# Conference Abstract


2018 the 2nd International Conference on
Robotics and Mechantronics
**ICRoM 2018**

2018 the 2nd International Conference on
Automation and Mechatronics Engineering
**ICAME 2018**

November 9-11, 2018

Venue: Nanyang Executive Centre,
Nanyang Technological University, Singapore
Address: 60 Nanyang View, Singapore 639673

# Nanyang Technological University

http://www.ntu.edu.sg/

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the colleges of Engineering, Business, Science, and Humanities, Arts and Social Sciences, and its Graduate College. NTU's Lee Kong Chian School of Medicine was established jointly with Imperial College London. NTU's campus is frequently listed among the Top 15 most beautiful university campuses in the world and has 57 Green Mark-certified (equivalent to LEED-certified) buildings, of which 54 are certified Green Mark Platinum.

In 2018, NTU was placed 12th globally in the Quacquarelli Symonds (QS) World University Rankings. It was also ranked the world's best young university (under 50 years old) by QS for the fifth consecutive year. In addition, NTU was named the world's fastest rising young university by Times Higher Education in 2015.

In engineering and technology, NTU is ranked 5th worldwide in the QS World University Rankings by Subject 2018. With six schools, NTU's College of Engineering is among the top nine globally for research output and the 5th most cited in the world (Essential Science Indicators 2017).

Mirroring this success is the College of Science, whose young chemistry department is ranked 10th among universities in the Nature Index 2018. Boosted by research at the Lee Kong Chian School of Medicine, NTU is also strengthening its foothold in areas such as biomedicine and life sciences.

The well-established Nanyang Business School is regularly featured among the leading business schools in Asia, with its MBA programme consistently rated top in Singapore since 2004 by The Economist.

November 9-11, 2018

Nanyang Executive Centre, Singapore

Address: Add: 60 Nanyang View, Singapore 639673

http://www.ntu.edu.sg/NEC/Pages/default.aspx

# 2018 the 2nd International Conference on Robotics and Mechantronics (ICRoM 2018)

## 2018 the 2nd International Conference on Automation and Mechatronics Engineering (ICAME 2018)

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Mechanical Engineering and Robotics Research

# Instructions

### Registration Guide:

Arrive at the Conference Venue→Inform the conference staff of your paper ID→Sign your name on the Participants List→Check your conference materials.

### Checklist:

1 receipt, 1 name card, 1 printed conference abstract, 1 lunch coupon, 1 dinner coupon, 1 computer bag, 1 USB stick (paper collection).

### Devices Provided by the Conference Organizer:

Laptops (with MS-Office & Adobe Reader)

Projectors & Screen

Laser Sticks

### Materials Provided by the Presenters:

PowerPoint or PDF files

### Duration of each Presentation:

Regular Oral Session: 15 Minutes of Presentation including 2-3 Minutes of Q&A

### Notice:

*Certificate of Listener can be collected in the registration counter.

*Certificate of Presentation can be collected from the session chair after each session.

*The organizer will not provide accommodation, so we suggest you make an early reservation.

*One best presentation will be selected from each session. The best one will be announced when each session ends, and will be awarded by the session chair after each session in the meeting room.

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# Welcome Message from General Chair

Nowadays, Automation and Mechatronics Engineering play an increasingly important role in both control and engineering applications. In the real world, the environment is complex and dynamics. As such, the automation systems should learn and adapt accordingly and more efforts should be focused on the methodology of the learning system on one hand. For example, fast adaptation and self-organizing capability are highly desired and research activities on this type of development should be expedited. On the other hand, one should leverage on artificial intelligence and machine learning to enhance their performance. Towards this end, the 2018 the 2nd International Conference on Robotics and Mechantronics (ICRoM 2018) and 2018 the 2nd International Conference on Automation and Mechatronics Engineering (ICAME 2018) were organized.

The main goal of ICRoM 2018 and ICAME 2018, which will be held from 9 to 11 November 2018, in Singapore, is to address latest original results in advanced intelligent control of automation systems, including both theoretical advances and practical implementations, which are becoming more and more popular in industry and in our daily lives. The ICRoM 2018 and ICAME 2018 will provide a premier interdisciplinary platform for scientists, researchers, industry leaders, engineers and educators throughout the world to present and discuss the most recent innovations, trends, concerns, as well as practical challenges encountered, and streamline solutions in the fields of Automation and Mechatronics Engineering. The meeting will provide an opportunity to highlight recent developments and to identify emerging and future areas of growth in Robotics and Mechantronics and AME.

Towards this end, the Technical Programme Committee has assembled an excellent programme comprising of 2 excellent Keynote Speeches and 3 Plenary Talks from renowned scientists from the world, 2 parallel technical oral sessions comprising of 18 oral presentations. A total of 18 papers were selected from 41 original contributions after a rigorous review process reflecting a high rejection rate of more than 56 %.

On behalf of the Organising Committee, I wish to thank the keynote speakers, invited speakers and authors of selected papers for their outstanding contributions. I would also like to thank members of the organizing committee, anonymous reviewers and volunteers for their great efforts. Without their contribution, dedication and commitment, we would not have achieved so much. We sincerely hope that you will find the ICRoM 2018 and ICAME 2018 beneficial and fruitful for your professional development. We also hope that you will enjoy our hospitality and will have an enjoyable and memorable time in Singapore.

