

# SIE<sup>2022</sup>

12 – 13 December 2022

Bayview Hotel, Langkawi,  
Malaysia

## SUSTAINABLE & INTEGRATED ENGINEERING INTERNATIONAL CONFERENCE 2022

# PROGRAM BOOK

Organized By:



**UTM**  
UNIVERSITI TEKNOLOGI MALAYSIA

## Universiti Teknologi Malaysia



# CONFERENCE PROGRAM

## SIE 2022

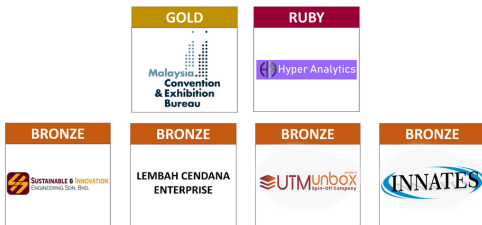
SUSTAINABLE AND INTEGRATED ENGINEERING  
INTERNATIONAL CONFERENCE 2022

DECEMBER 12-13, 2022

BAYVIEW HOTEL LANGKAWI, MALAYSIA

Organized by  
Universiti Teknologi Malaysia

Sponsored by



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# DAILY SCHEDULE

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**DECEMBER 12, 2022**

Bayview Hotel Langkawi, Malaysia

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## **07.30 AM | REGISTRATION**

- Foyer, Bayview Ballroom, Level 2

## **08.15 - 11.00 AM | OPENING CEREMONY**

### **• 09.25AM : PLENARY SPEAKER 1**

**Ts. Shamsul Bahar Mohd Nor**

Chief Executive Officer, Malaysian Green Technology & Climate Change Center (MGTC), Malaysia

### **• 10.10AM : PLENARY SPEAKER 2**

**Ir. Dr. Norshah Hafeez Shuaib**

Executive Director/Chief Technical Officer at MTC Engineering Sdn Bhd., Malaysia

## **11.00AM | MORNING TEA BREAK**

- Foyer, Bayview Ballroom, Level 2

## **11.15AM | KEYNOTE & PARALLEL SESSIONS 1**

- Sapphire, Diamond, Ruby, Emerald, Aquamarine, Level 2

## **01.00PM | LUNCH BREAK**

- Flamingo Coffee House & The Phoenix, Level G

## **02.15PM | PARALLEL SESSIONS 2 PART 1**

- Sapphire, Diamond, Ruby, Emerald, Aquamarine, Level 2

## **03.30PM | AFTERNOON TEA BREAK**

- Foyer, Bayview Ballroom, Level 2

### **03.45PM | PARALLEL SESSIONS 2 PART 2**

- Sapphire, Diamond, Ruby, Emerald, Aquamarine, Level 2

### **05.00PM | CONFERENCE ADJOURNED**

### **08.00PM - 10.00PM | GALA DINNER**

- Bayview Ballroom, Level 2
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## **DECEMBER 13, 2022**

Bayview Hotel Langkawi, Malaysia

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### **08.00 AM | REGISTRATION**

- Foyer, Bayview Ballroom, Level 2

### **08.30AM | PARALLEL SESSION 3**

- Sapphire, Diamond, Ruby, Emerald, Aquamarine, Level 2

### **10.20AM | MORNING TEA BREAK**

- Foyer, Bayview Ballroom, Level 2

### **10.45AM | PARALLEL SESSION 4**

- Sapphire, Diamond, Ruby, Emerald, Aquamarine, Level 2

### **12.35PM | LUNCH BREAK**

- Flamingo Coffee House & The Phoenix, Level G

### **02.15PM | PARALLEL SESSION 5**

- Sapphire, Diamond, Ruby, Emerald, Aquamarine, Level 2

### **04.45PM | AFTERNOON TEA BREAK**

- Foyer, Bayview Ballroom, Level 2

### **05.00PM | CONFERENCE ENDS**

# WELCOMING SPEECH



On behalf of the organizer, I am delighted to welcome all presenters and participants to the Sustainable and Integrated Engineering International Conference 2022 (SIE2022) conference organized by Universiti Teknologi Malaysia (UTM) at Bayview Hotel, Langkawi, Malaysia on 12 - 13 December 2022. I would also like to extend our warm welcome to our honourable guests and plenary speakers, Ts. Shamsul Bahar Mohd Nor, Chief Executive Officer of Malaysian Green Technology & Climate

Change (MGTC), Malaysia and Ir. Dr. Norshah Hafeez Shuaib, Executive Director/ Chief Technical Officer of MTC Engineering Sdn. Bhd., Malaysia.

We are also grateful for the commitment and effort of all keynote speakers in participating in this conference. As this is the second time of SIE, we received large number of papers submission from authors all over the world including Australia, Bangladesh, Brunei, China, Czechia, Egypt, Ethiopia, France, Indonesia, Iraq, Yemen and others.

The SIE2022 is a platform enabling participants to share their ideas, research output and knowledge. This conference hopefully will expose all participants to different aspect of technology and scientific knowledge that is beneficial to the sustainability and prosperity of humankind.

Apart from the technical and scientific meetings, we wish all the participants especially who are new to Langkawi, would take the maximum benefit of enjoying the scene and atmosphere of this Malaysia island. Finally, I would like to take this opportunity to thank all authors, presenters, reviewers as well as the conference committee members who have relentlessly put their effort into making this SIE2022's success.

**PROF. DR. ROSLI MD ILLIAS**  
**Deputy Vice Chancellor (Research & Innovation)**  
**Universiti Teknologi Malaysia**

# GENERAL CHAIR'S MESSAGE



Dear ladies and gentlemen,

On behalf of the organizing committees, it is a great pleasure to welcome all of you to the Sustainable and Integrated Engineering International Conference (SIE 2022), which will be held in Langkawi Island, Malaysia, from 12 December to 13 December 2022.

It has been 3 years since this conference was last held in Putrajaya. Let me provide a brief overview of the conference as we eagerly await your active participation and presentation of your project and findings. The event will be held for two days from December 12th (Monday) to December 13th (Tuesday).

Previously, the SIE 2019 conference was held around mid-December of 2019, this year the entire schedule has been moved to December 2022, so it is recommended that you make the necessary arrangements, so that everyone can participate physically after we have faced covid 19 pandemic. Bayview Hotel Langkawi was chosen to encourage an international participant to come and enjoy the scenic view of Langkawi at the same time joining the conference to share their studies and findings to all participants.

SIE 2022 is the 2nd time hosted conference organised by Universiti Teknologi Malaysia (UTM) after the accomplishment of SIE 2019. This conference provides a platform for scientists, academicians, policy makers and industry players among others to discuss and disseminate issues and progress in the interconnected and multidisciplinary fields of sustainable development and engineering. We are certain that your presence, along with your expertise, vision, knowledge, and experience will help us consolidate our thoughts and practices, as well as pave the way into the future. We certainly cannot accomplish what we are doing without your support.

Sustainable and engineering is the chosen theme. This is indeed significant as it underlines the fact that research and knowledge in the field of sustainable development and engineering develops at such a rapid and significant pace that we must keep continually abreast with the newest developments

lest we fall behind. Hence the need for this conference to be held continuously. Howbeit, I personally don't know, what will happen to this conference in the next coming years, whether it will be continuously organized or not. I will leave it to the next committee to decide.

Our local organizing committee has put in place an exciting presentation program, with presentations by renowned speakers such as plenary speakers and keynote speakers from the region and beyond, to provide us an insight into the cutting-edge developments in sustainable development and engineering. Our organizing committees has packed all two days with rousing presentations and plenary sessions according to 6 different engineering fields. It promises to bridge the latest findings and studies in sustainable development and engineering. We have also prepared an attractive social program, which we are confident will facilitate networking among the participants.

