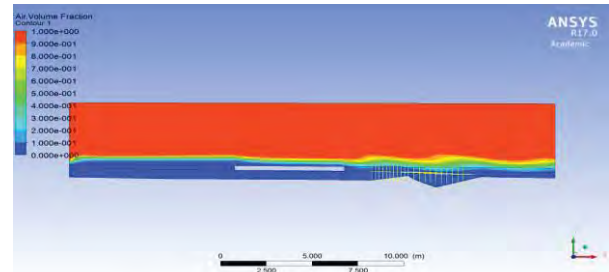

Figure 1 – Culvert Model

studied. The maximum scour potential at downstream end is studied using velocity profile obtained at critical points as shown in figure 1.

4. Key Outcomes

ANSYS results indicate that forces due to water flow varies with geometry including the length of the culvert. AS5100.2-2004 is incapable of handling variation as well as underestimates the drag forces in absence of load factors. Further, ANSYS results confirm that geometry of the downstream end plays a major role in terms of scour mitigation approaches. In absence of any scour control measures, scour depth can increase up to 750mm under the maximum flood condition studied in this research.

5. Further Work

The research requires further comparison between the AS 5100.2-2004 bridge loading and the results calculated from the model. Further investigation into critical parameters surrounding the scour downstream of the culvert will also be conducted.

6. Conclusions

The initial findings indicate that the current use of AS 5100.2-2004 bridge loadings for culvert structures is not sufficient. The effect of scour will have a significant impact on culvert and will require some further analysis and possible experimental work in the future.

Acknowledgements

References

LVRC 2014a, Submission to the Australian Government Productivity Commission Inquiry into Natural Disaster Funding Arrangements, <http://www.pc.gov.au/_data/assets/pdf_file/0015/138021/sub108-disaster-funding.pdf>

Managing Our Heritage: Monitoring, Maintaining and Restoring Our Timber Bridges

Melissa Stark

Bachelor of Engineering (Honours) (Civil)

Supervisors: Assoc. Prof. David Thorpe,

USQ *Keywords:* timber bridge, heritage, asset management

Figure 1: Tummaville Road, Leyburn bridge suffers from severe deterioration (Stark, 2016)

1. Introduction

As the number of timber bridges within Queensland continues to dwindle due to inadequate maintenance, severe degradation or deprived conditions - there must be an increased awareness passed onto the members within a community and government authorities. The primary focus of this research report is to raise awareness of the severely deteriorated timber bridges, assess the occurrence of deterioration in old timber bridges and reinforce the various repair methods available.

2. Background

In modern times, there is a high reliance on efficient transportation and an expectation that this will be delivered safely and economically. A large number of timber bridges in communities all over the world are currently undergoing a state of severe deterioration and corrosion. In order to rectify the ongoing problem, this project aims to raise awareness of such issues by providing information on the specific complications associated with various timber bridges and how to manage each complication according to the appropriate standards.

3. Methodology

The analysis within this report incorporates two case study components. The first component includes the analysis of five poorly maintained timber bridges within Queensland that have been personally examined. A brief overview of each bridge has been compiled and this has introduced the many common issues being faced today.

The second section of analysis includes the analysis of five anonymous bridge inspection reports within Queensland that were completed by a professional engineer. Repair and restoration methods will be made in conclusion and this will be an indication of how much work is required to bring them up to standards.

4. Key Outcomes

The aim of this project is to inform the public and government authorities of the many complications associated with timber bridges, justify the maintenance expected, identify the options available for repair and most importantly - protect our heritage. Upon completion of this research paper, it is expected that awareness will be raised and the future for our timber bridges will significantly improve.

5. Further Work

The analysis of personal bridge inspections is currently underway and the research project seems to be well on track. As time persists, a financial summary will be considered for the timber bridges that require remedial action or repair work.

6. Conclusions

At this stage in my research, it has become clear that the durability and condition of many timber bridges is deteriorating at a gradual rate. As bridges are a critical link to the transportation network for both the present and future generations, the upkeep and maintenance is equally as important as the initial construction of one.

Acknowledgements

References

Chen, W. F., & Duan, L. (1999). Bridge Engineering Handbook. Florida. doi: ISBN 0-8493-7434-0

Department of Transport and Main Roads. (2004). Bridge Inspection Manual. Queensland, Australia: Bridge Asset Management Structures Division. Retrieved April 4, 2016

Ritter, M. (1990). Timber Bridges; Design, Construction, Inspection and Maintenance. United States Department of Agriculture, Washington DC. Retrieved April 5, 2016

Vibroacoustic Transformer Condition Monitoring

School of Mechanical and Electrical Engineering

Dean Starkey

Bachelor of Engineering
(Honours) (Power)

Supervisors: Mr Andreas Helwig, USQ

Dr Narottam Das, USQ

Keywords: Condition Monitoring, Transformers, Vibroacoustic Method, Arduino, MEMs.

1. Introduction

Power transformers provide the crucial link between the generation, transmission and distribution of electricity to customers at different voltage levels. Due to the critical role of transformers in the electricity network power utilities place importance on the maintenance and condition monitoring of these assets.

2. Background

The predominant causes of transformer insulation degradation are from electrical, thermal and mechanical stresses. The most widely adopted method of condition monitoring transformers is chemical testing known as Dissolved Gas Analysis (DGA). The Vibroacoustic Method (VM) of condition assessment is one suggested by Bartoletti et al. (2004) and consists of measuring mechanical vibrations for transformer condition assessment. This research aims to identify the validity of monitoring transformer vibroacoustic emissions in the low frequency range as a predictive maintenance tool for the precursor events that lead to partial discharge and potential transformer failure.

3. Methodology

This project required developing an acoustic emissions measuring device using off-the-shelf, non-commercial grade and cost effective equipment.

A real-time monitoring program was developed in MATLAB, as shown in Figure 1.

The developed system was tested using a controlled experiment and substations were monitored to determine correlation between vibration signatures and dissolved gas analysis (DGA) results.
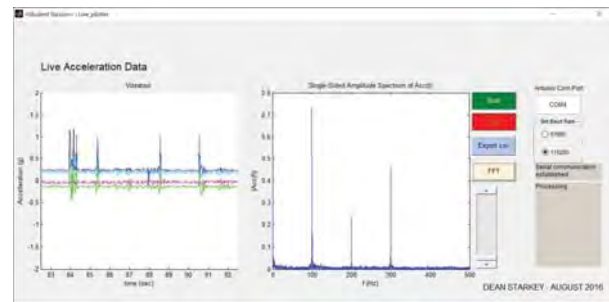

Figure 1 – Matlab GUI for real time signal processing

4. Key Outcomes

A real time vibration measurement system has been developed and tested utilising an Arduino microcontroller and wireless communication via Xbee to a Matlab user interface. A micro electro-mechanical system (MEMs) accelerometer has been used as the sensing element.

5. Further Work

From here further refinement of the signal processing user interface and finalising the field testing of substations is required.

6. Conclusions

Current literature on transformer vibration is limited and in depth studies are required before vibration characteristics can be used as a diagnostic method and predictive maintenance tool. As power utilities look to be more efficient and reduce capital expenditure the design of cost effective condition monitoring systems contributes to the field of maintenance engineering.

Acknowledgements

I would like to thank my supervisors Mr Andreas Helwig and Dr Narottam Das for their guidance and feedback on my project.

References

Bartoletti, C., Desiderio, M., Carlo, D. D., Fazio, G., Muzi, F., Sacerdoti, G., & Salvatori, F. (2004). Vibro-acoustic techniques to diagnose power transformers. *IEEE Transactions on Power Delivery,* *19*(1), 221-229. doi:10.1109/TPWRD.2003.820177

Signal Processing Techniques for Condition Monitoring

Sponsor – School of Mechanical and Electrical Engineering

James Steele

Bachelor of Engineering (Electrical and Electronic)

Supervisors: Prof. John Leis, USQ

Keywords: condition monitoring, characteristic fault frequencies, wavelets.

1. Introduction

Condition monitoring assesses the condition of a machine during its operating life. One of the most common methods for assessing the condition of a rolling element bearing is through monitoring its vibration signal for characteristic frequency content. As a bearing begins to fail certain frequencies become evident in the vibration signal.

System noise from other machines, other components in the bearing and electrical noise can corrupt the vibration signal and mask the characteristic fault frequencies. A relatively new field of mathematics called wavelets can be used to remove noise from the signal and provide earlier and improved detection of a failing bearing.

2. Background

Rolling element bearings are employed in a wide range of applications across many industries. The ability to monitor a bearing's condition and detect the start of a failure is important for planning future equipment maintenance tasks. Current research is focussed on earlier detection of faults and improving the ratio of positive to false fault detections.

3. Methodology

Three Matlab programs were written for assessing the frequency content of bearing vibration signals. The three methods were based on standard frequency analysis, cepstrum analysis and amplitude modulation.

Vibration simulation signals were then created and varying magnitudes of Gaussian noise were added. The simulation signals were denoised using the Daubechies family of wavelets 1 through 19. 24 different combinations of wavelet parameters were used with each wavelet to denoise the simulation signals. The denoised signals were then analysed for frequency
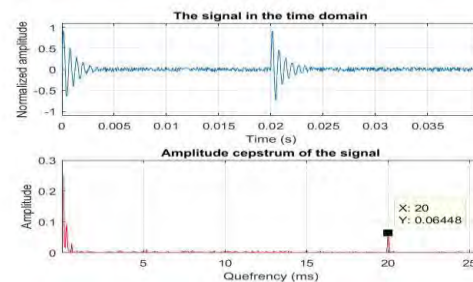

Figure 1 – Cepstrum analysis produces a *quefrency* spectrum.

content and the performance of each wavelet combination was recorded.

The best performing wavelet parameter combinations were selected for denoising real vibration signals taken from bearings in test bed setups and real world applications such as a 2MW wind turbine. The performance of the selected wavelet combinations were assessed and conclusion drawn about which wavelet parameters are most effective for removing noise from a vibration signal and providing early indication of bearing fault.

4. Key Outcomes

Many combinations of wavelets have improved the SNR of the vibration signal and increased the success rate of correct fault selection.

5. Further Work

The methodology could be tested using an alternate wavelet such as the Meyer wavelet. The best wavelet parameters could be optimised to create a wavelet that denoises a vibration signal in many different applications.

6. Conclusions

Wavelet denoising can be used to remove noise from vibration signals and improve fault detection in bearings.

Acknowledgements

References

Mechefske, C. K. (2005). *Machine Condition Monitoring and Fault Diagnostics*. Taylor and Francis Group.

Gustafsson, O., & Talinan, T. (1962). Detection of damage in assembled rolling element bearings, ASLE Transactions 5(1), 197-209.

SENSOR TO IMPROVE DETECTION OF LINE BREAK OR EARTH FAULTS FOR SWER LINES

Sponsor –School of Mechanical and Electrical Engineering

Benjamin Stephens Bachelor of Engineering (Honours) (Electrical and Electronics) **Supervisors:** Mr Andreas Helwig,USQ Mrs Catherine Hills,USQ
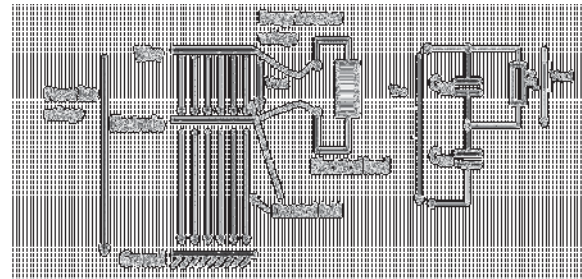
Keywords: Energy Harvesting, SWER, Fault detection

1. Introduction

The discrimination ability of conventional over-current protection devices to distinguish between high impedance faults (HIF) and normal load behaviour is very limited for Single Wire Earth Return (SWER) lines due to the high R/X ratio of this type of distribution system. This project proposes a system of broken conductor detection devices individually powered using energy harvesting techniques. These distributed devices communicate to enact a new logic based fault detection system to provide discrimination for HIF.

2. Background

The possibility of fire ignition from high impedance faulted powerlines within the Victorian SWER line network has been identified as a major concern by the Royal Commission into the Black Saturday Bushfires (RVB 2009). The recommendations put forward by the commission generally involve the replacement of all SWER lines by various methods, all of which run into the billions of dollars. This project investigates the possibility of creating a system that utilises a simple but novel detection strategy to remove the risk of SWER line live-conductor breakage or span sag to ground, resulting in potential bushfires. Such a system would eliminate the need to replace the SWER systems. A key element that makes this viable, is the creation of an easily deployed, 'self powered' device that relies upon energy harvesting techniques.

3. Methodology

An investigation determined electrostatic (capacitive) methods were the most appropriate method to scavenge energy from the 12.7kV SWER conductor. A model was created based on methods used by Zhao (2012) for similar situations (figure 1). Construction of a scaled 240V AC version of the system has been undertaken to

Figure 1 – Capacitive System with load (Source: Zhao et al 2012)

verify the model and determine the appropriate electronic build for SWER deployment.

4. Key Outcomes

The research contribution is proof of concept for a low cost networked system of self powered detection devices. The ability to extract enough power from a practical device to enable reliable communications and other peripheral functions will be a key focus of research outcomes.

5. Further Work

Successful completion of the energy harvesting concept investigation will result in subsequent research into a wireless mesh communications system to further develop into a functioning device.

6. Conclusions

Final conclusions have yet to be quantified in detail, however if the per-device power budget requirement for wireless communications can be met by energy harvesting, then development of a reliable detection system is feasible.

Acknowledgements

References

Royal Commission into (2009) Victorian Bushfires (RVB) 2010, 'Electricity-Caused Fire', *Volume II: Fire Preparation, Response and Recovery,*

Zhao, X, Keutel, T, Baldauf, M & Kanoun, O (2012), 'Energy Harvesting for Overhead Power Line Monitoring', *9th International Multi-Conference on Systems, Signals and Devices,* Chemnitz, Germany

Projectile Mass Distribution Following Impacts on Hardened Steel Plate

School of Mechanical and Electrical Engineering

John Stephens

Bachelor of Engineering (Mechanical)

Supervisors: Dr Ray Malpress, USQ

Keywords: Projectile, Armour, Ricochet

1. Introduction

Pistol target shooting often utilises hardened steel plate as a target material. This is due to the reusable nature of a steel target and the audible report upon projectile impact as a positive hit indicator. In some competition disciplines, such as IPSC (International Practical Shooting Confederation), these targets will be used in close proximity to people, which presents a safety hazard due to the projectile material fragments being deflected off the targets. These fragments are commonly referred to as spall.

2. Background

The aim of this project is to study the behaviour of projectiles that impact hardened steel plate and understand the distribution of the spall, and what effect the projectile impact angle plays on the distribution of spall material in relation to the target plane.

3. Methodology

The methodology employed for this research project will be carried out in two phases. The first phase will involve simulating the projectile impacts using ANSYS Explicit Dynamics software package. The second phase will involve carrying out experiments on a firing range where the distribution of the spall can be observed after impacts with a target.

4. Key Outcomes

The expected outcomes following this research and experimentation will be a clear understanding of the relationship between impact angle and spall distribution of lead projectiles against hardened steel plate. This information will assist those involved in sport shooting to better design target shooting layouts for safety

5. Further Work

The simulation and experimentation aspects of this research project are yet to be performed, however they are due to be completed before the Professional Practice 2 Conference Week begins.