General Chair, ICRoM 2018 and ICAME 2018
Professor Meng Joo Er
Nanyang Technological University, Singapore

# Conference Committees

### International Advisory Committee

Prof. Youmin Zhang, Concordia University, Canada

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### Conference Program Chairs

Prof. Christos Spitas, Nazarbayev University, Kazakhstan

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Dr. Pavan Hiremath, Manipal Institute of Technology, India

Asst. Prof. Manjunath Shettar, Manipal Institute of Technology, India

Dr. Gowri shankar, Manipal Institute of Technology, India

Dr. Siamak Hoseinzadeh, Islamic Azad University, Iran

# Agenda Overview

## Friday, November 9, 2018

**10:00-17:00** **Participants check-in & Materials Collection—Lobby**

## Saturday, November 10, 2018

Venue: Lecture Room 6

**09:00-09:05** **Opening Remark**
**Prof. Meng Joo Er, Nanyang Technological University, Singapore**

**Speaker I**
**09:05-09:45** **Prof. Youmin Zhang, Concordia University, Canada**
*Speech Title: New Developments on Fault Detection and Diagnosis (FDD), Fault-Tolerant Control (FTC), and Fault-Tolerant Cooperative Control (FTCC) of Unmanned Systems*

**Speaker II**
**09:45-10:25** **Prof. Andrew Ragai Henry Rigit, Universiti Malaysia Sarawak, Malaysia**
*Speech Title: Feasibility of Non-Thermal Plasma Assisted Semiconductor Material Synthesis for Thermoelectric, Photovoltaic and Energy Applications*

**10:25-10:50** ***Coffee Break and Group Photo-Foyer***

**Speaker III**
**10:50-11:30** **Prof. Meng Joo Er, Nanyang Technological University, Singapore**
*Speech Title: Cognitive Robotics: Recent Developments and Futuristic Trends*

**Speaker IV**
**11:30-12:10** **Prof. Christos Spitas, Nazarbayev University, Kazakhstan**
*Speech Title: High-performance Actuation Technologies for Mechatronic Systems, Including Multi-DOF Vibration Test Beds, Robotics and Space Satellites*

**12:10-13:30** ***Lunch at Club House***

**Speaker V**
**13:30-14:10** **Assoc. Prof. Rosli Bin Ahmad, Universiti Tun Hussein Onn Malaysia, Malaysia**
*Speech Title: New Lightweight Magnesium Alloys, Some Recent Developments and Potential Opportunities*

**Parallel Sessions**

**14:10—15:10** **Session 1 (Part A): Materials and Mechanical Engineering**
Lecture Room 6 RM009 RM107 RM101 RM103

**14:10—15:10** **Session 2 (Part A): Robot Development and Mechanical Control Technology**
Seminar Room 2 RM008 RM1022-A RM1029 RM1015

**15:10—15:30** ***Coffee Break-Foyer***

**15:30—16:45** **Session 1 (Part B): Materials and Mechanical Engineering**
Lecture Room 6 RM1013 RM1026-A RM1010-A RM1027 RM1028-A

**15:30—16:45** **Session 2 (Part B): Robot Development and Mechanical Control Technology**
Seminar Room 2 RM005 RM1014 RM1017 RM1020 RM1024

**17:30—19:30** ***Dinner at Club House***

## Sunday, November 11, 2018

**One Day Tour in Singapore**

# Introduction of Speakers

## Speaker I

Prof. Youmin Zhang, Concordia University, Canada

***Speech Title: New Developments on Fault Detection and Diagnosis (FDD), Fault-Tolerant Control (FTC), and Fault-Tolerant Cooperative Control (FTCC) of Unmanned Systems***

Abstract: Unmanned Systems (USs) including Unmanned Aerial Vehicles/Systems (UAVs or UASs), Unmanned Ground Vehicles (UGVs) and Autonomous/Driverless Vehicles, as well as Unmanned Surface/Underwater Vehicles (USVs/UUVs) are gaining more and more attention during the last a few years due to their important contributions and cost-effective applications in several tasks such as surveillance, sensing, search and rescue, agriculture, forest and environment, pipelines and powerlines, military and security applications. On the other hand, Diagnostics and Health Management (DHM) of USs have also been attracted more and more attention due to the requests of safety and reliability of using these USs for the above-mentioned various applications. In this talk, the DHM issues will be represented in detail as functions of Fault Detection and Diagnosis (FDD) and Fault-Tolerant Control (FTC). Benefited from the recent and significant advances and developments of USs, new developments on FDD, FTC, and even newly developed Fault-Tolerant Cooperative Control (FTCC) techniques have been emerged and developed quickly in recent years.

Biography: Professor Youmin Zhang received the B.S., M.S., and Ph.D. degrees from Northwestern Polytechnical University, Xi'an, China, in 1983, 1986, and 1995, respectively. He is currently a Professor with the Department of Mechanical, Industrial and Aerospace Engineering and the Concordia Institute of Aerospace Design and Innovation, Concordia University, Montreal, Quebec, Canada.

His current research interests include condition monitoring, health management, Fault Detection and Diagnosis (FDD), and Fault-Tolerant Control Systems (FTCS), cooperative Guidance, Navigation, and Control (GNC) of single and multiple unmanned aerial/space/ground/surface vehicles and their applications to forest fires, pipelines, power lines, environment, natural resources and natural disasters monitoring, detection, and protection by combining with remote sensing techniques; dynamic systems modeling, estimation, identification, advanced control techniques and signal processing techniques for diagnosis, prognosis, and health management of safety-critical systems, renewable energy systems and smart grids, and intelligent manufacturing processes. He has authored 4 books, over 460 journal and conference papers, and book chapters.