Presentation aside, Langkawi is a wonderful travel destination. From its perfect weather to incredible beaches, Langkawi is also an affordable travel destination with lots to do with the family. A multicultural melting pot, the local Malay culture is infused with strong flavors from China, India and the rest of Southeast Asia. Everywhere you look, it is a notion of fusion and diversity. The foreign delegates will enjoy the delectable cuisine and warm hospitality that Malaysia has to offer.

We ask for your patience and understanding in case of any imperfections, and we would appreciate it if you could share your opinion about the event with us through our conference committee or secretariat.

Last but not least, this conference would not be possible without support from several sponsors such as MyCEB, various other organizations and fees from participants. We have received several funding assistances to make this event even more successful.

It is the responsibility of all of us here at the conference committee to make sure that this conference runs smoothly, but its success largely rests on the collective effort of our members and sponsors. Hence, we would like to extend our warmest welcome to all, and we look forward to your keen support and participation

Best wishes,

**ASSOC. PROF. DR. AGUS BIN ARSAD**  
**General Chair**  
**SIE 2022**



# COMMITTEE

## ORGANIZING COMMITTEE

### ADVISORS

- Prof . Dr. Ahmad Baharuddin Abd Rahman
- Prof. Ts. Dr. Ruzairi Abdul Rahim (External Advisor)
- Assoc. Prof. Ir. Dr. Zaini Ahmad

### GENERAL CHAIR

- Assoc. Prof. Dr. Agus Arsad

### GENERAL CO-CHAIR

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### SECRETARIAT

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- Dr. Nadirah Darus

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- Dr. Noraliani Alias
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- Dr. Noor Hidayah Zakaria
- Dr. Aziatul Niza Sadikin
- Dr. Muhammad Faiz Hilmi Rani

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- Assoc. Prof. Dr. Zarina Ab Muis
- Dr. Aishah Rosli

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### PUBLICATION CHAIR

- Assoc. Prof. Ir. Dr. Malarvili Bala Krishnan

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- Dr. Adila Firdaus Arbain

### EVENT MANAGERS

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- Dr. Mohd Asmadi Mohammed Yussuf

### LOGISTIC & TECHNICAL CHAIR

- Dr. Aizuddin Supee

### PROTOCOL/LOCAL ARRANGEMENT CHAIR

- Dr. Mohd Saiful Azimi Mahmud

# COMMITTEE

## INTERNATIONAL PROGRAM COMMITTEE

- Ahmad Zahran Md Khudzari, Universiti Teknologi Malaysia, Malaysia
- Ahmad Ziad Sulaiman, Universiti Malaysia Kelantan, Malaysia
- Alexa Ray Fernando, National University, Philippines
- Alpha Agape Gopalai, Monash University, Malaysia
- An Liu, Shenzhen University, China
- Awais Gul Airij, Dawood University of Engineering & Technology, Pakistan
- Azuraliza Abu Bakar, Universiti Kebangsaan Malaysia, Malaysia
- Bassim H. Hameed, Qatar University, Qatar
- Bing Li, Northwestern Polytechnical University, China
- Chua Bih Lii, Universiti Malaysia Sabah, Malaysia
- Dominic Chwan Yee Foo, University of Nottingham Malaysia
- Dur Soomro, Universiti Tun Hussein Onn Malaysia, Malaysia
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- Inoue Masahiro, Keio University, Japan
- Kahar Osman, Universiti Teknologi Malaysia, Malaysia
- Kohei Arai, Japan, Saga Universiti, Japan
- Liming Chen, France, Ecole Centrale de Lyon, France
- Mohd Faizul Mohd Sabri, Universiti Malaya, Malaysia
- Mohd Kamaruddin Abd Hamid, Universiti Malaysia Sabah, Malaysia
- Motoi Machida, Chiba University, Japan
- Muslim Abdurrahman, Universiti Islam Riau, Indonesia
- Nayan Kalkoty, IIT Tezhpur, India
- Norazura Muhammad Bunnori, Universiti Malaya, Malaysia
- Norhazilan Md Noor, Universiti Teknologi Malaysia, Malaysia
- Norzali Mohd, Universiti Tun Hussein Onn Malaysia, Malaysia
- Nurzal Effiyana Ghazali, Universiti Teknologi Malaysia, Malaysia
- Sajad Farokhi, Islamic Azad University, Iran
- Siti Nazahiyah Rahmat, Universiti Tun Hussein Onn Malaysia, Malaysia
- Suksun Horpibulsuk, Suranaree University of Technology, Thailand

# COMMITTEE

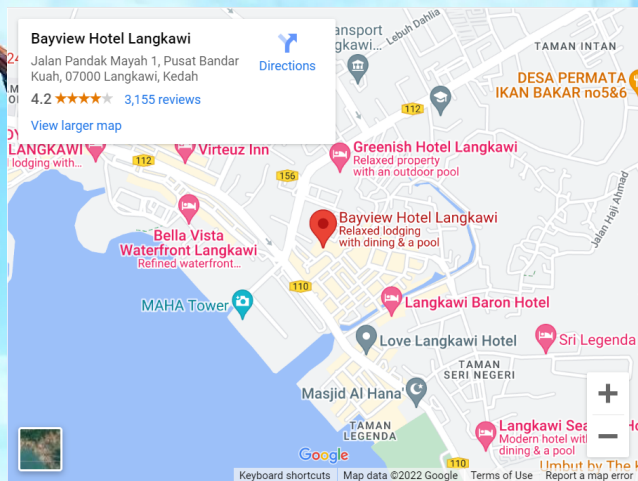
## INTERNATIONAL PROGRAM COMMITTEE

- Swati Vijay Shinde, Pimpri Chinchwad College of Engineering, Pune, India
  - T M Indra Mahlia, University Of Technology, Sydney, Australia
  - Teh Ying Wah, Universiti Malaya, Malaysia
  - Wan Azlina Wan Ab Karim Ghani, Universiti Putra Malaysia, Malaysia
  - Wan Mohd Nasir Wan Kadir, Universiti Teknologi Malaysia, Malaysia
  - Wenbing Zhao, Cleveland State University, USA
  - Zaki Yamani Zakaria, Universiti Teknologi Malaysia, Malaysia
  - Zuhailawati Hussain, Universiti Sains Malaysia, Malaysia
  - Zuwairie Ibrahim, Universiti Malaysia Pahang, Malaysia
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# CONFERENCE VENUE

The SIE 2022 will be held at **Bayview Hotel Langkawi, Malaysia.**

Address: Jalan Pandak Mayah 1, Pusat Bandar Kuah, 07000 Langkawi, Kedah



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# Plenary Speaker 1

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**TS. SHAMSUL BAHAR MOHD NOR**

Chief Executive Officer, Malaysian  
Green Technology & Climate Change  
Center (MGTC), Malaysia

## **GREEN TECHNOLOGY INNOVATION**

Green Technology Innovation (GTI) is the research of global trends and benchmarking with relevant innovation and environmental indices. The level of innovation consists of the cellular-molecular, modular, system, and business innovation. The GTI innovates at different levels to drive down the negative impacts to the environment. The global and regional megatrends are the key drivers that will change the way we live and plan for the future. The political commitment and green innovations are important in solving our environmental problems such as the demographic and social change (higher education enrolment, inclusion of women in workforce, youth involvement, public health, and global pandemic), rapid urbanization, shift in global economic power, the acceleration of the climate change and the reduction of the environmental quality and resources' stocks. Global benchmarking compares Malaysia with the regional and global peers in terms of the performance in innovation, environment, and sustainability. Malaysia is ranked highly among ASEAN countries for the relevant rankings reviewed, usually holding the second spot, lagging only behind Singapore. For the current greenhouse gas (GHG) emissions' landscape and baseline scenario, energy remains the biggest contributor to Malaysia followed by industrial processes, product use, and waste. The innovation with the largest potential to improve our Malaysian green landscape enhanced resource recovery (from waste) technologies includes recycling technologies and raw material extraction from waste (i.e.: e-waste, automotive waste).