6. Conclusions

This research project is yet to reach a point where conclusions can be drawn, however preliminary testing has shown that the expected outcomes from preliminary testing

Acknowledgements

References

Rosenberg, Z. Dekel, E. Springer Heidelberg, London 2012
Terminal Ballistics

Jauhari, M. Illinois, USA 1969.
'Bullet Ricochet from Metal Plates'
The Journal of Criminal Law, Criminology and Police Science, Volume 60 pages 387 - 397

Haag, Michael G. Haag, Lucien C. Forensic Science Consultants, Albuquerque, New Mexico 2011
'Projectile Ricochet and Deflection'
Shooting Incident Reconstruction (Second Edition), 2011, Pages 143–174

Implementation of Web-Based Keystroke Analytics for User Verification

School of Mechanical and Electrical Engineering

Ryan Stephenson

Bachelor of Engineering
(Honours) (Computer Systems)

Supervisors: Dr Hong Zhou, USQ

Keywords: keystroke, biometrics, verification

1. Introduction

Keystroke dynamics is concerned with user typing habits, rather than simply what they are typing. Through recording these characteristics and comparing them with a stored template, the user's identity can be verified. This project aims to implement a user verification system utilising keystroke biometrics, to examine the technical considerations of the implementation process.

2. Background

As the impact of online security breaches becomes more severe, the need for investigation into and implementation of multi-factor authentication systems becomes a necessity. Currently the majority of online systems use a simple password or pin number based system to authenticate users. Commonly systems which utilise keystroke dynamics compare collected user characteristics using either machine learning or statistical methods.

3. Methodology

The project consists of four areas including research into keystroke biometrics, design of a data collection system, design of a system to compare characteristics and the collection and analysis of data. Literature has been used to broadly inform the system's design and technical details. Specific implementation details are the result of trial and error and comparison of available methods.

4. Key Outcomes

The project has shown that JavaScript and PHP can be used for recording and storing typing characteristics, with a timing resolution as low as one millisecond (sufficient values are 0.1 to 1ms).

From the collection of one hundred login attempts, the recorded flight and delay time typing characteristics
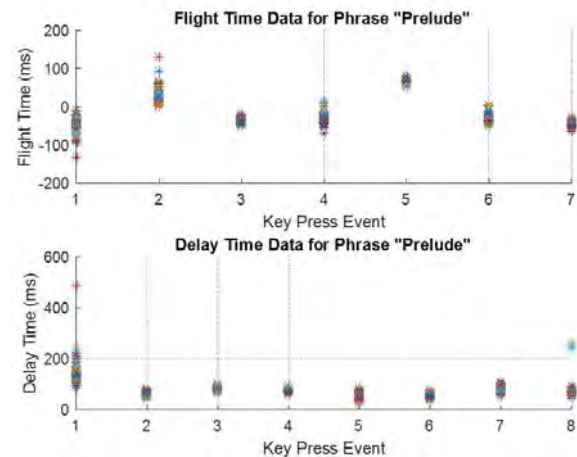

Figure 1 - Flight and Delay Time Visualisation using MATLAB

exhibit a relatively low degree of variability, as shown in Figure 1, showing their suitability for verification purposes. Literature states Equal Error Rates (ERR) of < 5% are reasonable. Euclidean distance methods can expect such values, demonstrating their suitability.

5. Further Work

Improving the performance of the designed classification system requires the collection of further user typing data to set the allowable degree of variability between attempts. This will allow for the system's performance to be fully evaluated.

6. Conclusions

Using current technologies, keystroke dynamics may be implemented into existing systems without interfering with the user's interaction with the system.

Acknowledgements

Dr Hong Zhou who has informed the project's creation and documentation process.

References

Teh, P. S., Teoh, A. B. J., & Yue, S. (2013). A survey of keystroke dynamics biometrics. *The Scientific World Journal, 2013*.

Ali, M. L., Monaco, J. V., Tappert, C. C., & Qiu, M. (2016). Keystroke Biometric Systems for User Authentication. Journal of Signal Processing Systems, 1-16.

Douhou, S., & Magnus, J. R. (2009). The reliability of user authentication through keystroke dynamics. Statistica Neerlandica, 63(4), 432-449.

Frying and Grinding of Lignocellulosic Materials as Pre-Treatments for Energy Purposes

Nikhil Suresh

Master of Engineering Science (Mechanical)

Supervisor: Dr Ihsan Hamawand, USQ

Keywords: Lignocellulosic materials, Bagasse, Pre-Treatment, Mechanical Pulverization.

1. Introduction

Biomass offers an abundant and inexpensive source of renewable resources. For example, sugarcane residue, called bagasse. Bagasse is the highly fibrous residue remaining after sugar-cane is pressed to remove sucrose. The main aim of the project is to increase the production of ethanol from Bagasse by reducing it to a micro particle size. Frying and Mechanical Pulverization of the lignocellulosic material will be investigated in relation to ethanol production.

2. Background

Biomass being a sustainable and inexpensive source of energy, has the potential to bring an end to our dependence on non -renewable sources for energy. As an alternative source for energy, production of ethanol from lignocellulosic material, such as bagasse is getting ample attention these days. The ethanol obtained from bagasse will also be a cleaner alternative compared to the conventional fuels that are presently in use.

3. Methodology

1) Pre-Treatment: The initial step in the project is to make the bagasse ready for pre-treatment which involves processes like frying and mechanical pulverization.

2) Fermentation: It is the process of converting biomass (bagasse) to ethanol using Baker's Yeast (Saccharomyces Cerevisiae).

3) Ethanol Separation and Purification: After the fermentation process, the amount of ethanol produced during each fermentation process will be analysed and compared so as to determine the optimum particle size of bagasse that produces the highest yield. Then the temperature and the pH of the sample will be measured and after filtration it is stored for further analysis.

Fig. 1: Bagasse Sample

4. Key Outcomes

The project will determine the amount of ethanol that can be derived from bagasse using frying and mechanical pulverization as pre-treatment. The effect of the degree of frying on the fermentation process will be investigated. The bagasse will be ground to different particle sizes in order to determine the optimum size that produce the highest ethanol yield.

5. Further Work

The bagasse sample will be fried and then will undergo mechanical pulverization as pre-treatment, followed by the fermentations process and the ethanol separation and purification phase. The project is still in the beginning phase and needs more work to achieve the required objectives.

6. Conclusions

Biomass being a sustainable and an inexpensive source of energy, can end our long-term dependence on non-renewable fossil fuels for energy. Producing ethanol from biomass also erases the question of emission of greenhouse gases as it is cleaner source of energy than all the other conventional fossil fuels. It is also the best solution for the ever increasing fuel crisis.

Acknowledgements

References

Dias et al, 2009, 'Production of bioethanol and other bio-based materials from sugarcane bagasse: integration to conventional bioethanol production process' School of Chemical Engineering, Brazil.

Umamaheswari, M et al, 2010, 'Bioethanol Production From Cellulosic Materials', Asian Journal of Science and Technology, Vol. 1, pp. 005–011.

Design of a truss bridge for lowest cost using Structural Topology Optimisation

Sponsor –School of Civil Engineering and Surveying

Wayne Sutcliffe

Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Kazem Ghabraie, USQ
Dr Sourish Banerjee, USQ
Christian English, Sedgman

Keywords: Structural Design, Structural Topology Optimisation, Truss Bridge

1. Introduction

The design of structures with the aim of reducing the project cost involves the combination of many factors. Material and fabrication costs, transportation, erection and design costs all contribute in varying amounts to the overall project cost.

Structural Topology Optimisation (STO) is a recent and rapidly advancing numerical method which models stresses on a design shape, adding and removing material to optimise the performance and weight of a structure.

This project explores the application of STO as a design tool to improve the shape of an industrial truss bridge, and then compares the effectiveness of this method in reducing project costs to other approaches that may be used.

2. Background

STO is considered a powerful design tool in the aerospace and automotive industries where the requirement for high performing structures and the use of mass production mean that the manhour cost of intensive design methods is warranted.

Structural design in industry often specifies hot rolled steel sections, and complex shapes can add extra cost through extra fabrication and machining required.

This is an exploratory study to determine the cost benefits, if any, of STO to a structural design project.

3. Methodology

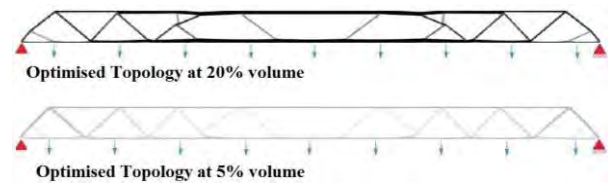An already completed design was used as a base case. The topology was optimised using a MATLAB

Figure 1 – Optimised topology at different volume fractions

program. A 2D planar truss was used to rapidly evaluate many layouts. Design of structural member size was completed for each layout and quantity take-off and application of cost rates gave cost estimates. To provide a comparison to STO, some conventional optimisations were undertaken on the depth of truss or structural geometry, and the effects of these changes were evaluated in comparison to STO.

4. Key Outcomes

The optimised topology produced a reduction in costs and an increase in stiffness of the truss compared to the base case. However other methods of optimising also produced similar reduction in costs.

5. Further Work

Further work evaluating the effects of different geometry is ongoing.

6. Conclusions

The practical aspects of design and construction for an industrial project are significant drivers of cost. STO is one of many ways to reduce the cost of material inputs while maintaining or even improving performance.

References

Sigmund, O & Maute, K 2013, *'Topology optimization approaches: A comparative review'*, Structural and Multidisciplinary Optimization, vol. 48, no. 6, pp. 1031-55.

Andreassen, E, Clausen, A, Schevenels, M, Lazarov, BS & Sigmund, O 2011, *'Efficient topology optimization in MATLAB using 88 lines of code'*, Structural and Multidisciplinary Optimization, vol. 43, no. 1, pp. 1-16.

Asset Management Maturity Model: A Case study of Coal and Hydro based Power Stations in Australia

Sponsor – School of Mechanical and Electrical Engineering

Student Name: Naushil Bipinbhai Talavia

Master of Engineering Science (Power)

Figure 1 – Systematic Literature Review method.

Supervisors: Dr MUHMMAD NATEQUE MAHMOOD, USQ

Dr. Narottam Das

Keywords: Asset Management, Maturity Model, Case Study, Coal and Hydro Power Stations.

1. Introduction

The sector of Asset management of coal and hydro based power stations is attaining a considerable amount of attention in today's world. Effective asset management has become quite essential as countries like India, Japan, China, Australia have started facing complex problems such as environmental issues, increasing demands of electricity, ageing of its present power stations, insufficient capital for upgradation and maintenance, unavailability of land to setup new power stations, increase in profitability etc. The people are heavily dependent on electricity for carrying out day to day activities. Also, power generation plays vital role in the development of any country. An asset management maturity model has been developed considering the factors like technical specifications, strategy planning, policy, governance, operational, maintenance as well as social elements pertaining to human resources, external factors like environmental issues like climate change, sustainability and its issues, stakeholders and community demands.

2. Background

Asset Management is the developing concept in the field of power industry its main motive is to increase the lifecycle of the power stations. Currently the power stations are suffering problems from asset creation till its disposal.
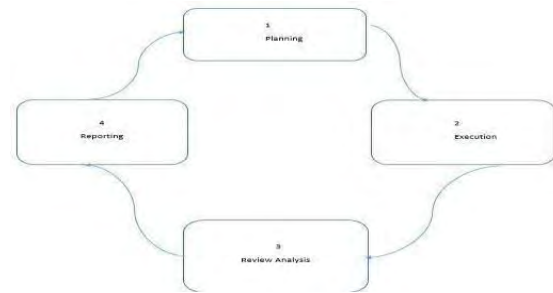
3. Methodology

The methodology was based on the qualitative research where systematic literature review method was used to fulfil the case study of coal and hydro based power stations it was divided into Planning, Execution, Review Analysis and Reporting.

4. Key Outcomes

The key outcomes of the project were to develop a maturity model with key attributes and also case study of two coal and hydro based power stations was carried out and presented in the form of radar chart.

5. Further Work

Disseminate the proposed maturity model to various asset managers for receiving feedbacks and to implement the revised maturity model on various coal and hydro based power stations in australia.

6. Conclusions

The capability maturity model developed was used to carry out the case study of two coal and two hydro based power stations in australia.

Acknowledgements

References

Asset management BS ISO 55000:2014, BS ISO 55001:2014 and BS ISO 55002:2014 2014, Switzerland: BSI Standards Limited 2014

Resilient Infrastructure Development and Management

Sponsor – School of Mechanical and Electrical Engineering

Jonikumar Tandel

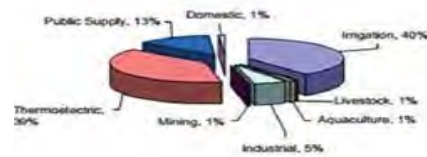Master of Engineering Science (Mechanical)

Figure 1 - Fresh water consumption (2005) (Feeley et al., 2008)

Supervisors: Assoc/Prof David Thorpe, USQ

Keywords: Resilience, Power Plant and Water Reservoir.

1. Introduction

This paper broadly considers climatic changes as the primary source of disasters in thermoelectric plants. The hazards included are high temperatures, drought, competition from other uses and occurrence of hurricanes and storm surges.

The document proceeds to consider the value of water reservoirs and the thermal power plants based on water. The method used involves a study of the water requirements and the power contribution in various regions of the Australia, together with the mentioned disasters to come up with a sustainable design as a solution. Still further, the design aspects including the storage-reliability-yield relationship (SRY) and the resilience factor are regarded as the primary factor in the solution.

2. Background

This section describes the values of water reservoir in power plants; water based thermo electric power plants, water disasters prevalent in thermo electric power plants, use of fresh water in thermo electric power plants, and effectiveness of water uses by thermo electric power plants.

3. Methodology

The methodology used to overcome the concern in thermal power plants for water requirements is a qualitative research to find a resilient and sustainable solution to develop a reservoir model for water. Further to it going to work on systematic literature review, planning, execution, and review and reporting. Make sure you include a heading and a reference to the figure.

4. Key Outcomes

Every nation in the world undergoes climatic changes with time, thereby necessitating the establishment of resilient structures in power plants for energy stability. For instance reuse of industrial waste water should be done in power plant facilities for cooling purposes instead of using it for domestic and agricultural purposes while reuse of domestic water after being treated can be carried out for domestic use.

5. Further Work

Utilization of waste water after being treated for cooling purposes instead of using fresh water.

6. Conclusions

Water reservoirs with high resiliency factor and well established SRY relationships considered during need design implementation in the plants.

Acknowledgements

This paper acknowledges the total support and assistance of Dr. David Thorpe from the University of Southern Queensland, Toowoomba, QLD during the completion of paper.

Also faith in God, support from friends and family is equally important during my journey of on campus student for Masters of Engineering Science.

References

Feeley, T., Skone, T., Stiegel Jr, G., McNemar, A., Nemeth, M., & Schimmoller, B. et al. (2008). Water: A critical resource in the thermoelectric power industry (1st ed.). Retrieved from <https://netl.doe.gov/File%20Library/Research/Coal/ wr/water/netl-water-estimate-article-Elsevier 1107.pdf>.

Shear behaviour of geopolymer concrete beams reinforced with spiral GFRP bars

Sponsor – V-Rod Australia

Tanniru Vamshi Krishna

Master of Engineering Science (Structural)

Supervisors:

Dr Allan Manalo

Mr Ging Maranan

Keywords: Beams, Shear, GFRP, Spiral reinforcement, Geo polymer concrete

1. Introduction

Glass fibre reinforced polymer (GFRP) composite bars has gained considerable worldwide interest as internal reinforcement to concrete structures that operate in highly aggressive environments, where corrosion of steel reinforcement is a major problem. Also, the geopolymer concrete is emerging attention due to its eco-friendly nature during the manufacturing process. Little research has gone into investigating the behavior of GFRP reinforced geopolymer concrete beams. Additional research, therefore, is required to enable engineers to understand the fundamental behavior of this new construction system so that it can be adopted by the construction industry. This project mainly aims to investigate the shear behaviour of geo-polymer concrete beams reinforced with GFRP bars and GFRP spiral stirrups.