He is a Fellow of Canadian Society of Mechanical Engineering (CSME), a Senior Member of the American Institute of Aeronautics and Astronautics (AIAA) and the Institute of Electrical and Electronics Engineers (IEEE), and a member of the Technical Committee (TC) for several scientific societies, including the International Federation of Automatic Control (IFAC) Technical Committee on Fault Detection, Supervision and Safety for Technical Processes, the AIAA Infotech@Aerospace Program Committee on Unmanned Systems, the IEEE Robotics and Automation Society TC on Aerial Robotics and Unmanned Aerial Vehicles, the ASME/IEEE TC on

Mechatronics and Embedded Systems and Applications, and the International Conference on Unmanned Aircraft Systems (ICUAS) Association Executive Committee. He has been invited to deliver plenary and tutorial talks at international conferences/workshops and research seminars worldwide for over 90 times. He is a founding Editor-in-Chief of the Journal of Instrumentation, Automation and Systems, an Editor-at-Large of the Journal of Intelligent & Robotic Systems, and an Editorial Board Member/Associate Editor of several other international journals (including three newly launched journals on Unmanned Systems). He has served as General Chair, Program Chair, Program Vice Chair, and IPC Member of many international conferences, including the General Chair of the 10th International Conference on Intelligent Unmanned Systems (ICIUS) in 2014, Montreal, Canada, Program Chair of the International Conference on Unmanned Aircraft Systems (ICUAS) in 2014, Orlando, FL, USA, one of General Chairs of the ICUAS in 2015, Denver, USA, a Co-General Chair of the ICIUS 2016 to be held at Xian, China, Program Chair of the ICUAS 2017 held at Miami, USA, a General Co-Chair of the 2nd Int. Symp. on Autonomous Systems (ISAS'18), Chongqing, May 19-21, 2018, and General Chair of the ICUAS 2018 to held at Dallas, USA in June 12-15, 2018. More detailed information can be found at http://users.encs.concordia.ca/~ymzhang/.

## Speaker II

**Prof. Andrew Ragai Henry Rigit, Universiti Malaysia Sarawak, Malaysia**

***Speech Title: Feasibility of Non-Thermal Plasma Assisted Semiconductor Material Synthesis for Thermoelectric, Photovoltaic and Energy Applications***

Abstract: Silicon being the major component in the semiconductor industry has proved itself very effective in myriad applications that include its use in transistors, energy storage, photovoltaics etc. A boom into its efficiency has emerged with the use of the Nano technology, when the same material is used at Nano scale for the fabrication of the devices in the said applications, it provides promising characteristics. Yet the synthesis techniques for the usage of the silicon as material at Nano scale encounter myriad hurdles, however, still the application of non-thermal plasma at Nano scale has found promising results in this field. It could bring about a huge improvement into its efficiency and can thus become ideal for the vast industrial uses. Yet it encounters several issues that makes this practice economically not feasible, like it needs more time to process such material rather than the conventional methods to synthesize materials on the liquid, solid or gas phases have their own short comings which will result into certain compromises the synthesizers have to deal with based on the properties of the end finished product. On the contras, Non-thermal plasma processing is found cost effective with properties like lack of agglomeration and more efficiency.

Biography: Professor Andrew Ragai Henry Rigit received his B.Eng. (Mechanical) from The City University, London, U.K. in 1995, M.Eng. (Mechanical) from Universiti Malaysia Sarawak in 1997, and Ph.D (Fluid Dynamics) from Imperial College London, U.K. in 2004. His doctoral study was in the field of charge injection electrostatic fuel atomizer and its spray characteristics. He is a practicing professional engineer registered with the Board of Engineers, Malaysia.

## Speaker III

Prof. Meng Joo Er, Nanyang Technological University, Singapore

***Speech Title: Cognitive Robotics: Recent Developments and Futuristic Trends***

Abstract: The quest for building human-like intelligence has gained enormous momentum in recent decades. Since the seminal works on Artificial Intelligence (AI), the desire of realizing the quest has become stronger. With the rapid developments in Science, Engineering and Technology, machines that mimic human intelligence have become a reality and sometimes indispensable parts in our daily life, such as Apple Siri and Google Voice. Cognition is a group of mental processes that include attention, memory, producing and understanding language, solving problems and making decisions and making decisions. Cognitive robotics is concerned with endowing robots with intelligent behavior by providing a processing architecture that will allow it to learn and reason about how to behave in response to complex goals in a complex world. In this talk, recent developments of cognitive robotics with applications in the healthcare industry, domestic services, marine vehicles etc will be reviewed. The futuristic trends and challenges will also be discussed.

Biography: Professor Meng Joo Er is currently a Full Professor in Electrical and Electronic Engineering, Nanyang Technological University, Singapore. He served as the Founding Director of Renaissance Engineering Programme and an elected member of the NTU Advisory Board from 2009 to 2012. Furthermore, he served as a member of the NTU Senate Steering Committee from 2010 to 2012.

He has authored five books entitled "Dynamic Fuzzy Neural Networks: Architectures, Algorithms and Applications" and "Engineering Mathematics with Real-World Applications" published by McGraw Hill in 2003 and 2005 respectively, and "Theory and Novel Applications of Machine Learning" published by In-Tech in 2009, "New Trends in Technology: Control, Management, Computational Intelligence and Network Systems" and "New Trends in Technology: Devices, Computer, Communication and Industrial Systems", both published by SCIYO, 18 book chapters and more than 500 refereed journal and conference papers in his research areas of interest.

Professor Er was bestowed the Web of Science Top 1 % Best Cited Paper and the Elsevier Top 20 Best Cited Paper Award in 2007 and 2008 respectively. In recognition of the significant and impactful contributions to Singapore's development by his research projects, Professor Er won the Institution of Engineers, Singapore (IES) Prestigious Engineering Achievement Award twice (2011 and 2015). He is also the only dual winner in Singapore IES Prestigious Publication Award in Application (1996) and IES Prestigious Publication Award in Theory (2001). Under his leadership, the NTU Team emerged first runner-up in the Freescale Technology Forum Design Challenge 2008. He received the Teacher of the Year Award for the School of EEE in 1999, School of EEE Year 2 Teaching Excellence Award in 2008, the Most Zealous Professor of the Year Award in 2009 and the Outstanding Mentor Award in 2014. He also received the Best Session Presentation Award at the World Congress on Computational Intelligence in 2006, the Best Presentation Award at the International Symposium on Extreme Learning Machine 2012, Best Paper Award (First Prize) at the International Automatic Control Conference 2016 and Best Presentation Award at the IEEE International Conference on Intelligent Control, Power and Instrumentation (ICICPI) 2016. On top of this, he has more than 60 awards received at international and local competitions.