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# Plenary Speaker 2

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**IR. DR. NORSHAH HAFEEZ  
SHUAIB**

Executive Director & Chief Technical  
Officer of MTC Group of Companies

## **ENGINEERING FOR SUSTAINABILITY OF MALAYSIAN ENERGY INDUSTRY : BUSINESS PERSPECTIVES**

The current state of the global economy is very volatile due to many challenges. The COVID-19 pandemic, the Russia-Ukraine war, the resulting inflationary environment, as well as the increasingly evident impacts of climate change have all posed various challenges that drive many organizations to reconsider and re-strategize in order to stay relevant in their respective industries. Many have put more emphasis on the need for sustainability, which in the business setting is now more known as the Environmental, Social and Governance (ESG) framework. The drive for ESG is a global theme and have permeated not only corporate listed companies but also cascaded down to organizations in their supply chains, including the Small and Medium Enterprises (SME). This talk discusses the challenges faced by companies in attempting to pivot their businesses towards ESG compliance. Case studies are presented to illustrate how ESG-related challenges can be turned into opportunities by leveraging innovative research and engineering solutions to meet the various ESG requirements.

It is hoped that the knowledge shared would prompt academics and other researchers to be more aware of the challenges faced by businesses and industry practitioners, which would further enhance their research impacts and strengthen the industry-academia linkages in future works.

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# Keynote Speaker

## Electrical Engineering

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### **ASSOC. PROF. DR. RAZALI NGAH**

Associate Professor, Wireless Communication Centre (WCC), Faculty of Electrical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

## **TOWARDS THE ERA OF 6G NETWORKS: OPPORTUNITIES, CHALLENGES AND RESEARCH DIRECTIONS**

The world is going through a fundamental transformation with the emergence of the intelligence information era. The key domains linked with human life such as healthcare, transport, entertainment, and smart cities are expected to elevate the quality of service with high-end user experience. Therefore, the telecommunication infrastructure has to meet unprecedented service level requirements such as ultra-high data rate and traffic volume for prominent future applications such as Virtual Reality, holographic communications, Internet of Everything, collaborative robots, and space and deep-sea tourism, and massive Machine Type Communication. There are significant challenges identifiable in the communication context to much the envisaged demand surge. The societal and technological developments driving the transition to 6G will be emphasized. Emerging applications to realize the demands raised by 6G driving trends are discussed subsequently. The requirements that are necessary to realize the 6G applications also be elaborated. Finally, research activities including standardization efforts toward the development of 6G are outlined.

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# Keynote Speaker

## Mechanical Engineering

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**ASSOC. PROF. IR. TS. DR.  
SHAHRIMAN ABU BAKAR**

Associate Professor Ir. at Faculty of  
Mechanical Engineering Technology ,  
Universiti Malaysia Perlis, Malaysia

### **TRANSPORTATION SYSTEM: INCEPTION, APPLICATION AND FUTURE**

Sustainable transportation discusses on technologies, systems, as well as governmental and industrial policies, which is aiming at the efficient transit of goods and services, sustainable freight, and delivery systems. Sustainable transportation should be more concentrated on efficiency and accessibility to the holistic nation-building that shares on the network of the green corridor that connects people, the marketplace, and open spaces. The combination of issues could bring a loss of efficiency in running effective nation management, from environmental issues in carbon footprints to people well beings and economic impact. Therefore, solutions that provide eco-friendlier accessibility and higher sustainability in the key areas such as these 3 essential areas; community, transportation, and agriculture are needed. The future of efficient transportation systems including agriculture elaborated and research activities toward the development of future sustainable transportation systems in the above key areas are outlined.



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# Keynote Speaker

## Biomedical Engineering

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### **PROF. DR. TJOKORDA GDE TIRTA NINDHIA**

Program Study of Mechanical Engineering, Engineering Faculty, Udayana University, Jimbaran Campus, Badung, Bali, Indonesia

## **PROGRESS ON DEVELOPMENT LOW COST AND EASY MAINTENANCE SMALL SIZE BIOGAS FUELED ENGINE FOR ELECTRIC GENERATOR**

Large size biogas engine for electric generator are well established with very expensive Price and high maintenance cost. Mainly the large size Biogas Engine was provided from developed country that include expensive import cost. In Contrary small size or family size biogas engine for rural area are not well established. The requirement in processing organic waste lead to promotion of establishment anaerobic digestion as one solution to process organic waste that provide benefit in availability of biogas as source of energy. The small size biogas engine was developed from various type of engines. The biogas engine can be designed from 4 stroke engine as well as diesel engine. More even, flexible fueled engine that can be fueled separately by using biogas or gasoline or liquefied petroleum gas (LPG) can be created to overcome the problem that a rise during biogas is not available during the process. The most recent progress is providing 2 stroke engine that can be fueled individually by using biogas and if biogas is not available the engine still can be run by using gasoline or methanol. If the quality of biogas is about low, the 2 stroke engine can be run also by mixing the biogas with methanol with castor oil as lubricant.

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# Keynote Speaker

## Chemical Engineering

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**MOHAMMAD YASIN  
ABDULFATAH**

Manager of Exploration &  
Development, PT SPR Langgak,  
Jakarta Selatan, Indonesia.

### **EOR IMPLEMENTATION TO MAXIMIZE ENERGY AVAILABILITY**

Renewable energy, alternative cleaner energy with minimum carbon emissions are hot topics to be discussed in the energy conferences. Plans to reduce investment for fossil fuels, and shifted to renewable energy investments is a very good effort to boost up the renewable energy growth toward avoiding a climate emergency. However, mankind's dependence on energy continues to increase, the need for cheap and available energy source like fossil fuels remains high. The investment in the Fossil fuel stills needs to be continued. At the opening of ADIPEC 2022, the Chairman said that cessation of investment in fossil fuels will reduce production by 5 million BOE per year. Renewable energy is still in development towards cheap, efficient, high availability and reliability energy sources, while fossil fuel energy sources will experience a decline if there is no EOR implemented in the mature hydrocarbon fields. Enhanced oil recovery (EOR) began to be known in the early 70s, EOR uses unconventional hydrocarbon recovery methods to increase hydrocarbon recovery from underground. Although this eor technique has been introduced a long time ago, Not many EOR is implemented in the Hydrocarbon fields, because unconventional hydrocarbon recovery methods make the investment higher than other recovery techniques, such as primary recovery, or secondary recovery. EOR requires a long study process, from screening the EOR method, laboratory test, Pilot test and full field utilization. The Langgak Field, a small and mature field, has been in production for more than 40 years and has taken the initiative to implement EOR to increase recovery. Together with Universitas Islam Riau and Universiti Teknologi Malaysia, We aim a successful pilot of continuous chemical injection in the field.