2. Background

GFRP bars are normally used to reinforce concrete beams. However, there are relatively few data that deal with the contribution of GFRP stirrups to shear strength, particularly in the case of geopolymer concrete beams. This project aims to investigate the shear behaviour of geo-polymer concrete beams reinforced with GFRP bars and GFRP spiral stirrups

3. Methodology

The main objective of this research is to investigate the shear behaviour of geo-polymer concrete beams reinforced with GFRP bars and GFRP spiral stirrups. In order to achieve this objective, experimental and theoretical investigation on large scale geo-polymer concrete beams reinforced with spiral GFRP reinforcements with different pitch/ spacing will be conducted. The behavior of the beams will be assessed based on crack pattern and propagation, failure mode, load–deflection response, shear strength, and deflection capacity, and strain in the geopolymer concrete and reinforcement.

4. Key Outcomes

The main outcome regarding this project is analysing the shear behaviour of geo polymer beams reinforced with GFRP bars and spiral stirrups. If the GFRP bars proved to be effective in extreme conditions the GFRP bars can be replaced by traditional steel to avoid the effect of corrosion in extreme weather conditions.

5. Progress to date

Presently working on preparation of moulds and literature review. These beams will be tested after 28 days of preparation of moulds. Then the test results will be analysed and processed for possible outcomes.

6. Summary

As at no conclusion has been drawn. Expected conclusion in this project involves acceptability of usage of GFRP stirrups instead of traditional steel materials in extreme weather conditions.

7. Acknowledgements

I would like to thank Dr. Allan Manalo and Ginghis Maranan for their contribution throughout my research so far.

Bibliography

Wouter De Corte, V. B. (2013). Effectiveness of spirally shaped stirrups in reinforced concrete beams. *Engineering Structures*, 667-675.

Effect of compression ratio on the performance, emissions and efficiency of E-85 blended biofuel

Sponsor – School of Mechanical and Electrical Engineering

Mark Taylor

Master of Engineering Science

(Mechanical)

Supervisors: Dr Paul Baker, USQ

Keywords: Ethanol, Biofuel, Energy Balance.

1. Introduction
High ethanol blend bio-fuels such as E-85 have the ability to reduce dependence on fossil fuels and extend the useful life of existing oil reserves. However the much lower latent heat of evaporation and corresponding lower energy output means that existing homogenous charge spark ignition (HCSI) engines require modifications to operate effectively on this fuel source. This study utilised a variable compression engine to determine the effect compression ratio has on the specific output of E-85 and therefore determine an optimum range to balance performance, thermal efficiency and emissions.

2. Background
Ethanol is a renewable resource produced from the fermentation and distillation of glucose which is readily available around the world. Previous research has shown that ethanol blended fuels operating with an optimised compression ratio can produce higher specific output with fewer emissions than pure unleaded petrol (Yucesu H.S.et al 2006).

3. Methodology
A G.U.N.T CT300 11 kW variable compression ratio (VCR) single cylinder engine was operated at compression ratios from 8:1 through to 15:1 on both E-85 and Unleaded petrol. Three runs with different amounts of ignition timing were made on each fuel at each compression ratio. Engine performance, energy balance data and the exhaust gas composition was collected using various sensors, an exhaust calorimeter and a five gas analyser.
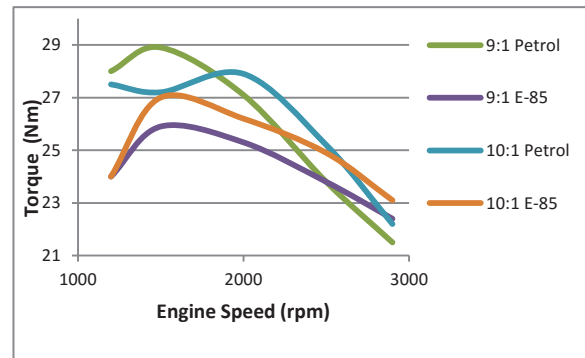

Figure 1 – Maximum Brake Torque Curve

4. Key Outcomes
Key outcomes are to identify if E-85 biofuel is a viable alternative fuel in an optimised engine. The limited data to date has shown a more linear torque curve for E-85 than petrol with significantly increased NO_x emissions.

5. Further Work
Due to an issue with the G.U.N.T. VCR engine testing is yet to be completed. Additional testing will be required to gather the remaining data once the engine is fully operational.

6. Conclusions
Higher compression ratios increase the power and efficiency of E-85 blended biofuel. However as the compression ratio increases so does the concentration of NO_x emissions. This increase in noxious emissions may be mitigated by using a selective catalytic reduction (SCR).

Acknowledgements
I would like to thank my supervisor Dr Paul Baker for his assistance and guidance throughout the project as well as the USQ workshop staff. I would also like to thank my family, friends and work colleagues for their patience and support.

References
Yucesu H.S. et al, (2006). Effect of ethanol-gasoline blends on engine performance and exhaust emissions in different compression ratios. Applied Thermal Engineering, (26), 2272-2278.

Turkoz N. et al, (2013). Experimental investigation of the effect of E85 on engine performance and emissions under various ignition timings. Fuel, (115), 826-832.

Implementation of Negative Phase Sequence Protection in the High Voltage Distribution Network

Sponsor – Essential Energy

Scott Taylor

Bachelor of Engineering (Honours) (Power)

Supervisors: Assoc Prof Tony Ahfock

Mr Bill Howell, Essential Energy

Mr Doug Wray, Essential Energy

Keywords: Negative Phase Sequence, Protection

1. Introduction

Negative Phase Sequence (NPS) protection is effective at detecting certain fault conditions, and is now available on modern reclosers but has not been widely utilised in the distribution network. This paper reviews and researches protection schemes with a focus on NPS and puts forward methods for its implementation specific to the distribution network.

2. Background

Charles Fortescue's 1918 paper detailed his discovery of symmetrical components on which much of modern power system analysis and protection is based (Fortescue 1918). The theory of symmetrical components is essentially a way of describing and modelling the relationship between the three phases of an electrical distribution network.

Faults on the distribution network result in current flow with specific characteristics. Modern electronic reclosers can be programmed to analyse and operate for faults based on these sequence (symmetrical) components.

3. Methodology

NPS protection can have a pick up setting lower than normal load current, and still detect particular fault types including line to line faults. The traditional methods of network modelling and grading study is performed, and an equivalent full phase NPS curve is selected to grade with overcurrent and earth fault.
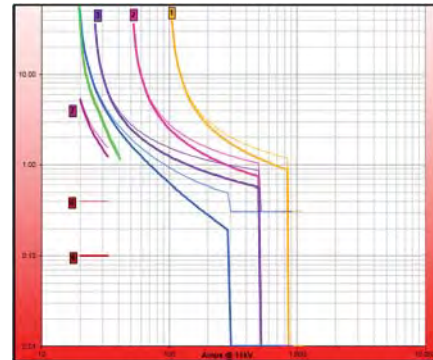

Figure 1 – Protection grading study with NPS

4. Key Outcomes

NPS is effective at operating for line to line faults on single phase spurs, but only when implemented on an upstream recloser on the three phase part of the network. The last and second last recloser on a feeder may present opportunities for NPS protection implementation to provide primary and backup to low fault level areas.

5. Further Work

Quantification of non-faulted NPS current normally present on the network needs to be investigated further.

6. Conclusions

Although the concept of NPS protection is not new, it has yet to be widely implemented, and may be more unfamiliar to network staff than traditional protection techniques. NPS protection can be more effective than other techniques at detecting line to line faults, which are often the most difficult to provide coverage for.

Acknowledgements

I would like to thank Associate Professor Tony Ahfock, Mr Bill Howell and Mr Doug Wray for their supervision and guidance. Additionally, I must acknowledge Essential Energy who has sponsored my studies throughout this degree, for which I am very grateful.

References

Fortescue, C. L. (1918). *Method of Symmetrical Co-Ordinates Applied to the Solution of Polyphase Networks.* Transactions of the American Institute of Electrical Engineers, 27(2), 1027-140.

Elneweihi, A. F., Schweitzer E. O. & Feltis M. W. (1993). *Negative-Sequence Overcurrent Element Application and Coordination in Distribution Protection.* IEEE Transactions on Power Delivery.

Grainger J. J. & Stevenson W. D. (1994). *Power System Analysis*, McGraw-Hill, Inc.

Influence of Preparation Method and Additives on the Viscosity of Waste Cooking oil for Tribological Applications

Sponsor – School of Mechanical and Electrical Engineering

Nevin Thomas

Masters of Engineering Science (Mechanical)

Supervisors: **Dr YOUSIF BELAL**

Faculty of Engineering and Surveying, University of Southern Queensland.

Keywords: waste cooking oil, tribological application, viscosity.

1. Introduction
The globe is standing up to the staggering weight of rising natural defilement and a worry of cutting oil saves. Ecological concern and direction has raised the interest of renewable and biodegradable ointments, for example, oil grease, oil or strong oils. The consistently interest for petroleum construct ointments include weight in light of generation of petroleum and its individual unsafe to the earth prompted expanding interests in the improvement of bio oils from renewable assets.

2. Background
Lubricant acts in between two moving surfaces to reduce friction. Lubricants provide a protective film which allows the surfaces to be separated and reduce the friction. There for the lubrication is very important between the moving particles. Lubricating oil can be a mix of base oil which will be commonly petroleum products or synthetic oils and additives to change its chemical composition and desired properties. The base oil influences the type of lubricating oil. If the base oil is type of synthetic oil and mineral or petroleum oil then the lubricant known as the synthetic and mineral oil respectively. If the base oil derived from the vegetables or seeds it is known as bio lubricants.

3. Methodology
The methodology starts with collecting of waste cooking oil and large impurities will be filtered using sieves.Then the oil is heated and again filters using micro filters. Using the industrial synthetic oil, different blend will make and viscosity is tested using Viscometer.

4. Key Outcomes
The key outcome of the projects is to evaluate the preparation method influence the viscosity of the waste cooking oil.

5. Further Work
The future work includes analyse different type waste cooking oil including coconut oil, olive oil and sunflower oil. Also try different type of industrial chemicals for viscosity modifying which will not harm environment.

6. Conclusions
One of the biggest achievement of the project was the waste cooking oil has blended properly with synthetic oil. The properties have to be analysed through the viscosity testing machine.

7. Acknowledgements
I should express my esteem gratitude towards my project supervisor Dr. Belal Yousif, for giving all support and guidance to go further with this project.

8. References
1. Gawrilow, I., 2004. Vegetable oil usage in lubricants. *INFORM - International News on Fats, Oils and Related Materials,* pp. 702-705.

2. Quinchia, e. a., 2009. Viscosity Modification of High-Oleic Sunflower Oil with Polymeric Additives for the Design of New Biolubricant Formulations. *Environmental Science and Technology,* p. 2060–2065.

3. Sharma, e. a., 2005. Soybean oil based greases: influence of composition on thermo-oxidative and tribochemical behavior. *J Agric Food Chem,* pp. 20;53(8):2961-2968.

4. M.P. Joseph, C. W. E., 2005. The effect of chemical structure of basefluids on antiwear effectiveness of additives. *Tribology International,* p. 321–326.

5. M.A. Delgado, L. Q. C. G., 2010. Viscosity modification of different vegetable oil with EVA copolymer for lubricant applicants. *Industrial Crops and Products,* pp. 607-612.

ETHANOL PRODUCTION FROM LIGNOCELLULOSIC MATERIAL (BAGASSE) USING MECHANICAL PULVERIZATION AS PRE-TREATMENT

Toji Thomas

Master of Engineering Science (Mechanical)

Supervisor: Dr. Ihsan Hamawand, USQ

1. Introduction

In this research, the attempt is to obtain maximum ethanol yield with the help of mechanical pulverization as the only pre-treatment method. Grinding the bagasse to different samples, varying in particle sizes and subjecting these samples to fermentation are among the crucial methodologies of the research. The ethanol yield after fermentation of each sample will be analysed, noted and compared with each other to determine the optimum particle size.

2. Background

Bagasse is an inexpensive & renewable source for producing ethanol. According to Australian sugar milling council, 2014, nearly 10 million tonnes of bagasse are produced in Australia alone. According to National Pollutant Inventory, 2013, use of renewable bagasse for the production of 'green' ethanol reduces Australians green gas emissions by over 1.5 million tonnes annually. According to Journal of Clean Energy Technologies, 2013, mechanical pre-treatment is preferred over chemical treatments for bagasse to prevent production of toxic components & improve fermentation process.

3. Methodology

a. Bagasse required is obtained from Bundaberg Sugar Mill & stored a 4°C. Before pre-treatment, the bagasse is dried in an oven at 100°C for 24hrs. Dried bagasse is grinded, sieved and stored in air-tight containers.

b. Next is the fermentation of test sample(sugar+yeast). The result from the preliminary experiment of the test sample will be used as a reference.

c. Different sized bagasse samples will also undergo fermentation. The ethanol obtained will be analysed and compared with the reference ethanol. Conclusion will be drawn after comparison.
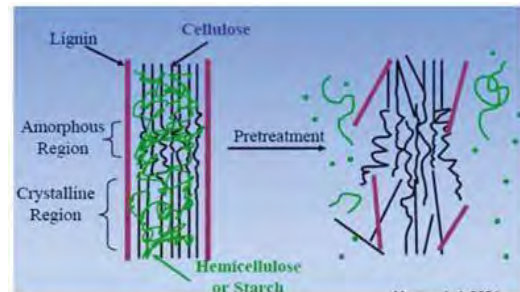
■ Schematic Diagram for pre-treatment on Bagasse (Niyaz, A, 2014)

4. Key Outcomes

a. Heating the bagasse in an oven at 100°C for 24hrs has been done.

b. Bagasse weight before and after heating were noted for future reference.

c. Dried bagasse is grinded and sieved to obtain different samples with different particle sizes.

d. These samples were labelled and stored in air-tight containers.

5. Further Work

a. Preliminary fermentation experiments with yeast & sugar solution (test sample) will be conducted.

b. Ethanol yield from fermentation of test sample will be analyzed and tabulated.

c. Similar fermentation experiments will be conducted using yeast & different sizes of bagasse sample.

d. Ethanol yield after fermentation of each sample will be noted to determine the optimum particle size that produces the maximum yield of ethanol.

e. These data's obtained will be compared with the data's obtained after fermentation of test sample to determine the success of the project.

6. Conclusions

The primary aim of the project is to maximize the production of ethanol from bagasse by reducing its particle size to micro (and if possible to nano) levels.

Acknowledgements

References

■ Niyaz , A, M, L, 2014, 'Pre-treatment Of Energy Cane Bagasse For Bio fuel Production.

Integration of Trimble V10 Imaging Rover with R10 GNSS receiver for data collection under dense tree canopies

School of Civil Engineering and Surveying

Zaine Thompson

Bachelor of Spatial Science (Honours) (Surveying)

Supervisor:
Dr Zhenyu Zhang, USQ

Keywords: Topography, Surveying, Photogrammetry.

1. Introduction

Traditionally a level and detail (Topographic) survey has been conducted through the use of either the modern day total station or GNSS receiver, or both. The aim will be to assess whether the Trimble V10 rover is an adequate tool for conducting a topographical survey under a tree canopy where it is near impossible to conduct a "normal" GNSS survey because of obstructions between the receiver and satellites, and compare this to current surveying methods when confronted with such a situation.

Accuracy, cost and time of conducting a topographical survey will be broken down into its base components and a highly detailed comparative review between the two separate methodologies of conducting the same survey will be assessed, reviewed and commented upon.

2. Background

Through the research of this project, there is potential for surveyors the world over to use a new tool in this ever developing field in order to complete the task at hand.

3. Methodology

The methodology behind the project is all strictly comparative. By gathering all my data using current techniques and using this data as my control, I was then able to gather data using the V10 rover and do a comparative review between the two.