Currently, Professor Er serves as the Editor-in-Chief of 3 international journals, namely International Journal of Intelligent Autonomous Systems, Transactions on Machine Learning and Artificial Intelligence and the International Journal of Electrical and Electronic Engineering and Telecommunications. He also serves an Area Editor of International Journal of Intelligent Systems Science and an Associate Editor of 14 refereed international journals, namely IEEE Transaction on Cybernetics, Information Sciences, Neurocomputing, Asian Journal of Control, International Journal of Fuzzy Systems, ETRI Journal, International Journal of Humanoid Robots, International Journal of Modelling, Simulation and Scientific Computing, International Journal of Applied Computational Intelligence and Soft Computing, International Journal of Business Intelligence and Data Mining, International Journal of Fuzzy and Uncertain Systems, International Journal of Automation and Smart Technology, International Journal of Intelligent Information Processing and an editorial board member of the Open Automation and Control Systems Journal and the EE Times.

Professor Er has been invited to deliver more than 60 keynote speeches and invited talks overseas. He has also been active in professional bodies. He has served as Chairman of IEEE Computational Intelligence Society (CIS) Singapore Chapter (2009 to 2011) and Chairman of IES Electrical and Electronic Engineering Technical Committee (EEETC) (2004 to 2006 and 2008 to 2012). Under his leadership, the IEEE CIS Singapore Chapter won the CIS Outstanding Chapter Award 2012 (The Singapore Chapter is the first chapter in Asia to win the award). In recognition of his outstanding contributions to professional bodies, he was bestowed the IEEE Outstanding Volunteer Award (Singapore Section) and the IES Silver Medal in 2011. Due to his outstanding contributions in education, research, administration and professional services, he is listed in Who's Who in Engineering, Singapore, Edition 2013.

## Speaker IV

Prof. Christos Spitas, Nazarbayev University, Kazakhstan

***Speech Title: High-performance Actuation Technologies for Mechatronic Systems, Including Multi-DOF Vibration Test Beds, Robotics and Space Satellites***

Abstract: The talk will discuss case studies related to the use of electro-mechanical, thermo-mechanical, hydraulic and piezoelectric actuation principles for mechatronic systems, including vibration test beds, ultra-high precision robotic FMS and space satellite systems from the portfolio of the Space Technology Research Group at Nazarbayev University and work done previously at the Delft University of Technology and IMMG. The different physical principles enabling the various technologies will be classified and explained and their fitness-for purpose in different application contexts will be discussed. Finally, the directions for future research of the Space Technology Research Group on actuation technologies will be discussed as well.

Biography: Prof. Dr. Christos Spitas is professor of Machine Design at Nazarbayev University, leader of the Space Technology Research cluster and head of the Machine Design laboratory in Astana, Kazakstan. During the past 18 years, also in his previous positions as professor of Embodiment Design and head of the Product Engineering section at Delft University of Technology and as manager R&D in the high-tech industry, he has developed with his teams a number of technologies on compact, high load capacity, high efficiency, high accuracy mechatronic systems based on multiphysical principles of mechnical contacts and mechanisms, hydraulics, piezoelectricity, and thermal expansion/ morphing. These principles are combined with composite and smart meta-material topologies, incl. particle- and directional-fibre-reinforced and graded polymer- and metal-matrix composites, flat and spatial honeycombs, and frequency-tuned damping-, strength- and stiffness-optimised structures. The primary fields of application have been space satellites, precision machines, mechanical transmissions, machine foundations and alignment systems, and robotics, in the context of several JIPs, as well as national and EU-funded projects with partners such as CERN, ESA, Kazakh Space Agency, Toyota, Kawasaki, etc.

## Speaker V

**Assoc. Prof. Rosli Bin Ahmad, Universiti Tun Hussein Onn Malaysia, Malaysia**

***Speech Title: New Lightweight Magnesium Alloys, Some Recent Developments and Potential Opportunities***

Abstract: In recent years, Magnesium (Mg) alloys have made inroads into applications in transportation industries, where weight savings are critical. Their favorable property profile promotes increased usage. Despite Mg alloys being in service for years, there is still a lack of knowledge on capability of Mg alloys. New or optimized alloys are inventing new ideas to substitute traditional materials. Developments in the last decade have led to an improvement of the property profile and effectiveness of magnesium alloys. Rare earth metals as alloying components in Mg alloys open new opportunities in tailoring of property profile and functionality. The strength of Mg alloys can be enhanced by adding proper amounts of certain alloying elements. This presentation will give an overview of the status of alloy development, and discuss the challenges in extension of use of magnesium alloys and various applications.

Biography: Dr. Rosli Bin Ahmad is an Associate Professor at the Universiti Tun Hussein Onn Malaysia (UTHM). Associate Professor Dr. Rosli Ahmad is a metallurgical researcher known for his contribution to the magnesium research as well as his work in promoting magnesium for light-weighting applications in the transportation sector. He received his Doctorate in Mechanical Engineering from University of Wales in 2006. Over the length of his career, his areas of interest have spanned the breadth of magnesium and aluminium research, with special emphasis on the development of new magnesium rare-earth alloy. He was Head of Department of Manufacturing and Industrial Engineering, UTHM between 2007-2009.