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# Keynote Speaker

## Computing

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**PROF. TS. DR. DAYANG  
NORHAYATI ABANG JAWAWI**

Deputy Dean (Academic & Student  
Affairs), Universiti Teknologi  
Malaysia (UTM), Malaysia

### **NURTURING COMPUTATIONAL THINKING SKILLS THROUGH EDUCATIONAL ROBOTS**

The fourth industrial revolution bring changes in terms of technologies and a major shift in the job environment. One of the important skills that can be promoted with this revolution is computational thinking (CT) skills. CT is a vital and fundamental skill which involved solving problems activities, designing system, and understanding human behavior by mapping the concepts into computer science discipline. Robots are becoming a popular educational tool in areas of science and technology for primary and secondary school and in several areas of engineering and technology in universities. The popularity of Educational Robotics (ER) has resulted in the proliferations of similar ER pedagogical tools being developed with customized feature based on its educational requirements level. Realizing the benefits of robots in teaching, in 2012 Universiti Teknologi Malaysia (UTM) introduced ER Co-Curricular Service-Learning program and in class formal education for the purpose of teaching the CT Skills and computer programming. The Covid-19 pandemic demands the education institutions to utilize the digital platform in ensuring that the teaching-learning process can be conducted amid the pandemic. Thus, in this sense, ubiquitous learning is a learning environment to support digital learning paradigm. The overall aim of this presentation is to share our approach in nurturing CT skills among schools' students in two different environments: face-to-face environment before Covid-19 pandemic and ubiquitous learning environment during Covid-19 pandemic.

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# Keynote Speaker

## Civil Engineering

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### **ASSOC PROF. IR. TS. DR. MOHAMAD HIDAYAT JAMAL**

Associate Professor, Faculty of Civil Engineering, Universiti Teknologi Malaysia (UTM), Malaysia

## **OVERVIEW OF COASTAL PROTECTION STRUCTURES AND ADAPTATION TO SEA LEVEL RISE IN MALAYSIA**

Malaysia is a coastal nation with a long stretch of coastline. Based on the National Coastal Erosion Study (NCES) reported in 2015, Malaysia coastline is approximately 8840 km long inclusive of Peninsular Malaysia, Sabah and Sarawak. The coastline is exposed to the threats of coastal erosion and an increase in sea level. As reported in NCES (2015), 15% of the coastline is currently eroding, where one-third of those lies under the critical and significant erosion categories that require structural protection. Whilst Sea Level Rise (SLR) study in Malaysia (2017) had indicated that the projected water level increment is about 0.67 – 0.74 mm per year. Therefore, the aim of this presentation is to provide an overview of coastal protection measures and the adaptation to SLR based on coastal management strategies and practices in Malaysia. One of the most common practises in Malaysia is “hold the line” strategy by constructing hard structures such as rock revetment, groynes, and breakwater along the coastline. Increasing the platform level of seawalls, revetments and earth bunds is considered as an “adaptation” strategy that is effective for erosion protection and adaptive to SLR. Mangrove greenbelts and replanting mangrove programs along the shore are suitable as a “limited intervention” strategy to minimise the long-term threat of erosion and SLR. On the other hand, land reclamation or beach nourishment is considered as “move seaward” strategy that expands the beach although it still requires protection to maintain the coastline. If

any of the strategies are unable to be implemented, hence “managed realignment” that involves the relocation of critical structures or properties further inland should be adopted. Selection of hard structures, soft engineering or both options are very much depending on the erosion categorisation and land use needs. Conventional hard structures such as seawalls, rock revetments, concrete-type bunds, and groynes structures are preferred as coastal defence protection for selected eroded beaches but its less economic, environmentally less friendly, and may adversely impact the surrounding ecology. Alternatively, soft engineering methods or ecological-based approaches such as beach nourishment and mangrove replanting are more favourable considerations but require an extensive period before witnessing any significant outcomes. Finally, most of those coastal protection structures such as offshore breakwaters, submerged breakwaters, revetments, and groynes are solely for protection purposes and are not as effective for SLR adaptation. As the sea level continuously increases due to climate change, their function as coastal protection will also become less effective. Thus, SLR should be considered in any future design of coastal protection measures in Malaysia.

# Quick Glance on Presentation Schedule

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## 12 DECEMBER 2022

11.15 AM - 11.40AM | KEYNOTE

11.40AM - 1.10PM | SESSION 1

1.10PM - 2.15PM | LUNCH BREAK

2.15PM - 3.30PM | SESSION 2 PART 1

3.30PM - 3.45PM | TEA BREAK

3.45PM - 5.00PM | SESSION 2 PART 2

## 13 DECEMBER 2022

8.30AM - 10.15AM | SESSION 3

10.15AM - 10.45AM | TEA BREAK

10.45AM - 12.45PM | SESSION 4

12.45PM - 2.15PM | LUNCH BREAK

2.15PM - 4.30PM | SESSION 5

# Parallel Session Tentative Program

Session 1 | Day 1 : 11.40AM - 1.10PM

SAPPHIRE Level 2	EMERALD Level 2	DIAMOND Level 2	RUBY Level 2	AQUAMARINE Level 2
ID 18 Evaluation of Factors in Dielectric Material Production from Pineapple Leaf	ID 76 Microencapsulation of Chlorogenic from Green Coffee Bean Using Spray Drying	ID 22 Unmanned Aerial Vehical (UAV) images for coastal erosion monitoring	ID 58 Erudite Survivor: Usability Testing of a Gamification-based Mobile App for Disaster Awareness Among Children	ID 130 A New Assessment Method for Classification of Respiratory Diseases
ID 20 Investigation of the Relationship between Carbon Composition and Permittivity Performance using Agricultural Waste	ID 78 Sea Level Rise Hazard on Renewable Power Plants in Malaysia	ID 108 THE PRELIMINARY INVESTIGATION ON THE PERFORMANCE OF POROUS CONCRETE DRAINAGE SYSTEMS	ID 19 Review on the Initiatives Taken by the Education Sectors to Nurture CT with Ubiquitous Learning Paradigm	ID 144 Impact on Physiological Responses during Atmospheric Environment Changes in Malaysia
ID 26 Optical Signal Taper Using Large Cross-Section Rib Silicon-On Insulator Parallel Waveguide with Different Geometries	ID 79 Artificial Neural Network Modelling of Bioethanol production	ID 123 The Presence of Ag in the Surface Water of Skudai River, Johor	ID 57 IoT-Based Smart Shelf Monitoring System	ID 122 Assorting Usability Questionnaire on Respiratory Monitoring Medical Device: A Prospective Assessment of User Experience

<p>ID 41 Segmentation of Outdoor Oil Palm Fruit Images for Ripeness Detection using YOLO Algorithm and Features Thresholding</p>	<p>ID 89 Enhanced Mechanical Properties of RPET/PA11 Blends</p>	<p>ID 31 A Study on Prediction and Actual Ground Settlement Induced By Urban Tunneling</p>	<p>ID 61 Hybrid Encryption Method using Trapdoor Flag Tagging and Shifting Method for Password Authentication</p>	<p>ID 13 Integration of Principal Component Analysis and K-Means Clustering for Type 2 Diabetes Sub-clustering Model</p>
<p>ID 50 Kalman Filter based ultrasonic sensor for accurate distance measurement</p>	<p>ID 92 Evaluation of Antioxidants and Proliferation of Human Skin Fibroblast Cell (HSF1184) on Backhousia citriodora Extract by Ultrasonic Assisted Extraction</p>	<p>ID 68 Assessment of Pedestrian Characteristics at Crosswalks in an Urban Environment</p>	<p>ID 62 Energy Trading Using Blockchain</p>	<p>ID 35 A Study on The Supply Chain Link of Covid-19 Vaccines to Malaysia Armed Forces Community Via My Sejahtera Application</p>
<p>ID 53 Development of Integrated Sound Pressure Level Measurement Device Using Electret Microphone</p>	<p>ID 4 Langgak Fracturing Projects: Thin and Low Resistivity Formation in Central Sumatera Basin</p>	<p>ID 80 Speed Distribution Analysis of Heterogeneous Traffic Stream under Varying Time Headway</p>	<p>ID 87 Student Engagement Level during Emergency Remote Learning: K-Means Clustering</p>	<p>ID 36 Three-Dimensional Printed Passive Transtibial Prosthetic Leg: Design Process, Kinematics and Thermal Analysis</p>