4. Key Outcomes

Identifying the possibility of using such a technique in the first place is a massive milestone in the world of surveying in general. It is a very interesting concept as we continually find new ways to accomplish tasks faster and more reliably.

5. Further Work

As always, there will always be the possibility of further work. I have only tested this equipment in one single controlled environment. When talking about conducting a topographic survey of an area, the environment plays a very important factor and this method of topographical surveying should be heavily tested to suite your needs for your particular environment.

6. Conclusions

By using these two pieces of equipment in unison, it is possible to complete a topographic survey, the only problem being accuracy. It can be very situation dependent.

Acknowledgements

References

University of Southern Queensland. (2013). *Introduction to GPS*. Toowoomba: University of Southern Queensland.

University of Southern Queensland. (2014). *Automated Surveying Systems*. Toowoomba: University of Southern Queensland.

Lee, I.-S., & Ge, L. (2006). *The performance of RTK-GPS for surveying under challenging environmental conditions.*

Using Renewable DC Energy Sources: Improving Domestic Energy Efficiency

School of Mechanical and Electrical Engineering

Mark Thorley

Bachelor of Engineering (Honours) (Electrical and Electronic)

Supervisors: Mr Andreas Helwig, USQ

Keywords: DC Energy Supply, Efficiency, Renewable Energy Sources

1. Introduction

Since the 'War of Currents' which took place between George Westinghouse and Thomas Edison around 1890, AC energy has been the accepted energy type for grids throughout the world. However, loads and generating types have changed significantly in recent times with a move towards renewable domestic generation and an impending revolution in the installation of distributed domestic battery storage systems. Similarly, there is an increase in the number of electronic devices all operating primarily on DC now in use in domestic daily applications.

This poses the question, should domestic DC energy sources be utilised directly from the generation sources or storage medium without being inverted to AC?

2. Background

The use of DC to directly power loads has been gaining interest in recent years, predominately in the commercial sector due to its good match with the renewable generation profile. Apart from off-grid installations, analysis on DC energy in grid connected domestic installations has received little focus. This project investigates the potential energy savings that can be obtained by utilising DC energy directly in a domestic installation.

3. Methodology

Typical household energy consumption was required to determine the average usage profiles. This was obtained from data logging and research before being used in MATLAB and Homer Energy modelling, along with the installation of PV and batteries.

As DC internal appliances are typically more efficient then their AC equivalents these were installed and modelled in each situation to ensure a consistent and fair analysis. Various different configurations were assessed in order to determine the most efficient operation. A small selection of these models is shown in Figure 1.
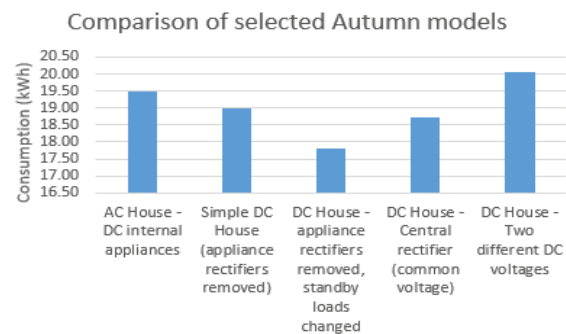

Figure 1 – Comparison of selected autumn models

4. Key Outcomes

Simulations of developed models provided kWh usage patterns for the installation for an average day in each of the four climatic seasons. The research contribution is the development of a MATLAB model that allows variation of the parameters in order to assess and improve design of individual installations.

5. Further Work

To complete this project a collation of results and a high level assessment of the financial implications of a DC versus AC installation still needs to be conducted.

6. Conclusions

Initial findings suggest a small efficiency gain will be possibly by utilising DC energy in a domestic installation. But the current lack of available domestic white goods appliances and ELV and LV standards for DC applications currently restrict advancements in this area.

Acknowledgements

References

Vossos, V., Garbesi, K., & Shen, H. (2014). Energy savings from direct-DC in U.S. residential buildings. Energy and Buildings, 68, Part A, 223-231.

Integrating scheduling with quality to minimise defects in construction

University of Southern Queensland

Austin Tippett-Whiteman

Bachelor of Construction (Honours)

Supervisor: Dr Vasantha Abeysekera, USQ

Keywords: Scheduling, Quality, Defects

1. Introduction

This research project has come to mind with the intention of benefiting the construction industry that has long suffered quality issues. The construction processes have been a focus with the aim of integrating quality into scheduling to minimise defects in the industry and construction phase, particularly the finishing trades which become more pedantic.

The research will focus on highlighting the current faults in construction and ways of minimising the occurrences. With the use of scheduling, integration of quality will be tested in order to minimise poor quality work.

2. Background

In every building there is a stage that so many trades are involved in to the extent that trade-density is very high and the potential for problems is likewise high. This being the reason that the need for better improved quality, in particular through scheduling to minimise defects is important and could possibly be a foot forward in the construction industry if a successful blueprint can be achieved.

3. Methodology

The methodology will be the process of identifying possible blueprints to minimise defects in construction. This will be achieved through identifying quality improvement strategies and scheduling types that are best suited to provide a better blueprint. A schedule will be put to use to analyse the affect of defects and whether the amount can be reduced.

4. Key Outcomes

So far it has been noted that defects are a common occurrence. It has come to the point that builders have allowed time and money/contingencies to cover the poor quality work expected from subcontractors. There being methodologies and theories available founded through extensive research, a blueprint schedule does not seem to exist to benefit the finishing trades process with particular focus on minimising defects through quality-led scheduling.

5. Further Work

The research project will still require additional work with regards to types of defects and whether a blueprint can work in any or most types of projects.

6. Conclusions

The project overall helped identify the possibilities of a schedule and possible quality control methods that could be integrated. In doing so, minimising defects can have the potential of improving not only the quality of work performed but also save time and money spent on revisiting works. Hence, the industry will be able to benefit greatly if defects can be minimised during the construction process and not left to the last stretch before the project completion date.

Acknowledgements

References

Ahzahar, N, Karim, NA, Hassan, SH & Eman, J 2011, 'A study of contribution factors to building failures and defects in construction industry', *Procedia Engineering*, *20*, pp.249-255.

Molavi, J & Barral, DL 2016, 'A Construction Procurement Method to Achieve Sustainability in Modular Construction', *Procedia Engineering*, *145*, pp.1362-1369.

Bragadin, MAAKK 2015, 'Safety, Space and Structure Quality Requirements in Construction Scheduling', *Procedia Economics and Finance,* 21**,** 407-414.

Remote Data Acquisition

Sponsor – School of Mechanical and Electrical Engineering

Tristan Turner

Bachelor of Engineering (Honours) (Electrical and Electronic)

Supervisor: A/Prof Alexander Kist, USQ
Keywords: Remote, sensor, Arduino, Raspberry Pi, radio, wireless, transmission

1. Introduction

The aim of this project is to develop and implement a low cost data acquisition system for remote areas. It shall collect data from remote locations where telecommunications infrastructure and mains power isn't available then transmit the data via radio frequency (RF) back to a base station where it can be processed and uploaded to a cloud server.

2. Background

Data acquisition systems are certainly not a new concept as they're already widely used in many industries. However, the majority of the systems utilise either a wired connection or the 3G/4G network to transmit data back to a central unit. Remote locations, where telecommunication infrastructure and mains power isn't available pose a significant challenge for engineers to develop a cost effective and reliable long range system. The agricultural industry would likely be the main beneficiary of this technology as it would allow the monitoring and logging of water levels, flow rates, atmospheric pressure, humidity, temperature, soil moisture etc. which can then be used to improve farming efficiency.

3. Methodology

It was determined that the test system would be implemented with multiple remote data acquisition nodes and a single base station configured in a partial mesh topology (refer to figure 1). This allows the nodes to 'hop' the data from one node to the next until it reaches the base where it can be uploaded to a cloud server and accessed from anywhere in the world. Each node comprises an Arduino microcomputer, RFM98W LoRa RF transceiver, generic temperature sensor and power supply (battery and solar panel). The base station needed greater processing power than the nodes as well as Ethernet capabilities and hence a Raspberry Pi microcomputer was chosen over an Arduino.
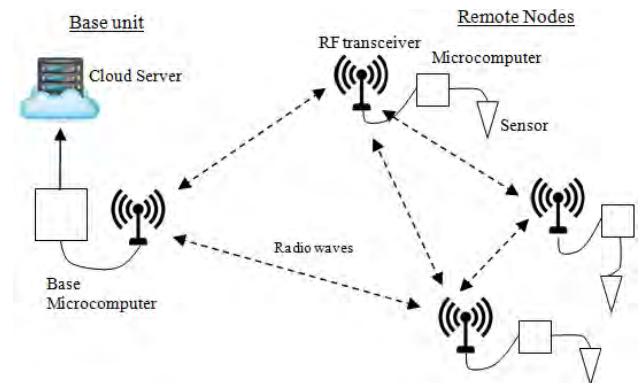

Figure 1: Basic schematic of remote data acquisition system in partial mesh topology

4. Key Outcomes

Key outcomes include identifying the need to develop a mesh network rather than direct transmission from each node to the base. Incorporating LoRa modulation over traditional modulation techniques will significantly improves the range of the system.

5. Further Work

Further work is required to develop programming code to transmit the data between the base and the cloud server and a basic user interface also needs to be created to allow the user to remotely view the data.

6. Conclusions

This project is a low cost solution to transmitting data long distances without using the conventional 3G/4G or satellite transmission methods. The coverage of the system can be increased simply by incorporating more nodes. The project is a proof of concept and upon successful completion it could be up-scaled by disregarding the self imposed 'low cost' limitation and using upgraded system components.

Acknowledgements

I would like to thank my supervisor, A/Prof Alexander Kist for his support and advice and also for keeping me on track through-out the project. I would also like to thank my family, particularly my wife for their patience and support.

References

Downey, C 2013, *Understanding Wireless Range Calculations,* web article, Laird Technologies, London, United Kingdom, viewed 23 March 2016, <http://electronicdesign.com/communications/understanding-wireless-range-calculations>

Design optimisation of human powered e-bike for all Queensland conditions.

Sponsor – School of Mechanical and Electrical Engineering

Student Name: Mohammad Jasim Uddin

Bachelor of Engineering (Mechanical)

Supervisor: Dr. Ray Malpress

(Lecturer: Mechanical Engineering)

Keywords: Human powered e-bike, Fat tyre, Interview.

1. Introduction

Fossil fuel is being exhausted. Our planet is getting warmer and affected day by day because of environment pollution (Ramanathan & Feng 2009). To overcome this issues human powered e-bike can be a contributor to a greener Australia for future generation. Interviews with numbers of the public has informed the design process includes integrated cargo carrying capacity, in build GPS, left-right signalling mechanism, wide tyre to avoid tyre caught in between train lines, anti-theft device. Among them this paper focuses two main safety aspects such as train line bike tyre caught and night time cycling visibility test to avoid accident for all e-bike user.

2. Background

Opinion from 25 interviewee helped to find the barriers and future design features including safety issues. Safety is main concern among most of the e-bike user in Queensland. To avoid unexpected accident this paper contains some useful tests which may improve safety while cycling in the road at day and night. Hence, ordinary bike tyre (55 mm) and wide tyre (75-120 mm) is experimented in two different locations to see whether or not wider bike tyre can illuminate the issue (Monz & Kulmatiski 2016). Night time cycling visibility is a major concern from the cyclist. A left-right indicating device is installed and tested at day and night whether or not motorist can see the cyclist from 100 meter or more.

3. Methodology

Structured interview is collected in phase one whether or not e-bike is a good option for Queensland. Wide tyre experiment is simulated by 40 kg of rice bag and left-right indicating device test is conducted at day and night in phase 2. Results and comparison and recommendation is made according to my findings.

4. Key Outcomes

It has been found that wide tyre ranging from 100 mm and above significantly reduces bike tyre caught in train track. It also found that instead of hand signalling, a left right indicator with build in laser light significantly improve night time cycling visibility from far away ranging from 100 meter and more.

Bike type	Tyre width	Test location	Track gap	5° angle Tyre catch (YES/NOT)	15° angle Tyre catch (YES/NOT)	25° angle Tyre catch (YES/NOT)
Wide tyre mountain bike	100 mm	1	65 mm	No	No	No
		2	72 mm	No	No	No

5. Further Work

Integrated cargo compartment, train and bus station battery charging arrangement, integrated anti-theft device need to introduce for better usability in future.

6. Conclusions

Although wider tyre has some road resistance effect which reduces the battery efficiency, overall this may fix bike tyre caught into train line. Instead of hand signalling a left right indicator device significantly improves visibility at day and night ensuring piece of mind while riding an e-bike.

Acknowledgements

References

Monz, C & Kulmatiski, A 2016, 'The emergence of "fat bikes" in the USA: Trends, potential consequences and management implications', *Journal of Outdoor Recreation and Tourism*, viewed 08/07/2016, <http://www.sciencedirect.com/science/article/pii/S2213078016300056>

Ramanathan, V & Feng, Y 2009, 'Air pollution, greenhouse gases and climate change: Global and regional perspectives', *Atmospheric Environment*, vol. 43, no. 1, pp. 37-50, viewed 9/07/2016, <http://www.sciencedirect.com/science/article/pii/S1352231008008583>

Energy Recovery from Electronic Waste

Anusha Uppalapati

Master of Engineering Science (Power)

Supervisors: Mr Andreas Helwig, USQ

Lecturer (Electro-Mechanical Engineering)

Keywords: Waste, Electronic, Energy

1. Introduction

Electronic-waste represents a form of industrial waste or electronics which is obsolete and in a non-working condition. The electronic waste is rapidly growing. The possibilities of storing e-waste are very less. And so the storage of E-waste is becoming very problematic and hence the entry of E-waste into municipal waste streams has been increasing (de Marco 2008).

The proposed study aims to investigate and implement the method of extracting energy from electronic waste mainly composed of printed circuit boards in the form of thermal fuel composed of liquid and gas by a typical method of pyrolysis. It is estimated that the printed circuit boards accounts for 30 % of the total e-scrap

2. Background

In 2014 the United States stood first in the e-waste generation followed by china, Japan, Germany etc. It is also known that 80% of the e-waste that has become older and is less eco-friendly is imported by the developing nations from the developed countries. The problem arises not only with the disposing of outdated e-waste but also the release of toxic metal content from the e-waste which causes serious threat to the environment and human health as well. Majority of the hazardous materials in the electrical and electronic components are concentrated in the printed circuit boards which accounts on an average about 30 % of the total e-scrap (Kiddee Peeranart 2013).

3. Methodology

The proposed methodology of project aims at developing a new method of recovering energy from electronic waste by chemical pre-solvent treatment. With the chemical dissolution of the Printed circuit boards of electronic waste the energy input to process the e-waste is theorised to be reduced. The experiments are conducted in the laboratory scale for both the pyrolysis method and pre-treatment method.
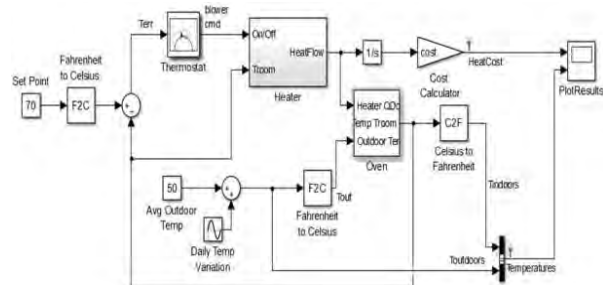

Fig 1 - Preliminary Simulink model of the pyrolysis method

4. Key Outcomes

The first most will be shredding the PCB's to small pieces of 1-2 sq.cm each and directly heated for destructive distillation in the presence of inert atmosphere. The complex hydrocarbon solids will tend to be broken and transform to the lighter fraction of both gas and hydrocarbon liquids. An alternative to this is to pre-dissolve the PCB by the use of phenol based methylene chloride solvent to pre separate the glass fibre and hold the epoxy resin breakdown compounds and plastic residue of other components in the solution. The remaining solid concentrate is then treated to be evaporated and reclaimed and solid residue remaining is then destructive distilled by the method of pyrolysis into energy rich hydrocarbon liquid oils and gases.