## Parallel Oral Presentation Sessions

### Saturday, November 10, 2018

✧ Tips:

**Please arrive at conference room 15 minutes earlier, in case some authors are not able to make the presentation on time.**

**There will be a session group photo part at the end of each session.**

**The best presentation will be chosen** after each session and the certificate will be awarded by the chair. Good Luck!

Session 1: Materials and Mechanical Engineering

Chairs: Prof. Jiang Ping, Huazhong University of Science & Technology, China

**Time: 14:10—16:45 (Tea Break between 15:10-15:30)**

**Venue: Lecture Room 6**

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| RM009<br>14:10-14:25 | Effect of ZrO2 Addition on Mechanical Properties and Microstructure of Al-9Zn-6Mg-3Si Matrix Composites Manufactured by Squeeze Casting<br>Muhammad Syarifudin, **Elisabeth Nadya Hale**, Bondan Tiara Sofyan<br>Universitas Indonesia, Indonesia<br><br>ABSTRACT<br>Steel is used because of its high strength and toughness, but it has high density, therefore lighter material with comparable toughness is developed. One alternative is aluminum matrix composite with zirconia (ZrO2) as the reinforcement with high fracture toughness. Al-9Zn-6Mg-3Si (wt. %) composites were developed with addition of 2.5, 5, and 7.5 vol. % ZrO2 through squeeze casting. To improve toughness, the composite was solution treated at 450 oC for 1 h, then aged at 200 oC for 1 h. Materials characterization included Optical Emission Spectroscopy (OES), Rockwell B hardness testing, impact testing, fractography analysis, microstructure analysis using Optical microscope (OM) and Scanning Electron Microscope (SEM) / Energy Dispersive X-Ray Spectroscopy (EDS), as well as X-Ray Fluorescence (XRF). The results showed that the more ZrO2 particles, the higher porosity is present decreased the hardness both in as-cast condition and after ageing at 200 oC at 1 h, although the impact values increased slightly from 0.091203 to 0.099974 J/mm2 with the peak at 0.121411 in 2.5 vol % ZrO2 particles. |
| RM107<br>14:25-14:40 | Effect of Cold Rolling and Annealing Temperature on the Characteristics of Cu-28Zn-3.2Mn Alloy<br>William Horizon, **Syarah Khayrun Nisa** and Bondan Tiara Sofyan<br>Universitas Indonesia, Indonesia<br><br>ABSTRACT<br>Common material for bullet shell is cartridge brass which contains 26-32 wt. % Zn. In the deep drawing process, problems are typically found, such as cracking and tearing, due to low ductility. Therefore, manganese is added to cartridge brass to increase its ductility. In this study, Cu-28Zn alloy with addition of 3.2 wt. % Mn was fabricated by gravity casting. As cast samples were homogenized at 800 °C for 2 hours. Afterwards, the specimens were cold-rolled with deformation of 20, 40, and 70 %. The 70 % cold-rolled samples were subsequently annealed at 350, 400, and 450 ℃ for 15 minutes. Samples undergo characterizations by microstructure analysis using optical microscope and Scanning Electron Microscope (SEM) - Energy Dispersive |

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| | Spectroscopy (EDS), and Vickers microhardness testing. The results showed that higher degree of deformation led to more elongated grains with the increasing values of L/D ratio, and higher hardness. Annealing at 350 ℃, for 15 min did not change the deformed microstructures which indicates the stage of recovery and stress relieve. Meanwhile, higher annealing temperatures of 400 and 450 ℃ led to recrystallization and grain growth, respectively. Hardness declined with the increase in annealing temperature. Mn increases the hardness and recrystallization temperature. |
| RM101<br>14:40-14:55 | Effect of Chute Angle on Segregation of Granular Particles<br>**Saleema Panda** and Danielle S. Tan<br>National University of Singapore, Singapore<br><br>ABSTRACT<br>The segregation of uniform granular mixtures is a common problem in pharmaceuticals, food processing, 3D printing, and cosmetic industries, due to quality control considerations. This is a common phenomenon for granular mixtures due to inherent differences among the individual particles such as size, density or shape. However for industrial purposes it may not be possible to change the granular mixture itself, and therefore we need to consider other ways to minimize segregation. Here, we study the flow of granular particles in a chute inclined at different angles using discrete element modelling in LIGGGHTS with the aim of investigating the significance of inclination angle on segregation. |
| RM103<br>14:55-15:10 | Experimental Investigation on the Tensile and Flexural Strength of Nano-Polymer Composites<br>U Achutha Kini, **Manjunath Shettar**, Sathyashankara Sharma and Pavan Hiremath<br>Manipal Institute of Technology, Manipal Academy of Higher Education, India<br><br>ABSTRACT<br>The prime aim of this investigation is to study the effect of Montmorillonite (MMT) nanoclay on the tensile and flexural strength of epoxy resin and GFRP. Two sets of composites viz., nanoclay as direct reinforcement (NCD) & nanoclay as filler material (NCF), were fabricated with varying weight percentage of nanoclay. In NCF, glass fiber weight percentage was also changed as 40 wt.% and 60 wt.%. NCD laminates were prepared by general casting technique where as NCF by hand lay-up technique. The specimens were prepared and tested for tensile strength, as per ASTM standard. The results reveled that increase in glass fiber weight percentage has enhanced tensile and flexural strength by 15 and 10%, respectively. Also, the nanoclay addition had positive influence on the tensile and flexural properties up to 13% and 15%, respectively. |
| RM1013<br>15:30-15:45 | Mechanical Characterization and Microstructural Analysis of AISI 4340 Ferrite-Martensite Dual Phase Steel<br>Gurumurthy B. M., Sathyashankara Sharma, Achutha Kini U. and **Ramakrishna Vikas S**<br>Manipal Institute of Technology, India<br><br>ABSTRACT<br>Present investigation deals with the mechanical properties and microstructure of dual phase (DP) steel. Normalizing and intercritical annealing heat treatments were carried out at 900, 750, 770, and 790 °C and DP ferrite–martensite steel was obtained. Interaction behavior of both phases has been analyzed through tensile, hardness and impact strength. Comparison of the DP steel with normalized steel has revealed that hardness and tensile strength increases as |