## Session 2 | Day 1 : 2.15PM - 5.00PM

<b>SAPPHIRE</b> Level 2	<b>EMERALD</b> Level 2	<b>DIAMOND</b> Level 2	<b>RUBY</b> Level 2	<b>AQUAMARINE</b> Level 2
ID 64 Service Robot Development with LIDAR Integration for Environment Mapping and WiFi Organic Fingerprinting Data Collection	ID 8 Optimization of Cellulose Extraction from Pineapple Waste	ID 134 Transit-oriented Development: A Review	ID 198 Surfactant/Co-surfactant Ratio Influences The pH, Viscosity and Stability of Extra Virgin Coconut Oil-in-Water Microemulsion	Keynote
ID 70 Model Free and Adaptive Controller Design for Position Tracking of Pneumatic Actuator System using Discrete Extremum Seeking Algorithm	ID 17 Factorial Analysis on Biological Treatment of Wastewater Treatment Plant	ID 175 Validation of Driver Behaviour Questionnaire on Nigerian Commercial Drivers: A Pilot Study	ID 200 EVALUATION OF DIABETES SELF-MANAGEMENT APPLICATIONS FOR ELDER USING HUMAN FACTOR ENGINEERING	ID 6 A Sustainability Project Towards Zero Continuous Flaring And Venting Hydrocarbon Of Bokor Betty Rejuvenation Project
ID 71 Effects of Voltage and Temperature on the Soft Error Sensitivity of CMOS Memory System	ID 32 Influence of Magnetic Stirrer Speed on the Properties of Chemical Bath Deposited FeSxOyThin Films	ID 191 Performance Assessment of Using Waste Cooking Oil as an Additive in Cup Lump Rubber Warm Mix Asphalt	ID 38 Current Trend of Lattice Structures Designed and Analysis for Porous Hip Implants: A Short Review	ID 7 Location of Wall-Mounted Air Supply Diffuser Matters? Application in Operating Room

<p>ID 88 Reduction of Peak-to-Average Power Ratio (PAPR) in OFDM by Selective Mapping (SLM) and Partial Transmit Sequence (PTS)</p>	<p>ID 33 Influence of Acetic Acid on Physical and Rheological Properties of Cassava Starch Nanoparticles</p>	<p>ID 11 Numerical Assessment of Post-tensioned Slabs due to Seismic Column Collapse</p>	<p>ID 40 Three-dimensional Modelling and Mesh Convergence Analysis of Transtibial Prosthetic Socket</p>	<p>ID 12 Effect of Air Change Rate on the Particle Dispersion in Single Bed Medical Ward: A Numerical Study</p>
<p>ID 90 Torque Meter Calibration for Powertrain Test Bench</p>	<p>ID 128 Fabrication and Characterization of Fresh and Rotten Potato Starch-Based Bioplastic</p>	<p>ID 27 Natural Light Transmittance of Light-transmitting Concrete (LTC) Incorporated with Optical Fibres</p>	<p>ID 95 Mesh Convergence Analysis of Three-Dimensional Tibial Bone Model: A Finite Element Method</p>	<p>ID 34 Fracture Toughness of 316L Stainless Steel Under Cyclic Bending Deformation</p>
<p>ID 93 Dual Symmetric Multiple-mode Resonators (MMRs) Designed with Defective Ground Structure for UWB Applications</p>	<p>ID 129 Molar Ratio Determination of Natural Deep Eutectic Solvent Using a Graphical Approach</p>	<p>ID 29 Structural Behaviour of a Medium-Scaled Scissor Structure Model: An Experimental Study</p>	<p>ID 159 Selecting Classifiers by Pooling over Cross-Validation Results in More Consistency in Small-Sample Classification of Atrial Flutter Localization</p>	<p>ID 54 Investigation of Dual Impact of Nanoparticles-Ethanol as Additive to Biodiesel-Diesel Fuel on an Engine Using Artificial Neural Network Prediction Model</p>
<p>ID 104 A Feasible Study of A 3D Motorized Nonlinear Black-box System using MATLAB's ARX and Hammerstein-Wiene Tools</p>	<p>ID 188 Immobilization of <math>\beta</math>-glucosidase on polyethersulfone membrane for cellobiose hydrolysis</p>	<p>ID 59 Waste Management Practice during the Design Phase of a Project</p>	<p>ID 195 Effect of Thermal Treatment on Electrospun Hydroxyapatite Nanofibers</p>	<p>ID 109 Effect of Heat Treatment Variables on Aluminium Chip base Feedstock Density For Direct Recycling</p>

<p>ID 106 Analysis of Fast Fourier Transform Using VEDIC and Booth Multiplication</p>	<p>ID 138 ASTM Assessment and On-Site Evaluation of MACO Hydropic-176 Anti-Corrosion Coating for Marine Application</p>	<p>ID 81 Acoustic Performance of Green Facade for Building Wall</p>	<p>ID 145 A mathematical model for the transmission dynamics of COVID-19: A multi-disciplinary approach to environmental transmission</p>	<p>ID 115 Development and Application of TRIZ-DFAM Contradiction Matrix: A Case Study of Juice Squeezer</p>
<p>ID 187 Grid Healthiness Monitoring During High Penetration Solar Photovoltaic using Static-LQP Technique</p>	<p>ID 72 Mathematical Modeling of Drying on Ready-To-Eat Food using Oven and Microwave</p>	<p>ID 39 Carbon Footprint Assessment at Terminal of Airport</p>	<p>ID 46 Development of Grip Strength Assessment by Computerized Digital Force Sensitive Resistor (FSR) for Athletes</p>	<p>ID 100 The Development of Solar Magnetic Bearing Control</p>
<p>ID 63 Water Quality Monitoring for Sustainable Smart Aquaponics System</p>	<p>ID 166 Microbial Degradation of UV-treated Polypropylene by Aspergillus terreus, Engyodontium album and Isolated Microorganisms Species</p>	<p>ID 24 ANALYSIS OF CRACKS IN RIGID AND FLEXBLE PAVEMENTS ON ROAD FAILURES USING CRACK INVESTIGATION MECHANISM</p>	<p>ID 96 2 Channel Electroencephalogram Signals for Person Authentication using Machine Learning</p>	<p>ID 181 Construction of Integrated Farming Apartments Suitable For Islands and Areas with Limited Land Resources: A Case Study of Bonny Island Rivers State Nigeria</p>