5. Conclusions

The project is expected to get desired results including the energy consumption, mass reduction of e-waste, recovered amount of metal content along with energy in the form of thermal fuel and gas.

Acknowledgements

References

Kiddee Peeranart, RN, Ming H Wong 2013, 'Waste management', Electronic waste

de Marco, I, Caballero, B.M., Chomon, M.J., Laresgoiti, M.F.,Torres, A., Fernandez, G., Arnaiz, S 2008, 'Pyrolysis of electrical and electronic waste', vol. 82, pp. 179-183,

Analysis of Reliability and Availability of IEC 61850 based Substation Automation Systems

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Master of Engineering Science (Power)

Supervisors:

Dr Narottam Das (USQ)

Keywords: Substation automation systems, architectures, reliability and availability.

1. Introduction

Electrical power substations play an important role in power generation, transmission and distribution of electricity networks. They control switches, relays and all other microprocessor based controllers, which can be used to control power system equipment are called "Intelligent electronic devices (IEDs)". Therefore, there is always need to analyse and keep a recording of the data communications among the IED's in substation automation systems (SAS) for maintaining the reliability and availability of power networks.

2. Background

The importance of this project is, there are different architectures such as a star, ring and cascaded topologies are used for the data communications in substation using IEC 61850 standards. This project aims to design an architecture which could be having more reliability and availability than the other architectures used in the substations. Before doing this project I was just having the knowledge of the substation architectures, but now I am analysing the characteristics of the architectures of the substation.

3. Methodology

I am using both calculation method and also the network simulation method for analysing the architecture with the best reliability and availability. OPNET software is used for the network simulation and designing of the architectures. In the calculation method ring topology, cascaded topology and general bay architecture is considered for the reliability and availability comparison. Break failure protection is used for the analysing the architectures. Reliability block diagram is used in the calculating the reliability and availability of all the architectures.
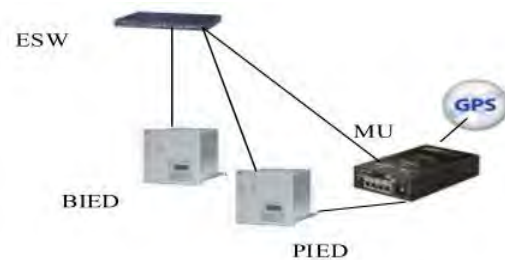

Figure 1: General Bay Protection structure (Mike Mekkanen 2013).

4. Key Outcomes

Outcomes of this project are more useful for the substation and the power industry. The substations are more beneficial to this project as there can be a network available with more reliability and availability if this project gets sucussed. There will be an increase in the power quality. Reducing the usage of the energy by developing the best architecture for substation automation system.

5. Further Work

The work is going on the OPNET software for construction of the architectures. After construction of the architectures through OPNET using the simulation the architectures can be tested for the reliability and availability. Once it is finished, hopefully, a new network model can be available for using in the real world with good reliability and availability.

6. Conclusions

As this project aims at the reliability and availability by increasing of which means the more efficiency. And the reduction in the use of more energy.

Acknowledgements

References

Konig J., et al. (2013). "Reliability analysis of the substation automation system functions using PRMs." *IEEE transactions on Smart Grid* 4(1): 206-213.

Mekkanen, M., eta al (2013) Reliability evaluation and comparison for next-generation substation function based on IEC 61850 using Monte Carlo simulation communications, signal processing and their applications (ICCSPA), *2013 1st International Conference on IEEE.*

Das, N. and S. Islam (2014) Analysis of power system communication architectures between substations using IEC 61850. Engineering and Technology (BICET 2014), *5th Brunei International conference on IET.*

Modelling Water Allocation Increases Using Climate Predictions

Daniel Verrall

Bachelor of Engineering (Honours) (Civil)

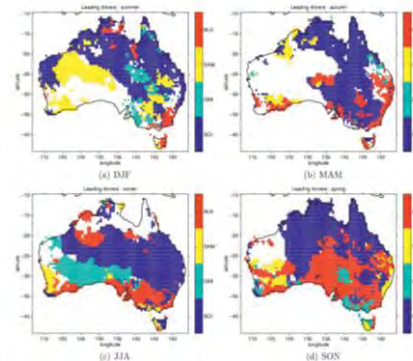Supervisors: Justine Baillie, USQ

Keywords: streamflow, ENSO, climate

1. Introduction

Water allocations in Australia often commence at the start of the year with less than 100% supply and rely on seasonal streamflows into dams throughout the year to meet demand. Therefore more than ever, water allocation models are used with forward planning in order to effectively predict when increases in water demand are needed. This dissertation focuses on developing a water allocation model incorporating climate forecasts for Cressbrook Dam, a major water supplier for the regional town of Toowoomba.

2. Background

As Australia's second largest inland city, Toowoomba faces the challenge of finding more water resources to keep up with increasing demand. With little literature applying climate to real world problems, a thorough investigation of a number of different climate indices will be used to determine which index has the most influence over the Cressbrook Dam catchment area during the different seasons of the year.

3. Methodology

After determining the best climate index of ENSO (**Figure 1**), the methodology is broken into three different parts. Firstly a water balance model is created which incorporates the volumes of the previous day, streamflows, rainfall, evaporation, infiltration, water draft, water spillage, and water releases from Cressbrook Dam. Secondly the streamflow data available is analysed on both a monthly and seasonal basis to determine if there is a correlation between SOI and streamflow with a continual lag increase. Lastly the water balance model and the streamflow prediction model are combined by developing cumulative probability distributions of available water volumes that is associated with the lag SOI phases found in the previous analysis.

4. Key Outcomes

The analysis between streamflow and SOI shows that there is a significant correlation in months of December

Figure 1: Seasonal Climate Index Correlations (*Risbey et.al, 2009*)

to March which is further strengthened when looking at a seasonal scale. The cumulative probability distributions of volume storages show results with a major difference between the negative and the positive SOI phase with falling, rising, neutral and all SOI phases being roughly the same in terms of percentage exceedance and the announced water allocation.

5. Further Work

Future extensions that could lead from this dissertation includes applying the same methodology and modelling to a number of different catchments to determine the true accuracy of SOI-streamflow relationship and its associated modelling and whether a larger catchment is likely to produce improved modelling results than that of Cressbrook Dam.

6. Conclusions

There is enough evidence (even with limited streamflow data) to suggest that a relationship between streamflow and SOI is strong enough to apply an accurate water allocation model to the summer months of Cressbrook Dam. The combined water balance and streamflow prediction model shows that there is a significant difference between the negative and positive SOI phases. A positive phase shows to a higher percentage of exceedance for higher water allocations whereas a negative SOI phases shows the opposite results.

Acknowledgements

References

Risbey, JS, Pook, MJ, McIntosh, PC, Wheeler, MC & Hendon, HH, 2009, *On the remote drivers of rainfall variability in Australia*, Monthly Weather Review, 137(10), pp. 3233-3253.

Grid Response to Generation Transients

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(Electrical and Electronic)

Supervisors:
Mr Andreas Helwig (USQ)
Dr Narottam Das (USQ)

Keywords: Generation Transients, Grid Response, Large Photovoltaic System.

1. Introduction

Non-renewable sources of energy such as coal, gas and oil used in Australian power stations will reduce in usage in the future. Renewable sources of energy still have inherent issues that need to be rectified in order to become cost effective alternatives to non-renewable sources. Transient weather events and in particular cloud transients, is one of the issues faced by large PV installations. In order to become an economically viable alternative, this needs to be resolved.

2. Background

To date there has been limited research conducted into the effects of cloud transients on large PV installations, or how these impact on large supply guarantees for the Australian Energy Market. By gaining a better understanding of this issue and the related effects on power output from large PV installations, more grid connected generation sites will begin to consider renewable sources of energy. This project aims to investigate the effects of transient weather events on large PV generation sites and to design a Battery Energy Storage System (BESS) to respond to these transient weather events.

3. Methodology

Two different software packages chosen for the simulation of cloud transient impacts were MATLAB-SIMULINK and HOMER ENERGY. Due to the lack of recorded data on large photovoltaic sites under Australia, a theoretical 1 MW system consisting of five, 200 kW arrays were used for simulation purposes. The two variables that impact the array power outputs are cloud speed and cloud coverage. The effect of cloud coverage on the power and voltage output of PV panels can be seen above in figure 1. To represent real-life cloud transient these two variables were tested for a variety of different values to determine how each combination affects the power output from the panels. The worst case scenario and size of the system will be required to design and appropriately size a battery backup system.
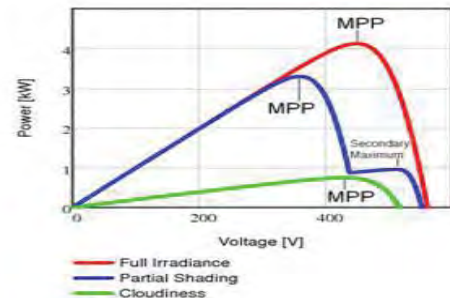

Figure 1 – Effect of cloud cover on power/voltage output.

4. Key Outcomes

The outcomes for this project will be beneficial for both industry and the environment. Industry will benefit from the development of a battery energy storage system with an improvement in reliability. Improved reliability means less costs associated with loss of generation. In making PV installations more economically viable, this will entice businesses to invest in solar power which means less pollution.

5. Further Work

Work is currently being conducted on the simulation and design phase of the battery backup system. Once completed, a generic model will be made to appropriately size a battery system for any large PV system. If time permits an investigation into costs associated with transient events will be conducted to determine the full economic benefit.

6. Conclusions

Cloud transients result in the sudden and often unexpected reduction or loss of power output from PV installations. For grid connected PV, this sudden loss of generation is costly and unacceptable. It is vital that the BESS is appropriately designed and sized to cater for the individual system.

Acknowledgements

References

Best, S. (2008), 'Solar Invertors and the issue of EMC Compliance',<http://www.interferencetechnology.com/solar-inverters-and-the-issue-of-emc-compliance>

Salameh, Z, Borowy, B (1996), 'Methodology for Optimally Sizing the Combination of a Battery Bank and PV array in a Wind/ PV Hybrid System', IEEE Trans. Energy Convers. vol. 11, no. 2, pp. 367-375, June 1996.

Agarwal, V, Patel, H (2008), 'MATLAB-Based Modeling to Study the Effects of Partial Shading on PV Array Characteristics', IEEE Trans. Energy Convers. vol. 23, no. 1, pp. 302-310, Mar. 2008.

Integration Effectiveness between Engineering Teams on Complex Defence Programs

School of Mechanical and Electrical Engineering

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Bachelor of Engineering (Honours) (Mechanical)

Supervisors: Mr Bob Fulcher, USQ

Keywords: Engineering integration, integrating factors, program management

1. Introduction

As programs grow in size and complexity, it is necessary to form sub-teams of engineers to break down the work to manageable portions. These teams, referred to in isolation as 'silos', typically focus on a specialised technical discipline (software, avionics, electrical, etc.). How well teams combine their work, or horizontally integrate, is a huge contributor to the success of a program, in terms of meeting the customer's needs, within cost and schedule.

2. Background

The integration of teams is hugely important for Defence, due to the complexity and size of programs, as well as geographic and political challenges. This drives segregation of engineering efforts, as shown in Figure 1. To realign teams in a common direction, develop an integrated product and achieve a successful program outcome, integrating factors are applied. The identification and evaluation of these integrating factors in Complex Defence Programs emerged as a gap in identified literature, and as such is the focus of my research.

3. Methodology

The research conducted was primarily qualitative, based upon the perspectives of subject program team members. The identification of integrating factors was achieved through a review of Systems Engineering literature, and the observations recorded in interviews. The evaluation of these factors has been subjective, but I have sought to quantify results by identifying trends for recurring perspectives through the use of surveys.

4. Key Outcomes

The goal of my research is to propose techniques teams can use to integrate the efforts of teams and get the best
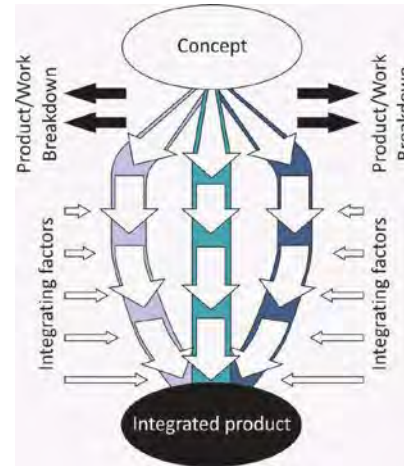

Figure 1 – The role of integration on Defence programs

result for the program. In doing this, I've needed to define the value of integrating teams, identify what can be done to integrate teams, and evaluate the efficiency of integration efforts.

5. Further Work

Analysis of collected interview data is ongoing, and should be reinforced by further surveys, to ensure that significant trends in the perceptions of integrating factors are established.

6. Conclusions

The preliminary findings are that programs are more likely to have an integrated product, if teams regularly interact through the whole of development, sharing technical perspectives. Notably, individuals require prompting to interact, through the direction of management. Team goals may be aligned through team charters and performance management, and formal mechanisms may be put in place to drive interaction, including the formation of Integration teams, and dedicated program meetings. Utilizing these techniques is likely to mitigate the risk of an un-integrated product.

Acknowledgements

References

Baiden, B. K. & Price, A. D. F., 2011. The effect of integration on project delivery team effectiveness. International Journal of Project Management, Volume 29, pp. 129-136.

NASA, 2007. NASA Systems Engineering Handbook. NASA/SP-2007-6105 ed. s.l.:s.n.

Modeling and analysis of multi-junction solar cells (MJSCs) to improve the conversion efficiency using MATLAB/Simulink

Sponsor-School of Mechanical and Electrical Engineering

Zhe Wang

Master of Engineering Science (Power)

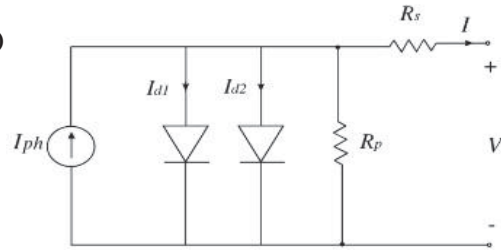Supervisors: Dr.Narottam Das

Figure1. A circuit model of practical PV cell

Key words: PV, MPPT, efficiency improvement

1.Introduction

This project mainly focuses on modeling of multi-junction solar cells (MJSCs) to increase the conversion efficiency of the cells by using MATLAB/Simulink software. Theoretical research on double and single-exponential diode model, and then proceed for MJSCs modelling to investigate and obtain its maximum performance with the comparison of conventional PV cell.

2. Background

Photovoltaic (PV) cells are an integral part of solar-electric energy systems, which are becoming increasingly important as alternative sources of utility power. PV cell is a specialized semiconductor diode that converts visible light into direct current (DC).

3. Methodology

1.Literature review of few current methods of PV cells including theories structure and performance.

2.Double and single-exponential diode model, and then proceed for MJSCs modeling to investigate and obtain its maximum performance.

3.Compare the performance of single, dual, and tandem cell. It will also be compared in terms of generated power and voltage.

5.Compare the performance of MPPT results based on the techniques.

6.Thermoelectric generator (TEG) will also be considered with the PV modules for conversion efficiency improvement.

4. Anticipated outcomes

Double exponential diode model has a better performance than sing exponential diode model in theory modeling. Photovoltaic advancements in the fields of thin film materials will continue to flourish and soon increase PV efficiency.