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| | intercritical temperature increases. Similarly ductility and toughness decreases as the intercritical temperature increases and normalized steel shows better elongation and toughness. The microstructure analysis shows, as the intercritical temperature increases, martensite quantity increases with decrease in ferrite content, which results in improvement in the tensile strength and hardness. The results have shown a decrease in the ductility and toughness as the volume of martensite increases. |
| RM1026-A<br>15:45-16:00 | Numerical Simulation of Thermoelectric Magnetic Effects on Free Dendrite Growth Using Phase-Field-Lattice Boltzmann Method<br>**Longchao Cao**, Ping Jiang and Xinyu Shao<br>Huazhong University of Science & Technology, China<br><br>ABSTRACT<br>Solidification in an imposed magnetic field during welding or casting has attracted much attention in recent decades. It is proved that the dendritic morphology can be significantly altered due to the thermoelectric magnetic effects. In present work, a simplified quasi-three dimensional mathematical model was presented to analyze the distributions of thermoelectric current and the Lorentz force. The analytical solutions show that the thermoelectric current in the solid was uniform and parallel to the thermal gradient, therefore the Lorentz force in the solid is uniform and perpendicular to the magnetic field and thermal gradient. Then a numerical model was proposed to study the influences of the external magnetic field on the dendritic morphology. In this model, the thermoelectric effect, the flow field, and the dendritic growth were fully coupled using the Phase-field-lattice Boltzmann method (PF-LBM). The simulated thermoelectric current and Lorentz force were compared with that of the analytical solutions and the results are well consistent. The simulation results indicated that the magnetic field can significantly affect the dendritic morphology via the induced fluid flow within the inter-dendritic region. With the evolution of dendrite, the primary and secondary arms arose, the distributions of thermoelectric current and the induced flow field were complex, and the simplified analytical solution is no longer applicable. Overall, this proposed model exhibits the feasibility of fully coupling the thermoelectric magnetic dynamics with dendritic growth and gives a comprehensive understanding of the influence of external magnetic field on dendrite growth. |
| RM1010-A<br>16:00-16:15 | Analysis of Influence Rules of Shaving Process Characteristics and Mechanism of Tooth Profile Concave Error<br>**Lei LIU**, Anjiang CAI, Libo LIU and Wenbo LI<br>Xian University of Architecture and Technology, China<br><br>ABSTRACT<br>Gear shaving is one of most efficient and economical methods in gear finishing. However, the tooth profile concave error in shaving process is the key issue that restricts the shaving applications. In order to reveal the mechanism of concave error comprehensively and systematically, this paper analyzes the influence rules of machine tool motion (MTM) on shaving process. Combining the metal cutting theory with empirical formula, the shaving cutting force model which includes the formulas of shaving force and speed is constructed. Based on unique variable principle, the variation of different MTM parameters is quantitatively analyzed, and the influence degree of each factor is sorted. The theoretical calculation and experimental research shows that the maximum shaving force occurs near the pitch circle, where the minimum shaving speed shows up. The excessive shaving happens inevitably in this position due to a large force |

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| | and long action time. As a result, it will cause the tooth profile concave error at the end of the shaving process. Thus, the correctness of the model has been proved by the experiment |
| RM1027<br>16:15-16:30 | An Improved Co-Kriging Multi-fidelity Surrogate Modeling Method for Non-nested Sampling Data<br>Ruan Xiongfeng, **Jiang Ping**, Zhou Qi and Yang Yang<br>Huazhong University of Science & Technology, China<br><br>ABSTRACT<br>The multi-fidelity surrogate model, which can effectively balance the prediction accuracy and the modeling cost shows enormous potential in the design and optimization of mechanical products. Among them, the Co-Kriging multi-fidelity surrogate model based on Bayesian theory can provide the prediction error at the non-test points, which makes it especially attractive in the field of design optimization under uncertainty. However, in the Co-Kriging modeling process, high-fidelity (HF) and low-fidelity (LF) sampling points must be nested to satisfy the Markov property. If the Co-Kriging coefficients are obtained based on the full correlation, the modeling process will be complicated and result in low modeling efficiency. Therefore, this paper proposes an improved Co-Kriging multi-fidelity surrogate modeling method for non-nested sampling data. The proposed approach makes use of the characteristics of the stochastic kriging model to take the error of the LF surrogate model into consideration. Two independent processes are used to get the hyper-parameters of the LF surrogate model and the discrepancy model, respectively. The prediction accuracy and robustness of the proposed method are compared to the existing typical multi-fidelity surrogate modeling method on a standard numerical test example and an engineering example. The comparison results indicate that the proposed approach possesses not only excellent prediction accuracy but also outstanding robustness. |
| RM1028-A<br>16:30-16:45 | Optimization of Milling Process Parameters Based on Variable-Fidelity Metamodel<br>**Yang Yang** and Wang Cai<br>Huazhong Agricultural University, China<br><br>ABSTRACT<br>To reduce the processing time and energy consumption of the milling part of the forged wheel hub, it is criticall to select the optimal process parameters such as milling force, feed rate and milling amount during the milling process. A variable-fidelity metamodel assisted multi-objective optimization method is proposed for integrating the sample data from both low and high fidelity models. The milling characteristics of forged wheel hub are analyzed, the low-precision sample points are obtained through the simulation software AdvantEdge and gained the high-precision sample points by the physical experiments. The high and low precision data are integrated by establishing a hierarchical Kriging model. The multi-objective Genetic Algorithm is used to solve the process parameter space, then the Pareto front of the optimal process parameters is obtained to achieve high-precision prediction of the optimization target. Results show that the method can effectively utilize the information of high/low precision sample points, reduces the milling processing time and energy consumption with only a small amount of computational cost is needed to obtain an desirable optimal solution. |