## Session 3 | Day 2 : 8.30AM - 10.20AM

<b>SAPPHIRE</b> Level 2	<b>EMERALD</b> Level 2	<b>DIAMOND</b> Level 2	<b>RUBY</b> Level 2	<b>AQUAMARINE</b> Level 2
ID 110 Effect of Surface and Geometrical Structures on ZnO Piezoelectric Output Voltage Characteristics	ID 151 Wettability Alteration and Interfacial Tension Reduction on High Salinity of Anionic/ Nonionic Surfactant	ID 112 The Theoretical Approach In Gig Rider's Occupational Safety Analysis	ID 118 Design, Analysis and Optimization of Crankshaft - A Review	ID 74 Students' Engagement During Virtual Learning Implementation at UNITEN
ID 126 Computational Study of Different Control Strategies for Controlling a Two Rotor Aerodynamical System	ID 154 Rheological Behavior of Recycled Poly(ethylene terephthalate) /Poly(amide) 11 Blends with Chain Extender	ID 165 Field Observation on the Wall Cracking of Twin Highway Tunnel using Non-Destructive Technique (NDT)	ID 119 Simulation and Analysis of Passive and Active Suspension for a Quarter Car Model of a Bumpy Road Profile	ID 75 Collaborative Learning Approach for Teaching Computational Thinking using Mobile Robot during Pandemic
ID 137 Energy Cost Saving Potential by Using Light Emitting Diode Lamps: A Case Study at a Female Hostel	ID 37 Thermogravimetric Catalytic Pyrolysis of High-Density Polyethylene over Iron modified Chicken Eggshell Wastes	ID 44 Stiffness and Damping Comparison of Solid and Hollow Seismic Isolator and Non-Seismic Design Rubber Bearing for Bridges	ID 160 Effect of Strontium Addition, Cooling Rate and T6 Heat Treatment on the Corrosion Behaviour of Al-20%Mg2Si Composite	ID 91 Feature Engineering Model for Students Prediction in Online Learning: A review
ID 177 Design and Analysis of Hexagonal Antenna for UHF RFID Reader	ID 49 Comparison between Chemical Modification of Biochar for Different Environmental Applications: A Review	ID 48 Stabilization of Peat Soil Using Palm Oil Fuel Ash (POFA)	ID 162 Effect of Erbium and Praseodymium Addition on Wear Properties of Al-15%Mg2Si In-Situ Composite	ID 101 Global Issues of Digital Education in TVET Fields: A Bibliometric Review

<p>ID 178 Design and Analysis of Triangular Array Antenna for UHF RFID Reader</p>	<p>ID 51 Analysis on the Presence of Nanosized Titanium Dioxide (TiO<sub>2</sub>) and Zinc Oxide (ZnO) in Compact Powder</p>	<p>ID 73 Performance Analysis of Urban Road Intersections: A Case Study of Kota Tinggi, Johor</p>	<p>ID 163 Effect of Er Addition on Microstructural and Mechanical Properties of Al-11%Mg2Si Alloy</p>	<p>ID 102 AWARENESS OF GREEN SKILLS AMONG AUTOMOTIVE INDUSTRY WORKERS</p>
<p>ID 182 Augmented Reality (AR) Navigation Application with End To End Encryption (EEE) Chat</p>	<p>ID 56 Ramie Reinforced ABS Solution Impregnation Composites Using Lay-Up and Vacuum Infusion Techniques</p>	<p>ID 116 FLEXURAL ANALYSIS OF THICK PLATE UNDER LOAD USING 3-D POLYNOMIAL SHEAR DEFORMATION THEORY</p>	<p>ID 164 The Characterization and Optimization of Operating Parameters for Gasification Using Indonesian Bamboo</p>	<p>ID 143 Case Study Teaching to Identify Awareness of Young Engineers About Ethical Challenges at Workplace</p>
<p>ID 10 Optimal Directional Relay Coordination for IEEE 33 Bus Distribution System with Distribution Generators</p>	<p>ID 69 In Silico Molecular Docking Study Interaction Of Secondary Metabolites In Kacip Fatimah As Antioxidant Activity</p>	<p>ID 148 Ultimate Strength of Reinforced Concrete Column Strengthened by Steel Caging</p>	<p>ID 94 Numerical Investigation on the Effect of Methane Diffusion Flame Parameters toward the Carbon Nanotubes Growth inside Quasi-Pyrolysis Chamber</p>	<p>ID 174 Sustainable Development for Instructor Professionalism in Oil &amp; Gas TVET Training Center</p>

## Session 4 | Day 2 : 10.45AM - 12.35PM

SAPPHIRE Level 2	EMERALD Level 2	DIAMOND Level 2	RUBY Level 2	AQUAMARINE Level 2
ID 190 Modelling of Vehicle Detection for Smart Traffic Light Controller using YOLOv5 and DeepSort	ID 202 Optimal Renewable Energy for Hydrogen Production in Methanation Process	ID 65 Flexural Strength and Flammability of Pineapple Leaf Fibre (PALF)/Fire Retardants Reinforced Polymer Composites	ID 16 The Delphi Technique As A Method To Obtain Consensus On Barriers to Implement Building Information Modeling (BIM) To The Indonesia Consultant Construction	ID 168 Designing the Layout of Disaster Logistics Warehouse Facilities with Class-Based Storage in Sukoharjo Village, Sleman Regency, Yogyakarta, Indonesia
ID 194 Development of Virtual Platform and Field Implementation for Mobile Robot Navigation in Greenhouse Environment	ID 157 Preparation of Beeswax Residue-ZnCl <sub>2</sub> -Activated Carbon for Adsorption of Methylene Blue	ID 66 Mechanical Properties and Flammability of Pineapple Leaf Fibre (PALF) Reinforced Polymer Composite with Hybridised Fire Retardants	ID 52 REGULATIONS THAT ARE OBSTACLING FACTORS IN INCREASING THE COMPETITIVENESS OF INDONESIAN CONSULTING SERVICES	ID 169 Risk Maturity Model: A Systematic Literature Review
ID 189 Design and Characterization of 5G Radiation Absorber using Rubber-based Conductive Carbon Black	ID 158 Effects of Biochar, Compost, and Composted-biochar as Soil Amendments on Okra Plant Growth	ID 82 Pin On Disc Evaluation of Wear for Aluminium Pin on Steel Rotating Disc	ID 203 INVESTIGATION OF TREATED WASTEWATER AND WATER DEMAND FOR WATER RECLAMATION IN PASIR GUDANG	ID 124 The Thermal Properties of Copper Alloy Valve Seats Imposed in the MODENAS CT115's Engine at Low Engine Speed

<p>ID 186 Vision-Based Smart Hand Gesture User Interface</p>	<p>ID 161 Implementation of Direct Current Electrical Stimulation to Improve Oil Recovery of Highly Paraffinic Oil Reservoir at Low Salinity Reservoir Condition</p>	<p>ID 83 Effects of Local Temperature on CNT Growth in Flat Premixed Flame</p>	<p>ID 117 Seasonal and Multivariate Statistical Analysis of Shallow Aquifers' Hydrochemistry in a Semiarid Sokoto Basin, Northern Nigeria</p>	<p>ID 141 Fuel Consumption Comparison – Real-World Driving Tests of Perodua Myvi during Peak, Off-peak, and Weekend Hours based on Selected Terengganu Routes</p>
<p>ID 173 Exploring Transfer Learning Strategies for Improved Model Generalization</p>	<p>ID 180 Modeling And Simulation of Wax Deposit Formation in The Oil and Gas Well Pipeline Langgak Field</p>	<p>ID 84 Analysis of fluidized bed for the synthesis of carbon nanotubes (CNT) on ceramic beads</p>	<p>ID 131 Review on Roadside Noise due to Transverse Rumble Strips Installation</p>	<p>ID 142 Fuel Consumption Assessment by Real-World Driving Tests of Perodua Bezza 1.3 L and Perodua Myvi 1.5 L based on Urban, Suburban, Rural, and Highway Routes in Penang, Malaysia</p>
<p>ID 196 Development of Face Recognition Attendance System Using Image Processing for Faculty of Computing</p>	<p>ID 192 Electric Bus Charging Schedule for Multiple Route and Multiple Charging Location via Mathematical Modelling</p>	<p>ID 85 Experimental Analysis of Tribological Performance of Base Ficus Carica Vegetable Oil with Different Polymers as Additives Using Four Ball Tribometer</p>	<p>ID 55 Modelling of Flow over Roughed Crump Weir Using Experimental and Numerical Methods</p>	<p>ID 97 Effects of Temperature on Electro-Mechanical Parking Brake (EMPB) System on Commercial Vehicle</p>
<p>ID 204 Load Forecasting for Renewable Energy Development via Comprehensive Parameter Selection using Support Vector Machine</p>	<p>ID 30 Trial Application of Pressure-Activated Sealants for Simulated Tubing Leak</p>	<p>ID 86 Influence of Zn and Mg Alloying Elements on The Mechanical Properties of Al Coating Deposited via Twin Wire Arc Spray Process</p>	<p>ID 21 Demographics Factor on Utilization of E-hailing in Kota Kinabalu</p>	<p>ID 47 A Review on Controllers Used for Drone Obstacle Avoidance</p>