5. Further work

Depending on the my specification to do simulation and results analyze, if possible, I will focus on the temperature influence in PV cells performance.

6. Conclusion

The project is under the schedule. In project, all the results will be compared to conventional PV cells.

Acknowledgments

In here, I will express my most sincere and deepest gratitude to my supervisor Narottam Das not only for his criticism, guidance, encouragement, patience and insight throughout the project, but also for his assist in helping me building up my confidence and his valuable contribution to my future career.

Reference

H. Felten, A. Kreutzmann, and P. Welter, "Increase in grid-connected PV system power in germany," Photovoltaic Energy Conversion, 2006.

I.Altas and A.Sharaf, "A photovoltaic array simulation model for matlab simulink gui environment," Clean Electrical Power, 2007.

Strategic Asset Management Framework for the Improvement of Large Scale PV Power Plants in Australia

Sponsor –School of Mechanical and Electrical Engineering

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Master of Engineering Science (Electrical and Electronics)
 Supervisors: Dr Nateque Mahmood, USQ
Dr Narottam Das, USQ
Keywords: **AMC, ISO55000, AAMCoG**

1. Introduction

The stringent environmental regulations and higher energy demands due to increasing population are main concerns for the energy industries. In order to comply with the environmental regulations and also to improve the energy supply of large scale photovoltaic (PV) power plants are developing rapidly as an alternative energy source to fossil fuels. Management of large scale PV power plants has become a challenging issue mainly due to the absence of less structured strategic asset management framework**.**

 This research has addressed to this gap and proposed a well-structured strategic asset management framework for large scale PV power plants. The study have also pointed out that due to lack of clear policies and without having a specific framework for PV or solar assets, Australia is lagging behind in the production of solar energy than Europe and Asian countries despite having highest solar radiation per kilometer square. The proposed framework will provide a basis for understanding the current status of individual solar farms and the way forward to improve the asset management capabilities**.**

2. Background

The main purpose of this research is to explore the current asset management frameworks, the main elements and components of asset management framework, identify the gaps and then finally proposed a new strategic asset management framework for the improvement of large scale PV power plants in Australia.

3. Methodology

In this study, a systematic data gathering process was followed based on descriptive and qualitative data analysis. Several relevant journals, conference proceedings, books, and industry standards frameworks such as ISO 55000, AAMCoG and AMC and reports are identified to develop the most appropriate practice asset management for the solar energy industries in Australia.

4. Key Outcomes

The objectives of the developed framework (as shown in Figure 1) are to integrate and make stronger links between all the elements which will allow top managers to improve the credibility of the decision making process and it improves the standards and cores of management practices.

Figure 1 – Proposed strategic asset management framework for solar farms

5. Further Work

Further research can be carried out to estimate the cost benefits of any improvements that organization can achieve using the proposed framework.

6. Conclusions

The proposed framework could be used in assessing the strengths and weaknesses of the current asset management processes and practice areas of solar or PV farms. It can also assist to critically review and analyze the asset management system of an organization with respect to making improvements in service delivery and fulfill the user's requirement.

Acknowledgements

References

AAMCoG. (2011). Guide to Integrated Strategic Asset Management: Australian Asset Management Collaborative Group (AAMCoG) and Cooperative Research Centre for Integrated Engineering Asset Management (CIEAM) Brisbane, QLD.

Mahmood, M. N., Dhakal, S., Wiewiora, A., Brown, K., & Keast, R. (2015). A comparative study on asset management capability maturity models. *International Journal of Strategic Engineering Asset Management, 2*(4), 328-347.

Asset Condition Monitoring of Gympie Regional Council's Road Network

Sponsor – Gympie Regional Council

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Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Nateque Mahmood, USQ

Keywords: asset management, condition assessment, funding allocation

1. Introduction

Gympie Regional Council (GRC) spends between $10M-$15M on roadworks as part of its annual capital works program. Currently, the selection of projects for these programs relies heavily on customer complaints, councillor requests and feedback from GRCs Construction and Maintenance Branch. GRCs Design Service Division have identified a need for this process to include quantifiable asset condition data, giving the project selection process a consistent and impartial foundation. This project seeks to define a process which will result in the collection of road condition data which can then be used to identify road segments in need of capital works.

2. Background

Road condition assessments seek to provide an indication of the overall condition of the road by identifying and recording defects in the road pavement and surfacing. As road condition is linked to the age of the asset, road segments found with high defect rates, thus approaching the end of their useful life, can be programmed in for capital works. The goal is to provide a reliable long term capital works program to ensure optimal distribution of the available funding.

3. Methodology

An analysis of the available literature covering road condition assessments was undertaken. This included nationally recognised best-practice manuals by Austroads, to research papers addressing state of the art data collection techniques. GRCs practices regarding road condition assessment were reviewed. This lead to conducting a gap analysis between GRCs existing road inspection procedure and what is currently accepted as best-practice. The above-mentioned research, review and gap analysis provided the platform for the development of draft corporate documents for GRC concerning road condition assessment, including an operational framework and procedure.

4. Key Outcomes

The key outcome of the research was that with moderate modifications, GRCs existing asset maintenance inspection program has the capacity to include asset condition assessments. The modifications would centre on the following findings:

- Quality data must be collected and used; otherwise there will be little confidence in the outputs of the system.

- From a strategic planning standpoint, the condition of a road does not change rapidly. Therefore, frequent inspection cycles are unnecessary and uneconomical.

- The amount of roadworks that can be undertaken is ultimately controlled by the available funding. Therefore, the number of candidate projects is limited by this and the scope of condition inspections should reflect this.

5. Further Work

Beyond this project, the next step will be to collect the condition data on GRCs road network and put the procedure to work. From there, a process of evaluation and review can be implemented to ensure that GRC benefits from the process as much as possible.

6. Conclusions

In conclusion, the establishment of a road condition assessment program for GRC is very much achievable in the short term. This will lead to increased confidence in the outputs of the capital works programming process.

Circuit Breaker Simulator – Operation & Behaviour Under Faulted Power System Conditions
School of Mechanical and Electrical Engineering

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Supervisors: Dr Tony Ahfock, USQ

Keywords: Single Pole Circuit Breaker, Mayr Arc Model, Cassie Arc Model

Figure 1 – Fault Current

1. Introduction

To maintain the ever increasing supply and reliability demands whilst meeting economic and environmental concerns electrical transmission and distribution companies must have fewer transmission lines that are reliably capable of supplying very large amounts of power. This is often achieved by installing EHV (Extra-High Voltage) transmission lines which become backbones to the electricity network. When EHV backbones are utilised it is intuitive that additional reliability measures must be implemented to prevent mass outages in the case of system fault; this is often achieved by the application of single pole tripping and reclosure.

2. Background

It has been proven that single pole tripping vastly increases reliability; however, it is also important to note that it greatly increases the complexity of system events and the subsequent protection and control devices. Due to the additional complexity important characteristics such as circuit breaker clearance times are often assumed as the largest practicable time instead of a system specific time being calculated. Hence, there is an additional need to understand, determine, and model the behaviour of three phase networks that operate with a single pole tripping schemes.

3. Methodology

Mathworks Simulink Simscape Power Systems was utilised to simulate an entire portion of transmission network under numerous system conditions. Definite Time, Mayr and Cassie circuit breaker arc models were employed at numerous variations of system condition to achieve a realistic determination of circuit breaker clearance time under each faulted scenario.
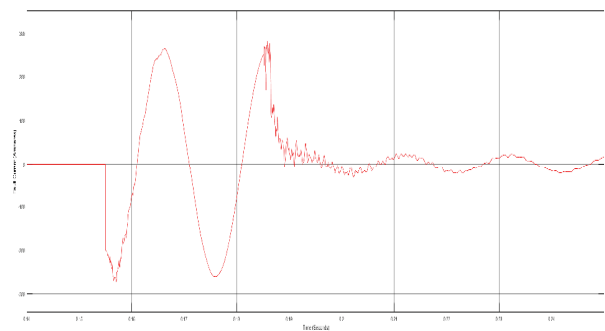
4. Key Outcomes

A technique to produce a realistic simulation model of a transmission network was established. Figure 1 is a good representation of the fault current modelling achieved. Definite Time, Mayr and Cassie arc models were simulated under numerous network conditions to determine a worst case circuit breaker clearance time.

5. Further Work

All project objectives have been addressed; however, investigations into hybrid Cassie-Mayr arc models and utilisation of different modelling software are two major items that could be investigated as further work.

6. Conclusions

In conclusion a technique to determine the maximum circuit breaker clearance time was established; this technique was utilised within a specific case study to achieve a time of 27ms. Subsequently, a generic minimum circuit breaker failure time of 94.2ms was established.

Acknowledgements

References

GE Group (2002). Protective Relays High Voltage Transmission Line Protection with Single Pole Tripping and Reclosing.

Gustavsson, N. (2004). Evaluation and Simulation of Black-box Arc Models for High Voltage Circuit-breakers. Linkopings University.

Tracking Machinery to investigate the effect of Compaction during Sugar Cane Harvesting

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Supervisor: Dr Troy Jensen, USQ

Keywords: Tracking Machinery, Compaction, Sugar Cane

1. Introduction

Technology within the agricultural industry has advanced exponentially over the past decade with the introduction of larger machines and GPS guidance. The use of larger machines means that the weight now passing over the soil is now larger than the critical amount that the soil can handle. Soil compaction has become a prevalent problem in modern agriculture. Due to the larger machines the soil compaction has become an even bigger problem for different operations such as planting, spraying and harvesting. This project will investigate the compaction caused during the harvesting of sugar cane.

2. Background

It is important for the knowledge around compaction to be updated as the machinery used within the agricultural industry advances. This ensures that all practices being used are maintaining the health of the soil as much as possible. Existing knowledge is built on by investigating the different scenarios that can occur during sugar harvesting and linking the compaction data to loss of yield for the producer.

3. Methodology

Compaction will be assessed by taking soil cores to determine the change in bulk density before and after harvesting. Soil cores taken from the traffic lane will be compared between 2, 3 and 4 load-out passes to assess the damage.

Machinery tracking will be completed by attaching GPS units to each load out bin and the breadcrumb trail logged will be then compared to the known points of the traffic lane. Some interrogation will then yield for

Figure 1 – Sugar Cane Harvester

how long of the run that the machine passed over the growing bed.

4. Key Outcomes

Investigating this area of agriculture has further improved my knowledge of soil compaction and shown the need to develop an even more extensive base of knowledge in this area. Testing has not yet been completed; therefore results and outcomes for this project are still to be concluded.

5. Further Work

Further work in this area would include conducting tests at different moisture contents to ensure the validity of results. As new machines are developed, testing should be conducted to investigate if there are any specific differences between machines that may incur a change in production practices.

6. Conclusions

Testing is still to be conducted and therefore no conclusions have been made at this stage. The findings from this project will reveal the accuracy of load out bin driving and show the effect if they are not driven correctly in the traffic lane.

Acknowledgements

References

Antille, D. L., Bennett, J. M., & Jensen, T. A. (2016). Soil compaction and controlled traffic considerations in Australian cotton-farming systems. *Crop and Pasture Science, 67*(1), 1-28.

Defossez, P., & Richard, G. (2002). Models of soil compaction due to traffic and their evaluation. *Soil and Tillage Research, 67*(1), 41-64.

Soane, B. D., & van Ouwerkerk, C. (1994). *Soil Compaction in Crop Production*. Amsterdam: ELSEVIER SCIENCE B.V.

Remote Access Intravenous (IV) Pump Emulator Training System

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Supervisor: Mrs Catherine Hills, USQ

Keywords: PLC, HMI, IV Pump, Nursing, Automation.

1. Introduction

Remote Access Laboratory (RAL) based learning is fairly uncommon outside of engineering faculties. However, due to an increasing number of online higher education alternatives dominating traditional on-campus education options, and the sheer number of nurses spread across Australia, nursing and midwifery disciplines present another candidate for remote access learning applications. The project aim is to develop a flexible remotely accessible IV pump emulator (IVPE) for nursing and midwifery students based on a web server enabled Human to Machine Interface (HMI) operator panel and a Programmable Logic Controller (PLC). The IVPE will be based on the CareFusion Alaris® IV Pump (See Fig. 1).

2. Background

This project extends from an IVPE designed in 2012 for a Baxter IV Pump. Since its development, the Baxter IVPE has been used in teaching and research. The Baxter IV pump is no longer commonly used in Australian health facilities and teaching practices. USQ's School of Nursing and Midwifery is currently teaching IV administrations with the CareFusion Alaris® (See Fig. 1), it is also a commonly used pump across Australia.

3. Methodology

A literature review was conducted to mainly examine previous work completed in this area, remote access technologies and their learning applications. The IVPE required ladder logic and HMI software design (See Fig. 2). The basis of the HMI was designed first and then PLC was incorporated, final stages of design involved PLC and HMI simultaneously. Data can be imported/exported between the PLC program and the HMI program.

4. Key Outcomes

Key outcomes for this project were the development of an easily accessible training tool that is user friendly,

Figure 1 - CareFusion Alaris® PC and two pumps

Figure 2 - Alaris IVPE during software simulation

realistic, and incorporates learning resources, a learning mode and an assessment mode.

5. Further Work

Minor aspects of the software require further refinement. Further work to be included, if time allows, will be additional learning resources and analysis of assessment mode results.

6. Conclusions

With the use of forefront industrial automations technology and realistic, user-friendly design, this project has produced an enhanced training tool for IV pump training and assessment purposes that adequately fulfils project specifications.

Acknowledgements

I would like to sincerely thank Mrs. Catherine Hills for her enduring guidance, support and time. I would also like to thank my partner, Sathya, and my family for their continual support and understanding.

References

Osbourne, D. B. (2012). IV infusion pump training emulator. University of Southern Queensland.

Terry, V. R., Moloney, C., Bowtell, L., & Terry, P. C. (2016). Online intravenous pump emulator: As effective as face-to-face simulation for training nursing students. Nurse Education Today, 40, 198-203.

Development of New Methodologies to Establish Appropriate Speed Limits on Queensland Roads

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Supervisors: Ron Ayers, USQ

Peter Bilton, Point8 Pty Ltd

Keywords: Speed Limits, MUTCD Part 4, Road Safety

1. Introduction

Queensland speed limits are assessed against the guidelines outlined within Part 4 of the Manual of Uniform Traffic Control Devices (MUTCD Part 4). This set of guidelines is maintained by the Department of Transport and Main Roads.

This project was undertaken in order to develop recommendations for future revisions of MUTCD Part 4 that meet the needs of local government and industry users.

2. Background

The current framework outlined within MUTCD Part 4 can be difficult for practitioners to follow and often adds unnecessary cost and complexity to speed zoning processes. Results between different users may be inconsistent as a result. It is also structured towards application on State roads, which means that it does not consistently align with local government needs regarding transport planning and traffic operations. MUTCD Part 4 requires amendments to particular elements in order to increase practicality in application and ensure consistent speed zoning in Queensland.

3. Methodology

Local and international guidelines for speed zoning were reviewed to understand the processes undertaken by other road authorities. The possibility of using speed measuring technology and risk assessment tools to analyse speed limits was also considered.

Interviews were conducted to identify stakeholder issues with MUTCD Part 4, and to assist in making informed recommendations for future revisions.

Case studies were conducted using different speed zoning processes on a sample of roads to identify the strengths and weaknesses of processes used by other state and international road authorities. These results were compared to those obtained using MUTCD Part 4.

4. Key Outcomes

Project tasks highlighted numerous aspects of MUTCD Part 4 that could be improved and provided a basis for recommendations to be considered in future revisions of the guidelines.