✧ Tips:

**Please arrive at conference room 15 minutes earlier, in case some authors are not able to make the presentation on time.**

**There will be a session group photo part at the end of each session.**

**The best presentation will be chosen** after each session and the certificate will be awarded by the chair. Good Luck!

Session 2: Robot Development and Mechanical Control Technology

Chair: Asst. Prof. Himawan Hadi Sutrisno, Universitas Negeri Jakarta, Indonesia

**Time: 14:10—16:45 (Tea Break between 15:10-15:30)**

**Venue: Seminar Room 2**

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| RM008<br>14:10-14:25 | Obstacle Avoidance of Mobile Robot using Fuzzy Logic and hybrid Obstacle Avoidance Algorithm<br>Rajmeet Singh and **Tarun Kumar Bera**<br>Thapar Institute of Engineering and Technology Patiala, India<br><br>ABSTRACT<br>The road accidents due to traffic problems and human erroneous driving are the major challenges for researches. The self-driving car or mobile robot is the solution to avoid such mishaps. In this paper, an attempted has been made to develop obstacle avoidance algorithms for bicycle vehicle model of mobile robots. The hybrid obstacle avoidance algorithm is proposed on the merits of line, wall following and tangent bug algorithm. Then, the fuzzy logic (FL) based obstacle avoidance controller is proposed. Twenty-three set of rules are proposed for fuzzy logic approach. Both the obstacle avoidance algorithms are implemented on the mobile robot. The dynamic model of the mobile robot is developed using bond graph theory and is converted into Simulink block using S-function directly from the library of SYMBOLS Shakti software. The vehicle model is equipped with three ultrasonic sensors to measure the distance from the obstacles. Three input membership functions and one output membership function are considered in fuzzy logic controller. During avoiding two static obstacles and reaching the target, the comparison of obstacle free paths traced by both obstacle avoidance algorithms is done in this paper. |
| RM1022-A<br>14:25-14:40 | Development of Flexible Pipe Inspection Robot Using Flexible Pneumatic Actuators and Compact Valve Unit<br>**Kengo Nakagawa**, Tetsuya Akagi, Shujiro Dohta, Wataru Kobayashi, Takashi Shinohara, Keichi Kusunose and Mohd Aliff<br>Okayama University of Science, Japan<br><br>ABSTRACT<br>In an inspection of a water supply line, the development of a pipe inspection robot is strongly desired to reduce the inspection cost. In our previous study, a novel pipe inspection robot using a flexible pneumatic cylinder that can move along to a pipe by changing the geometry of the robot naturally was proposed and tested. However, the mechanism of the robot became more complex and heavier. Therefore, we found the problem of lack of moving force of the sliding mechanism in a corner of a pipe. In this study, in order to improve its moving force, a sliding mechanism using extension type flexible pneumatic actuators and a compact valve unit with larger flow rate are proposed and tested. As a result of the driving test using the whole robot, it can be confirmed that the mobility of the |

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| | robot is improved. |
| RM1029<br>14:40-14:55 | Design and Implementation of Flood Fill and Pledge Algorithm For Maze Robot<br>**Semuil Tjiharjadi**<br>Maranatha Christian University, Indonesia<br><br>ABSTRACT<br>Maze Robot is a path finding autonomous mobile robot which can reach a certain point. One of its capabilities is moving from one point to another autonomously. Maze Robot able to explore an unknown environment. Mapping the environment and seek good path to reach a certain point. This Maze Robot is a mobile robot which moves using wheels with differential steering type. It is designed to solve a maze environment that has a size of 5 x 5 cells and it is used to implement the flood-fill algorithm and the pledge algorithm. It is using ultrasonic range finders to detect walls and opening in the maze. The robot has ability to use pledge algorithm to collect the information and learn the maze, it finds all possible routes and solve the problem using the shortest one. Result of experiments show the robot can explore the maze and map it, Robot also can find the shortest path to destination point with 80% success rate. |
| RM1015<br>14:55-15:10 | Protocol for Organization of a Decentralized Autonomous Agents Network in Factories using Market Mechanisms<br>**Aleksandr Kapitonov**, Ivan Berman, Vitaly Bulatov, Sergey Lonshakov and Aleksandr Krupenkin<br>ITMO University, Russia<br><br>ABSTRACT<br>The paper describes work organization methods for factories with plenty of autonomous agents with the help of market mechanisms what authors call robot economics. As a technological basis, the application of decentralized technologies is presented and justified: Blockchain technologies and smart contracts of the Ethereum network. The work is an extension of the article "Blockchain-based protocol of autonomous business activity for multi-agent systems of UAVs" and describes in more detail the architecture of the robots economics protocol. The main attention is paid to the protocol functionality and its basic elements. There is a description of the architecture of an autonomous agent working on the principles of robot economics in the article. The article shows how the work of agents is organized and how the self-correction of the factory and its agents happen. As a result, the experience of approbation of the presented methods in experiments is presented. |
| RM005<br>15:30-15:45 | A Novel Distributed and Compound Control of an Adaptive Neural Network and PD for Manipulators<br>**Pu Zhao** and Yunfei Zhou<br>Huazhong University of Science and Technology, China<br><br>ABSTRACT<br>In this report, a new compound control scheme is proposed for manipulators based on a proportional-differential (PD) controller and a back-propagation neural network. By modifying the dynamic model of manipulators, a second-order function of tracking errors is obtained and approximated by the neural network. A PD-type reference model is |