## Session 5 | Day 2 : 2.15PM - 4.45PM

SAPPHIRE Level 2	EMERALD Level 2	DIAMOND Level 2	RUBY Level 2	AQUAMARINE Level 2
<p><b>ID 113</b> Simulation-Based Power Estimation for High Throughput SHA-256 Design on Unfolding Transformation</p>	<p>ID 121 Hydrodynamic Analysis of Ship Propeller with Leading Edge Tubercles</p>	<p>ID 199 Establishing the Four Dimensions of Characterization for Sustainability Courses in Engineering Education</p>	<p>ID 25 One-dimensional Dam Breach Hydraulic Simulation of Palasari Dam</p>	<p>ID 5 Green Synthesis of Isopropyl Myristate Using Immobilized Candida antarctica Lipase: Process Optimization Using Response Surface Methodology</p>
<p>ID 125 Combinatorial Technique for The Enhancement of Multifactor Weighted Approach for Event Sequence Test Cases</p>	<p>ID 135 The effects of chamber and thickness of airfoil on the aerodynamic performances of small-scale wind turbines</p>	<p>ID 185 Sustainable in Quality Control for Delivery Competency-Based Training (CBT) in Oil &amp; Gas Skills Institution</p>	<p>ID 111 Effect of Metakaolin And Crumb Rubber on Pervious Concrete Bricks Properties</p>	<p>ID 23 Simulation Study Of Lead Removal From Wastewater By Using Tea Waste As Biosorbent</p>
<p>ID 103 A Blockchain Data Size Reduction Strategy through Data Explosion Reduction Algorithm</p>	<p>ID 140 SYNTHESIS AND CHARACTERIZATION OF NICKEL BORIDE NANOPARTICLES FOR ENERGY CONVERSION CATALYST MATERIALS -THE EFFECT OF ANNEALING TEMPERATURE</p>	<p>ID 107 Preparation and characterization of Andrographis paniculata Extract Loaded onto Chitosan-based nanoparticles</p>	<p>ID 98 Elitism-based Barnacle Mating Optimization and Its Application to PID Controller Design for a Buck Converter</p>	<p>ID 127 Preparation and Characterization of Poly(Lactic Acid) / Poly(Caprolactone) Shape Memory Polymer Blends Compatibilized with Epoxidized Palm Olein</p>



<p>ID 105 Ensemble Filter Feature Selection Technique for Classification of Human Activity Recognition</p>	<p>ID 146 MIXTURE OF GYPSUM AND PALM BUNCH ASH TO IMPROVE FIRE RATING</p>	<p>ID 77 Isolation and Characterization of Soda Lignin from OPEFB and Evaluation of its Performance as Wood Adhesive</p>	<p>ID 99 Entomology for Insect Characterization Using CW Radar</p>	<p>ID 152 Seismic Data Enhancement for Optimized Determination of Brown Field Reserves in Enhance Oil Recovery (EOR) Study</p>
<p>ID 132 Expert Survey Analysis on the Risk Mitigation for Agile global Development Framework : a validation study</p>	<p>ID 171 Ventilation Strategies and Operating Conditions in Hospital's Operating Room: Scopus Data-Driven Mini Review</p>	<p>ID 176 Refractory organic compounds in River Nile and its tributaries</p>	<p>ID 172 The Effect of Bending Condition towards the Performance of Pac-Man Textile Antenna for Smart Wearable Antenna Application</p>	<p>ID 42 Initial Study On Cassava Peel With Crosslinker Cr3+ Biopolymer As Alternative Material In Water Coning Control</p>
<p>ID 133 Covid-19: Classification of Patients' Health Status based on Influencing Factors</p>	<p>ID 179 Preliminary Attempts to Reduce the Risk of COVID-19 Transmission: A Mini Review</p>	<p>ID 114 Maceration Extraction and Soxhlet Extraction of Orthosiphon Stamineus - A comparative study</p>	<p>ID 67 Cogging Torque Reduction of IPMSM By Adjusting the Stator Opening Width</p>	<p>ID 170 A Review of the Digital Twin Technology Application in Energy Industry for Performance Improvement</p>
<p>ID 147 Enhanced Quality of Web Service Recommendation Approach based on Individual Preference</p>	<p>ID 197 Enhancement Of Polyurethane Mechanical Properties Through Optimization Of Its Pristine Microstructure</p>	<p>ID 184 Quality Control for Delivery Competency-Based Training (CBT) in Oil &amp; Gas Skills Institution</p>		<p>ID 43 Information System for Reporting Vulnerabilities to Protect Digital Infrastructure</p>

<p>ID 149 Energy And Congestion Awareness Traffic Scheduling In Hybrid Software-Defined Network</p>	<p>ID 153 Eddy Flow Effect Analysis on Ducting HVAC System of Type 3 Malaysia Government Health Clinic</p>			<p>ID 193 Energy Analysis of a Solar Driven Combined Cooling, Heating, and Power (CCHP) System based on Selected Low Global Warming Potential (GWP) Refrigerants</p>
<p>ID 150 THE IMPLEMENTATIO N OF TECHNOLOGIES FOR THE ENCRYPTION OF DATA IN NETWORKS ENVIRONMENT FOR THE PROTECTION OF SHARED INFORMATION</p>	<p>ID 60 Elucidating Heat Transfer of Valve and Valve Seat through Thermal Measurement Method</p>			

# Simulation-Based Power Estimation for High Throughput SHA-256 Design on Unfolding Transformation

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**Abstract.** In recent years, security has grown in importance as a research topic. Several cryptographic SHA-256 hash algorithms have been developed to enhance the performance of data-protection techniques. In security system designs where data transmission must be properly encrypted to avoid eavesdropping and unwanted monitoring, the Hash Function is vital. In constructing the SHA-256 algorithm, high speed, compact size, and low power consumption are all factors to be taken into account for an efficient implementation. The purpose of this project is to reduce dynamic thermal power dissipation of SHA-256 unfolding transformation. State encoding is a method used in reducing power design strategies that have been proposed to lower the dynamic power dissipation of the algorithm. The algorithms are successfully designed using the Altera Quartus II platform. The ModelSim is used to test how accurate the results of simulations written in Verilog code are and to validate them. This study presents the unfolding transformation with Gray encoding approach to reduce the SHA-256 design's power consumption and increase its throughput. The SHA-256 unfolding transformation reduces the amount of clock cycles required for conventional architecture. In this research, the dynamic power SHA-256 unfolding factor 4 with Gray encoding reduces by 43.4 percent from Binary encoding with high throughput of the design. Therefore, it was suggested that to provide high performance of the embedded security system design, an unfolding transformation with Gray encoding design can be applied to the hash function design. Thus, the performance of the SHA-256 design can be greatly enhanced by changing the state encoding with the high number of unfolding factors. Based on this technology, the Power Analyzer in Altera Quartus II may produce an accurate simulation-based power assessment.