Suggested recommendations include amendments to road function classification, criteria-based speed limits for all speed limits, flowchart mapping of processes for clarity, inclusion of design guidance to effect speed reductions and updates to QLIMITS.

5. Further Work

The next action is to engage The Department of Transport and Main Roads to discuss the project and suggested recommendations for consideration in future amendments to MUTCD Part 4.

6. Conclusions

If adopted by the Department of Transport and Main Roads, future amendments to MUTCD Part 4 may result in more consistency in speed zoning practise and provide a document that will be practical for transport planning purposes.

References

The Department of Main Roads and Transport. (2015). Manual of Uniform Traffic Control Devices Part 4 Speed Controls. Brisbane: Queensland Government.

Guide to Road Safety Part 3: Speed Limits and Speed Management. (2008). Sydney: Austroads.

Jurewicz, C., Phillips, C., Tziotis, M., & Turner, B. (2014). *Model National Guidelines for Setting Speed Limits at High-risk Locations*. Sydney: Austroads.

Deterioration of Timber Bridges Using A Fault Tree Analysis

School of Civil Engineering and Surveying

Matthew Wilson

Bachelor of Engineering (Civil)

Supervisors: Dr Weena Lokuge, USQ

Keywords: Deterioration, Timber, Structures.

1. Introduction

The Department of Transport and Main Roads (TMR, Mackay/Whitsunday) has responsibility of 2,670 kilometres of road network with 297 bridges (62 timber bridges). The majority of timber bridges were constructed in the early 20th century which is indicative of their current Condition State (CS). Generally timber bridges have performed well under the conditions they are subjected to, however due to the period since constructed, the life of the bridges are nearing their end.

TMR is responsible for the maintenance and condition of timber bridges which is conducted through bridge inspection reports, Bridge Asset Management (BAM), Whichbridge and Bridge Information Systems (BIS). Bridge inspection reports are documented and entered into BIS which is controlled by the BAM and analysed by the Whichbridge software. It is predicted that Condition States of timber bridges can be analysed using algorithms, however probability deterioration of these timber bridges cannot be determined until the failure occurs.

2. Background

The scheduling and funding provided for timber bridges are limited to inspection reports and the rating given from the Whichbridge program. On this basis, the aim of the project is to provide a relevant probability of timber bridge deterioration using a Fault Tree Analysis of the failing components. Further development of the objectives within this report are to determine the probability of timber bridges to move Condition State, identify the possible deterioration mechanisms within the timber structure and to compare the probability of movement and the causes with deterioration probability software.

3. Methodology

A quantitative methodology is used to investigate the deterioration of timber bridges using a fault tree analysis. Inspection reports are to be investigated and used to determine the available and necessary data. This data will be subjected to a model which will depict the condition state of each component. The condition state from the quantitative data will be exposed to the Markov Chain (eq. 1) to illustrate the probability of a component moving condition states over a two and three year periods.
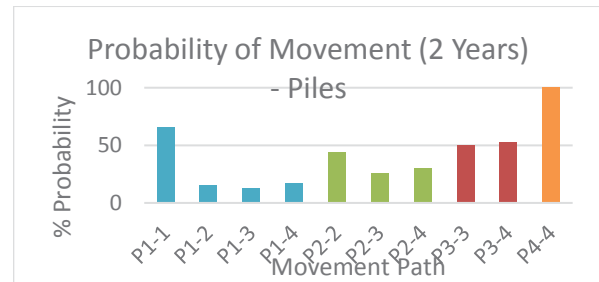

Figure 1 – Probability of Movement for Piles

After a probability is established, the component can then be mapped using the fault tree analysis which will depict the path a fault will take and the probability of this fault will occur.

4. Key Outcomes

The key objectives of this dissertation is to provide a probability analysis of components moving condition states over constant time periods. This analysis will aim to provide a deterioration model, in which a component of a timber bridge can be tracked to depict the probability of a condition state movement and the path the fault would follow.

Once each inspection report is recorded over that given period (2, 3 years) the data was then subjected to Markov Chain which then provides a probability of movement (e.g. 1 to a 3). To ensure data was correct, each component was followed directly from one period to the following.

5. Further Work

Further work after the dissertation has been completed could be the investigation into the probability of movement from other causes (e.g. flood, fire). The same method could be used, however in a different situation.

6. Conclusions

Conclusions from this dissertation will depict the representation of movement of condition states for timber bridge components. This report will show the reader the probability a condition state movement will occur over a 2 and 3 year period and the path the fault has taken (e.g. fungal, termite etc.). This analysis can be used for planning maintenance activities and cost analysis/scheduling.

Acknowledgements

Behaviour of concrete when using RAP (Reclaimed Asphalt Pavement) as a coarse aggregate material

Sponsor – School of Civil Engineering and Surveying
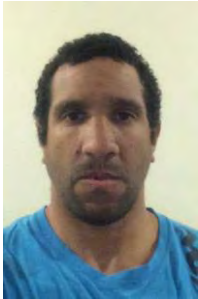
Robert Wiya

Bachelor of Engineering (Honours) (Civil)

Supervisors: Assoc Prof Yan Zhuge, USQ

Keywords: RAP, concrete, reclaimed asphalt pavement.

1. Introduction

This project researches the potential use of reclaimed asphalt pavement (RAP) as a potential coarse aggregate replacement in concrete.

For the purposes of the dissertation RAP was used in 0%, 20%, 40%, 60%, 80% and 100% increments in a 25MPa mix. The cylinders were then tested in a NATA approved laboratory in compression and for modulus of elasticity.

2. Background

Concrete is the most widely used product in the construction industry and the environmental and social cost of procuring the required components is quite vast.

In 2006-07 Australia produced more than 43.8 million tonnes of waste of which 38% was from the construction and demolition sector (Statistics, 2013). This waste has the potential to be recycled and reused to decrease the need for virgin materials.

There has been a significant amount of research undertaken all around the world into the use of RAP in pavement technology but limited amount for the use of RAP in concrete.

During the pavements normal lifecycle the binder content will undergo an ageing process and deterioration that will continue even after the pavement has been milled and processed (De Lira, Cortes, & Pasten, 2015). The project attempts to find out if the binder content and the level of oxidation that the RAP has undergone will affect the plastic and hardened state properties of the concrete when RAP is used as a coarse aggregate.

3. Methodology

Six batches of concrete with each containing different proportions of RAP and virgin aggregate were produced for the purposes of compression and modulus of elasticity testing. Modulus testing will only be done on the batches containing 0%, 60% and 100% RAP due to lab constraints. All batching and testing of the samples will been done in accordance with the Australian Standard AS1012.

Testing will be completed at the Roads and Maritime Services (RMS) NATA approved laboratory in Russel Vale, New South Wales and Boral Materials Technical Services Laboratory, Winston Hills.

4. Further Work

Batching and the final testing of the samples are to be completed within the next few weeks.

5. Conclusions

Assembling of the data and further analysis to determine if the amount of included RAP in the batch affects the properties of concrete is still to be completed.

Acknowledgements

References

De Lira, R. R., Cortes, D. D., & Pasten, C. (2015). Reclaimed asphalt binder aging and its implications in the management of RAP stockpiles. *Construction and Building Materials, 101, Part 1*, 611-616. doi: http://dx.doi.org/10.1016/j.conbuildmat.2015.10.125

Statistics, A. B. o. (2013). Total Waste Generated. Retrieved 31st July, 2016, from http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1370.0~2010~Chapter~Total%20waste%20(6.6.2)

Design, fabrication, performance evaluation and design optimisation of bridge culverts reinforced with GFRP bars
Sponsor – School of Civil Engineering and Surveying

Reece Woolley
Bachelor of Engineering (Honours) (Civil)

Supervisors: Dr Allan Manalo, USQ

Keywords: GFRP, Culverts, Modelling

1. Introduction
Bridge culverts are a widely used structure in modern society. Many of the bridge culverts currently in service, made of corrugated metal or reinforced concrete, are now approaching older age and are deteriorating at a high rate (Alkhrdaji, 2001). These structures are deteriorating due to the corrosion of the reinforcing steel in the concrete. Fibre Reinforced Polymer (FRP) composite materials offer a solution to the erosion of steel and can be incorporated into rehabilitation programs and new designs. FRP composite materials are lightweight, non-corrosive, are high in strength and stiffness, are easily constructed, and can be tailored to satisfy performance requirements (Masuelli, 2013).

2. Background
Currently in Australia there is no design code that relates to the use of FRP materials in concrete structures. Furthermore to this there is no acknowledgement in the Australian Bridge and culvert Design Codes. Glass Fibre Reinforced Polymer (GFRP) reinforcing bars used in concrete bridge culverts, have the ability to increase the lifetime of the structure, due to the non-corrosive nature of the material.

3. Methodology
An experimental design was constructed with the assistance of Inconmat Australia and then tested with respect to the Australian Small Culvert Design Code AS1597.1 – 2010. The W80 wheel loading was applied and the strain in critical bars were recorded using strain gauges. Refer to Figure 1.

4. Key Outcomes
To analyse the behaviour of GFRP bars in concrete bridge culverts. Analysis will provide Inconmat
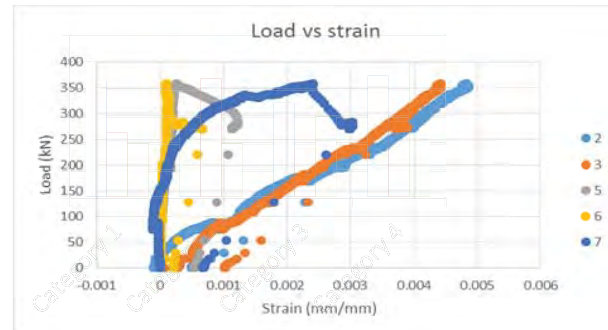

Figure 1 – Applied Load vs Strain results for GFRP reinforced culvert

Australia with a recommendation on where the current design can be optimised.

5. Further Work
The final task remaining before project completion is to model the concrete culverts in the strand7 software package.

6. Conclusions
Testing has indicated that this design significantly surpasses the ultimate limit state requirements. Strain gauge readings show that the recorded bars are not being used to their full strength.

Acknowledgements
I would like to thank my supervisor Dr Allan Manalo who has guided me in my endeavours. Darren Lutze of Inconmat Australia for providing the GFRP reinforced culverts for testing and also Rob Frazer for his assistance in the construction and setup of the culverts.

References
Alkhrdaji, T., & Nanni, A. (2001). *Design, Construction, and Field-Testing of an RC Box Culvert Bridge Reinforced with Glass FRP Bars:* Non-Metallic Reinforcement for Concrete Structrues-FRPRCS-5, Cambridge, 1055-1064.

Masuelli, M. (2013). *Introduction of Fibre-Reinforced Polymers:* Available from: http://www.intechopen.com/books/fiber-reinforced-polymers-the-technology-applied-for-concrete-repair/introduction-of-fibre-reinforced-polymers-polymers-and-composites-concepts-properties-and-processes.

Framework for the developing a Knowledge-based Decision support System for Managing Complex Construction Projects

School of Civil Engineering and Surveying

Sharn Woolnough

Bachelor of Engineering (Civil)
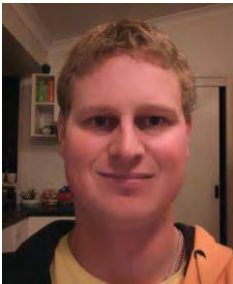
Supervisor: Dr Nateque Mohmood, USQ

Keywords: KBDSS, Framework, Construction

1. Introduction

Construction project management is typically complex and turbulent where decision making is crucial to accomplishing projects or individual milestones effectively. A decision support system greatly aids decision makers in their choices where resources and time are scarce.

Use of knowledge based decision support systems (KBDSS) in construction projects is poorly outlined. This dissertation aims at providing a clear and well defined framework for the development of KBDSS by considering the current literature and industry trends.

2. Background

KBDSS are the most appropriate systems to apply to construction project management. With more effective development and integration into common organisational practices by assisting users to implement and use such systems the industry could greatly improve its performance and competitiveness.

3. Methodology

Collected data is both quantitative and qualitative information. Comprehensive information and data was essential in developing a framework which will be readily adopted and valid for the target user.

The project aimed at grouping extensive literature review and feedback from an industry questionnaire to grasp current trends and requirements. From this data a graphical framework was developed similar to that in figure 1.
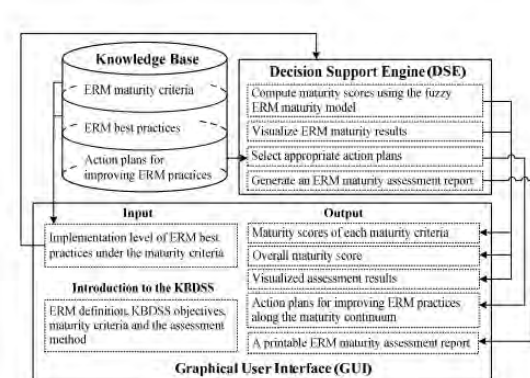

Figure 1 The KBDSS-ERM architecture

4. Key Outcomes

Extensive literature review and questionnaire have been completed, as well as development of the individual frameworks' sub-categories. Unexpectedly the users background and characteristic influence the decision making process, and more importantly, the final decision more than expected.

5. Further Work

The project requires final development of the framework itself including recommendations and findings. It would hope to oversee the development of a KBDSS using the final proposed framework at a future stage.

6. Conclusions

A framework to meet the outcomes resulted in a large than expected as it needed to incorporate additional development and maintenance aspects of the framework. A message form my research is to not underestimate the importance and potential of KBDSS in the future of project management.

Acknowledgements

References

Pascale Zaraté and Shaofeng Liu, 2015, A New Trend for Knowledge Based Decision Support Systems Design, University of Toulouse, France.

James Parkin, 1996, Management Decisions for Engineers

Bader A. Alyoubi, 2015, Decision Support System and Knowledge-Based Strategic Management, International Conference on communication, Management and information Technology, Volume 65.

High Efficiency Class-D Amplifier Magneto-Strictive Ultrasound Water Treatment Application

Sponsor – School of Mechanical and Electrical Engineering

Xue Xia

Master of Engineering Science (Power)

Supervisors:Dr. Les Bowtell

Mechanical and Electrical

Engineering

Keywords: Ultrasound, Class-D, Terfenol-D, water treatment.

1. Introduction

Ultrasonic technology use in water treatment applications has become increasingly popular. To begin with, the preliminary report includes the necessary theory and technology for the High efficiency Class-D amplifier used in this project. Magneto-Strictive procedures were selected to apply in this project because of its high efficiency.

2. Background

People searched for an effective environmentally sustainable method in water treatment for a long time. Then an innovative technology called ultrasound technology was introduced in recent years. The application of power ultrasound to chemical processes is referred to as Sonochemistry, and has become a promising method to remove pollutants from water. Therefore, a large amount of research into the applications of ultrasound in water treatment has occurred in modern times.

3. Methodology

1.Study standard H-bridge inverter topologies and optimize the switching losses for a low power-factor load, specifically a magneto-strictive transducer.

2.Investigate the suitability of a modified H-bridge inverter design with 2 active switches, to more efficiently drive a magneto-strictive transducer.

3.Operate a magneto-strictive transducer with a range of different temperatures and viscosities, observing the changes in transducer resonant frequency.

4.Compare the effectiveness of different applied voltage waveforms, between Square, Sinusoidal and Triangular wave shapes.

Figure 1 shows the block diagram of the digital power amplifier water treatment application.
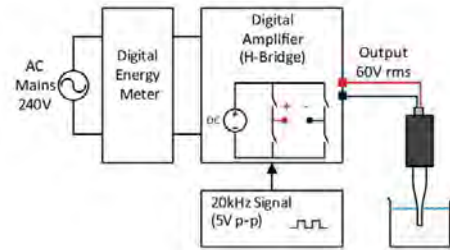

Figure 1 – Block Diagram of digital power amplifier water treatment application

4. Key Outcomes

To design and test a high efficiency digital power amplifier to suit a magneto-strictive Ultrasonic transducer for use in water treatment. The transducers need between 40-100V at a frequency of 10-30kHz, typically 60V rms @ 18.7 for the 25mm horn attachment, higher for the 13mm horn and lower for larger horns.