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| | introduced to update the weights of the neural network. By using additional PD controllers, rapid response of the control scheme can be realized. Simulation results highlight performance of the controller to compensate the nonlinear terms and its simpleness in the parameter tuning process. To be concluded, the controller is suitable for distributed control and can be used as supplementary of traditional PD controllers. |
| RM1014<br>15:45-16:00 | Soft-Computing Method for Detection of Abnormal Status of Plant Equipment<br>**Seong-Joo Kim**, Young-Joo Kim and Joo-Hoon Kim<br>Dae-Heung Industrial Gases Co., Ltd., South Korea<br><br>ABSTRACT<br>Currently, the safety monitoring process in a complex plant environment is proceeded by the human. Sometimes, human error that may occur in a filed causes a severe problem. This paper introduces a soft-computing method for detection of the abnormal status of plant equipment using sound information and neuro-fuzzy theory that is one of the intelligent theories. The sound for testing is acquired from the cylinder valve, compressor operation, safety valve open. In this paper, the high-pressure gas filling plant will be used as a test plant. The resulting system will be widely applied to more complex plant environments. |
| RM1017<br>16:00-16:15 | Improvement of Performance and Design on Firefighter Motorcycle as a Fast Response to Decrease Fire Disater in a Densely Populated Area<br>**Himawan Hadi Sutrisno**<br>Universitas Negeri Jakarta, Indonesia<br><br>ABSTRACT<br>Design on firefighter motorcycle by using an automatic scooter motorcycle is one of many efforts to reduce losses caused by fire disaster in a densely populated area, especially if the fire occurs in a narrow road that cannot be passed by firetruck. However, initial research for firefighter motorcycle requires some improvements so that the performance of firefighter in using this particular tool can be optimized. In this research, the improvement of firefighter motorcycle performance can be implemented by improving the engine of automatic scooter motorcycle, improving bracket as the holder of centrifugal pump, choosing centrifugal pump and choosing the way of installing centrifugal pump to automatic scooter engine. As a result of the improvement, the performance on water spray on firefighter motorcycle for extinguishing fire is increased, the way of maintenance of the utilized parts is easier and weight addition from the centrifugal pump does not affect the engine performance of the utilized automatic scooter. |
| RM1020<br>16:15-16:30 | Development of Portable Rehabilitation Device Driven by Low-Cost Servo Valve Using Tap Water<br>**Hideyuki Obayashi**, Tetsuya Akagi, Shujiro Dohta, Wataru Kobayashi, Yasuko Matsui, So Shimooka, Takashi Shinohara and Mohd Aliff<br>Okayama University of Science, Japan<br><br>ABSTRACT<br>Wearable driving systems for labor assistance and rehabilitation, such as power assist suits, have received much attentions and many studies have been done actively. In this study, |

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| | the final target is to develop a low-cost home rehabilitation device driven by fluidic actuators and low-cost control valves. In the device, the size and cost of control valves become serious concerns. In the previous study, to realize a home rehabilitation device, the flexible spherical actuator that was able to give passive exercise to patients was developed. To drive the actuator, control valves are required. However, a servo valve that can control flow rate in analogue way is very expensive compared with other elements in the pneumatic driving system. Therefore, a low-cost servo valve using buckled tubes was proposed and tested. This valve can control both gas and liquid flow. In this paper, the development of the spherical actuator driven by servo valves using buckled tubes is described as a low-cost home rehabilitation device. The construction and operating principle of the spherical actuator and the servo valve using buckled tube is also described. In addition, the position control using the tested devices is carried out. |
| RM1024<br>16:30-16:45 | Vertical Takeoff and Landing Wing Developed for Long Distance Flight and Stable Transit Flight<br>Daeil Jo and **Yongjin Kwon**<br>Ajou University, South Korea<br><br>ABSTRACT<br>With the rise of the public interests in the UAVs, the UAVs are becoming one of the important technological areas of the 4th industrial revolution era. For the UAVs, the fixed-wing type is advantageous, because it has a longer flight time than the multi-copter type, along with the faster speed.<br>However, it requires a separate, lengthy, obstacle-free landing area, which can be difficult to find in the urban area. Additionally, it is not easy to safely land the fixed-wing type UAVs. Because of this, demand for the VTOL-type UAV is on the rise. The purpose of this study is to design and develop a VTOL capable of vertical landing and lift-off, as well as having appropriate thrust and lift during vertical, horizontal, and transition flights. We developed a formalized UAV development process, to provide a theoretical guideline to the development process. In order to determine the aerodynamic characteristics of the VTOL, we employed the 3D CAD & CAE methods, which can simulate the wind tunnel test for the optimal aerodynamic efficiency. Using the developed process, we determined the criteria for the internal modules that constitute the UAV, and we could assemble the airframe, considering the proper center of gravity. We conducted the SW setting for the flight adjustment and able to carry out the flight test accordingly. In the flight experiment, it was found that the developed process was adequate to provide a guideline to the successful design of the VTOL-type UAV. |

# Note

2019 IEEE 10th International Conference on *Mechanical and Intelligent Manufacturing Technologies*

# ICMIMT 2019

***February 15-17, 2019***
***Cape Town, South Africa***

**What We Are**

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Accepted abstract will be invited to give the oral presentation at the conference, the presentation will not be published.

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Acceptance Notification
December 25, 2018
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January 10, 2019

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