5. Further Work

The further work will improve the efficiency of power amplifier and apply it to a large-scale industrial water treatment application.

6. Conclusions

Power analyses were conducted to evaluate the efficiency of the system in converting the electrical power into acoustical effects. Class-D amplifier was used to study the performance of the system at different waveforms.

Acknowledgements

References

AH Mahvi 2009 Application of Ultrasonic Technology for Water and Wastewater Treatment, School of Public Health and Center for Environmental Research, Tehran University of Medical Science, Iran, Iranian J Publ Health, Vol.38, No.2, 2009, pp.1-17

Read A.Al-Juboori, Talal Yusaf, Leslie Bowtell, Vasantha Aravinthan,2016, Insights into the scalability of magnetostrictive ultrasound technology for water treatment applications Ultrasonics Sonochemistry 28(2016)357-366

Deepwater Pumped Storage Investigation

Sponsor – School of Mechanical and Electrical Engineering
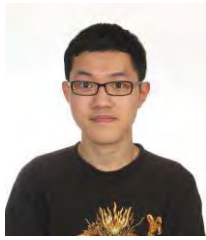
Peijie Xu

Master of Engineering Science (Power)

Supervisor: Mr Andreas Helwig, USQ

Keywords: Energy Storage, deep-water PHESS.

1. Introduction

As the geographical location of Australia in the world, the average insolation in Australia significantly exceeds the values in Europe or North America. However, one of the problems for renewable solar generation it is a highly variable supply where its energy production rarely matches load demand (Clifton & Boruff, 2010). This project is an investigation to seek to determine conceptual models and operation and maintenance costs of deep water pumped hydro-storage system, as well as other multi-discipline area requirements to make this an option for large scale renewable energy storage potential possible in Australia, and even potential energy export to Asia.

2. Background

Deep Water Pumped Hydro-Energy Storage Systems (DWPHESS) is a hydroelectricity energy storage system charged by pumping water out of a large submerged undersea storage chamber or chambers. During discharge the water is allowed to flood the chamber again via a hydro-generation plant entry, with an air snorkel to the surface to allow for the displacement of air in the submerged storage. This project aims to investigate the possibility to store significant quantities of solar energy and export to Asia.

3. Methodology

The methodology applied in this project included literature review, data collection, developing and analysing conceptual models. The first model is accomplished in HOMER Energy software as per Figure 1. The second model is developed in SimPowerSystems (MathWorks, 2016) to simulate the losses in the transmission link from the seafloor to shore hydro-generator HV DC link. This could vary from 15 km to over 500 km. A 500 MW (250 kV – 2 kA) HVDC transmission system will be utilised for this second model.

Figure 1 - HOMER analysis of DWPHESS model

4. Key Outcomes

The literature review identified the potential of DWPHESS storing solar energy in Australia, the advantages and weaknesses of DWPHESS, as well as three potential for transmitting of energy between Australia and Asia. The contribution of this project is proof of concept models and costs of DWPHESS to establish if continuing future research work is warranted.

5. Further Work

Other investigations in addition from three mentioned potential would be processed with HOMER and SimPowerSystems. Further work would also comprise power transmission design and planning.

6. Conclusions

This project, Deepwater Pumped Storage investigation, has explored the potential to store solar energy in northern Australia through pump-storage hydroelectricity facilities, and qantified the potentials to transmit this energy to the high power demand regions within Australia network in Western Australia and Victoria, or to export to Asia countries such as Indonesia and Singapore via storage in the East Timor Sea region.

Acknowledgements

References

Clifton, J & Boruff, BJ 2010, 'Assessing the potential for concentrated solar power development in rural Australia', *Energy Policy*, vol. 38, pp. 5272-5280.

MathWorks 2016, *Simple 6-pulse HVDC transmission system*, MathWorks, viewed 2 June 2016.

Performance of Highway Embankments Constructed Over Deep Soft Soils

Sponsor – School of Civil Engineering and Surveying

Michael Youngberry

Bachelor of Engineering (Civil)

Supervisor: Jo Devine, USQ
              Jim Campbell, RMS

Keywords: Geotechnical, Road, Design, Construction

1. Introduction

The east coast of Australia has significant road networks for transportation needs. Much of this road network is built adjacent to the sea-board over deep soft soils. These soft soils have very low shear strength and permeability, and high compressibility, which present significant challenges to engineers and designers. Various geotechnical ground treatments have evolved to improve stability during construction, reduce time to reach soil consolidation, optimise staging of embankment construction, and minimise long term and differential settlement in service.

2. Background

The project will assess and report on the overall performance of the Ballina Bypass highway embankments to improve our understanding of the performance of highway embankments constructed over deep soft soils.

3. Methodology

Investigate the performance of the Ballina Bypass highway embankments in service by comparing the predicted design longitudinal and differential settlements to the observed/measured settlements since road opening in 2011 and report on cost and performance of each different type of ground treatment.

4. Key Outcomes

A key finding is that the level of performance of the highway embankments in service is not necessarily proportional to the investment made through the design and construction phases. For example, the cost of light weight fill and vacuum consolidation was relatively high when compared to other ground treatment
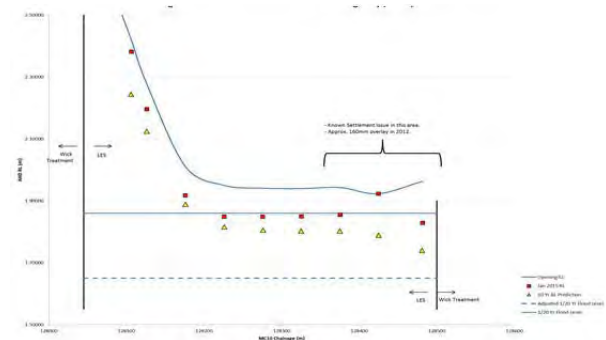

Figure 1: Predicted verse actual settlement Pacific Highway Ballina Bypass STN128400 to STN128500 (max settlement to date is 200mm)

methods but have not performed as well in terms of settlement / ride-ability in service.

The lessons learned from this project will be utilised to enhance the development of the geotechnical design and construction methods on similar soft soil projects in northern NSW by presenting findings at key Roads & Maritime learning workshops and providing "on the job" mentoring for project teams.

5. Further Work

Determine the root cause of the failure mechanisms for the embankment areas that used light weight fill. Further assess the efficiency of the selected ground treatment methods including cost review.

6. Conclusions

Generally, the Ballina Bypass highway embankments have performed in accordance with the predicted design performance. The project utilised ten different ground treatment types, which for future similar projects could be rationalised to gain efficiencies in design, construction and maintenance phases.

Acknowledgements

References

Nil.

Management of Engineering Assets

Sponsor – School of Civil Engineering and Surveying

Student Name: Zijing Yu (Yuri)

0061064149

Master of Engineering Science (Civil)

Supervisors: Associate Professor David Thorpe, USQ

Keywords: hydro-electric; dam; asset management; maximum value; management plan.

1. Introduction

This research project is aiming at investigating current management plan of five hydroelectric dams located in both North Island and South Island New Zealand, and improve the current management process after studying and analysing so that the maximum value of the assets can be achieved.

2. Background

Engineering assets are very valuable construction costing millions of dollars. How to get maximum value out of the asset becomes more and more important. As main electricity providing method in NZ, hydroelectric dams are widely spread through the whole country. Good management reduces administrative cost and the risks. It helps to extend total asset life cycle which will increase the assets' values. Finally, good management is aiming at sustainability which is committed to long-term benefit rather than short-term's.

3. Methodology

This project will be a mainly desk study project, therefore, desk research will be the major methodology for this project. The project is started by some given information from the instructor and the instructor can provide help all the time through the project period. Online research is very important for this project, professional journals may be accessed from USQ library website.

4. Key Outcomes

By finishing this research project, the following outcome are expected to achieve:

- back ground information and literature review
- study current management plan
- improvement on management plan
- estimate the cost

They are all important tasks because they help the engineering assets to get most of their cycles so that the maximum value can be achieved.

5. Further Work

Future work will continue focusing on studying current management plan and find useful information and technologies to improve the plan to achieve the maximum value of the assets. Health and safety plan is another aspect needs future improvement as it is updating all the times. Extended literature review might be needed, it depends on the availability of existing management plans.

6. Conclusions

Hydraulic dams in NZ has provided most of the electricity to the society. Minimising the operating cost will not only reduce the business cost but also reduce the electricity prices. The improved management plan shall include health and safety plans and keep it updated as required. It also helps the hydraulic dams have sustainable development in the future.

Acknowledgements

References

Professor G.E. Petts, 2014, River Research and Applications, 2014:21/83 (Water Resoucese), 97/223 (Environmental Science), viewed 21 May 2016, <http://onlinelibrary.wiley.com.ezproxy.usq.edu.au/journal/10.1002/(ISSN)1535-1467/homepage/ProductInformation.html>

Energy Efficiency and Conservation Authority 2015, Energy Efficiency and Conservation Authority, Christchurch, viewed 17 May 2016, < https://www.eeca.govt.nz/energy-usein-new-zealand/renewable-energy-resources/hydroelectricity/>

Assessing spatial labour market patterns in the Gold Coast

Sponsor: School of Civil Engineering and Surveying

Student Name: Tari Zador
Degree: Bachelor of Spatial Science (Honours) (Surveying)
Supervisors: Dr Marita Basson, USQ
Keywords: spatial mismatch, Gold Coast, Statistical Local Area (SLA), employment

Introduction

This research project empirically tests for the presence of spatial mismatch in the city of Gold Coast, Australia, at the spatial unit, Statistical Local Area (SLA) level. The research spatially identified three low socio-economic SLAs, and combined it with employment data, in order to identify if households were able to reach employment growth regions within reasonable commuting times. The research also investigated whether public transport was sufficient to provide households in low socio-economic areas sufficient access to employment rich areas.

Background

The spatial mismatch theory focuses on whether a worker with locally inferior access to jobs is likely to have worse labour market outcomes (Kain 1968). Several large scale longitudinal empirical studies in the US and France have supported the existence of the theory in those countries.

1. Methodology

The quantitative data used in the research was from 2006 and 2011 Australian Bureau of Statistics (ABS) census. The techniques used was similar to the method used in Dodson (2005), whom tested the theory in Melbourne.

Key Outcomes

1. Use the ABS Table Builder program to identify low socio-economic SLA's in the Gold Coast.

2. Using ABS SLA data, map relative change in labour market indicators (part-time, full-time and unemployment) from 2006-2011.

3. Identify if employment growth has predominately occurred distant from identified low socio-economic areas, i.e. presence of spatial mismatch.

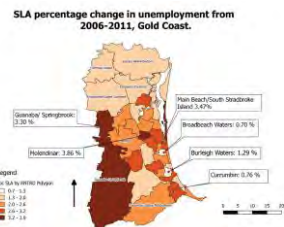Figure1.1: Steps needed to complete spatial mismatch assessment.

Figure 1.2: SLA relative change in full-time employment from the 2006 to the 2011 census

Unemployment increased in every SLA with the inner central SLAs of Molendinar and Main Beach/South Stradbroke, the worst performing SLAs, despite being close to employment hubs of Southport, Surfers Paradise and Robina. Thus, **spatial mismatch was not considered an issue** as there was no employment growth SLAs. Southport had the highest number of low income households, yet it was also identified as the highest employer of people by location in the city.

Further Work

It would have been great to incorporate data from the 2016 census, or test the theory, in a larger, more diverse, city like Brisbane.

Conclusions

Spatial mismatch is not considered an issue in the Gold Coast; however, a major issue identified was the increase in part-time work; however, overall reduction in full-time work over the period. Gold Coast needs to shift towards a more diverse knowledge based economy, that resembles the current employment profile of Brisbane.

Acknowledgements
I would like to thank Marita for her guidance.

References
Dodson, J 2005, *Is there a spatial mismatch between housing affordability and employment opportunity in Melbourne?* AHURI Final Report No. 80, Australian Housing and Urban Research Institute Limited, Melbourne.
Kain, J 1968, 'Housing segregation, Negro employment, and metropolitan decentralization', *Quarterly Journal of Economics* vol. 82, pp. 175-197.

THE PERFORMANCE OF METAL SCREENS IN MITIGATING FIREBRAND ATTACKS

Sponsor - School of Mechanical and Electrical Engineering

Shahrukh Zaman

Master of Engineering Science (Mechanical)

Supervisors: Dr A.S. Barfoush, USQ

Figure: Ember generation

Keywords: Firebrands, Mesh opening, Eucalyptus, Pine, Bark

1. Introduction

In extremely favourable conditions large firebrands can get carried to extremely high altitudes, and then if picked up by strong prevailing winds they can initiate ignition of secondary fires at distance far away from their birth, several kilometres ahead from the main fire front.

The objective leading the present study is to investigate the potential of the meshes found in application for windows and vents against the protection from firebrand attack during the bushfire for houses located in bushfire prone areas. With this aim of quantification an experimental setup has been designed for the purpose of experimentation.

2. Background

The information that had been referred from the past reports and investigation aided in zeroing down the vital details necessary for the experimentation. Firstly, several studies that have been conducted in connection to the firebrand attacks focused on the mass and distance travelled by the firebrand (embers) (NIST). These firebrands were collected in a pan filled with water. And later dried and post processed as per the relevant analysis (Harris 2011). Secondly the vegetation reported from the area of bushfire or the in instances of experimental tests were mostly the Pine tree, Eucalyptus tree, Douglas-fir tree (Wang 2006).

3. Methodology

To support the demanded requirements for the investigation we had come up with an indigenous design. The solution for our needs was offered through a channel of 150mm internal diameter which stretched over 16.6m in length to serve as a wind tunnel. This length included of 30cm of transparent sections at every 3m of distance. At these transparent sections we had planned to install video cameras to record the passing firebrand (embers). At the end of the length of the tunnel a screen and a collection pad was planned to be placed to collect the ejected firebrand (embers) from the tunnel. The tunnel comprised of 5 transparent segments and 6 recording stations.

While the meshes to be studied were planned to be placed just after the first 30 cm transparent segment. The mesh was required to be redundantly secured between these two sections of the tunnel such that it does not break away while the test is in progress.

4. Key Outcomes

An ingenious experimental setup was designed and demonstrated. Meshed of five different opening sizes were assessed namely the opening sizes are 5mm, 3mm, 2mm, 1.3mm, 0.8mm. It was noted that the presence of mesh as the first line of defence from firebrand attack makes a difference when compared to the damage possible to buildings without any screens.

5. Further Work

From the overall results we can say that installation of mesh around a structure can increase the potential to survive the firebrand attack when there is a distance between the mesh screen and the wall of the structure. Certainly the meshes are less capable to stop the firebrands from passing through them, but they do reduce the potential of the firebrands once they pass through the mesh

6. Conclusions

The Australian standards for the buildings in bushfire prone area recommend a mesh less than 2 mm is to be installed, in our views this size should be dropped to around 1mm to maintain higher safety standards.

Acknowledgements

To begin with, I express my thankfulness towards almighty Allah (the Most Gracious, the Most Merciful) whose blessings are the primary reason and motivation for me being able to work my way through the tough times till date

References

Blanchi, R., Leonard, J. and Maughan, D. (2004). Towards New Information Tools for Understanding Bushfire Risk at the Urban Interface. CSIRO Manufacturing & Infrastructure Technology, Bushfire Research, Bushfire CRC Research Project.

California Building Standards Commission, 2010, "California code of Regulation".