## INTRODUCTION

To efficiently convert fixed binary chains of any length into bit sequences, a hash function can be used [1]. The outputs of a hash function are variously known as the hash value, the message digest, and the hash code. Short messages containing the bit shifts from the input message are generated using the unkeyed hash function. The hash function is described by its properties, which include resistance to preimages, resistance to second preimages, and collision resistance. It is hard to find message  $M$  with one-way attribute  $h = H$ . This means that while calculating the hash code from the message is simple, calculating the message from the hash code is far more difficult. Finding message  $M_2$  in the second preimage resistance with the same output hash code as  $M_1$  is challenging. Lastly, it's not easy to find a pair of hashes  $H(M_1) = H(M_2)$  for two different messages  $M_1$  and  $M_2$ .

The rapid implementation of hash functions on reconfigurable hardware is now a crucial part of modern technology. FPGA is an answer to the hardware implementation difficulty. Consisting of thousands of programmable interconnected building blocks called Configurable Logic Blocks (CLB), this system is entirely customizable [1]. It includes an input/output (I/O) block that serves as a bridge between the external environment and the internal logic structure. FPGA-based digital logic design can be defined using the Hardware Description Language (HDL) or schematic design. The reconfigurability of FPGA is its primary benefit. In addition, it has inexpensive development

costs and is simple to verify but has a high-power consumption. State encoding has been presented as a strategy in reducing power consumption in SHA-256 hash function design.

Since speed is a must in modern design, there are numerous techniques to boost the performance of SHA-256 design. When developing a successful SHA-256 hash function, it is crucial to take the high speed and throughput of the designs into account. Gray encoding techniques were used in conjunction with the unfolding transformation to increase the SHA-256 throughput of algorithm. Power consumption is also considered in efficient design. The performance of the design can be improved by obtaining a low power design. Short circuit, dynamic, and static power consumption are the three components of CMOS transistor power consumption (leakage). During circuit power-on, CMOS transistors leak power due to the subthreshold currents and reverse biased diodes [2]. Switching power includes both dynamic and short circuit components. It occurs when the logic states of the signal change.

In this study, Verilog code and Altera Quartus II were used to write and synthesise the SHA-256 designs. A netlist representing the HDL code mapping to the Arria II GX was produced as a result of these findings. The physical allocation of the SHA-256 designs was then decided upon during the implementation process using the place-and-route algorithm. Following the successful completion of the implementation phase, ModelSim was used to model these designs in order to evaluate SHA-256 results.

## DESIGN CONCEPT OF SHA-256 ALGORITHM

Throughput performance was improved with the help of these designs. The SHA-256 algorithm was created using Verilog code. This design architecture contains the modules for the counter SHA-256 module and the other five modules. The difference between the two types of SHA-256 designs is in the organization of the modules inside the unfolding architecture. It was discovered that the order of constants and messages changed when different inputs were utilized. Fifteen blocks of 32-bit data were added as input. The message,  $t W$ , was created using Eq. 1 in this design.

SHA-256 message,  $W_t$

$$W_t = \text{message input} \quad 0 \leq t \leq 15$$

$$W_t = \sigma_1^{256}(W_{t-2}) + W_{t-7} + \sigma_0^{256}(W_{t-15}) + W_{t-16} \quad 16 \leq t \leq 63 \quad (1)$$

$$\sigma_0^{256}(x) = ROTR^7(x) + ROTR^{18}(x) + SHR^3(x) \quad (2)$$

$$\sigma_1^{256}(x) = ROTR^{17}(x) + ROTR^{19}(x) + SHR^{10}(x) \quad (3)$$

Both functions were produced using Eq. 2 and Eq. 3. Eq. 2 for sigma 0 displays the rotation value for the x value. The message x in Eq. 3 can be rotated with the value specified in Eq. 3 to yield sigma 1, while for Eq. 3, this can be done. For the compression function, it was split into two halves. While that, Maj and  $\sum_0$  make up  $Temp_2$ , Ch and  $\sum_1$  do the same  $Temp_1$ . Eq. 4 and Eq. 5 display the equations for summation 0 and summation 1, namely  $\sum_0$  and  $\sum_1$ . Like sigma 0 and sigma 1, the number of rotation inputs,  $a$  and  $e$ , were based on the number stated in the equations.

$$\sum_0(a) = ROTR^2(a) + ROTR^{13}(a) + ROTR^{22}(a) \quad (4)$$

$$\sum_1(e) = ROTR^6(e) + ROTR^{11}(e) + ROTR^{25}(e) \quad (5)$$

The message sequence was constructed with the assistance of a counter module. The final module was formed when the SHA-256 hash algorithm completed all rounds of iteration. Before SHA-256 began processing the message, a Multiplexer module generated eight initializations for the message's buffers. The value of Kt was programmed into the ROM in 64x32-bit chunks. The output module was then utilized to produce the result. In this model, the output of the final result of compression algorithm was merged with the initialization of the buffer.

## Unfolding Transformation

The SHA-256 hash function was enhanced due to these modifications. Using an unfolding design strategy, the delay was decreased based on the value of the factor, J [3]. Additionally, this strategy increased the throughput of the design. For unfolding factor 2, the latency decreased by 46.4 percent compared to the conventional design, and for unfolding factor 4, the latency decreased by approximately 45.1 percent. The number of delays was computed in the results. It was reduced as the design architecture developed and modified in response to various inputs. To improve the performance of the throughput SHA-256 design, each module must be modified. For the factor two architecture, two 32-bit parallel inputs with constants were needed. Similar to that, this design required four parallel 32-bit inputs and four parallel constants. As a result, all data for the subsequent sequence cycle needed to be modified. For this approach to work, each input module must be modified. The overall structure of unfolding factor 4 and the structure of next\_wt2 are shown in Fig. 1 for the message schedule. The message W0's input data message begins with W4 and ends with W15. In unfolding factor 4, the next\_wt output sequence follows a similar pattern to that of factor 2.

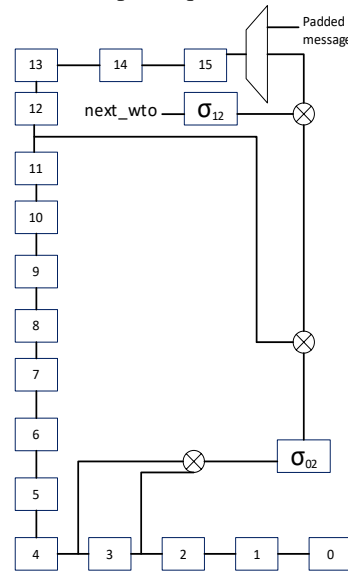


FIGURE 1. SHA-256 Factor 4 Unfolding Message Schedule

## Gray State Encoding

Many researchers with various interests and goals are involved in developing the SHA-256 design [4-18]. The proposed concepts in this research concentrate on low power design implementation. Switching activity is a method to reduce dynamic power. State encoding was introduced in this study as an activity technique for low power devices to reduce the power consumption of SHA-256. For state encoding, the SHA256 unfolding transformation designs were divided into two unique designs: SHA-256 unfolding with Binary encoding and SHA-256 unfolding with gray encoding. Simple examples of encoding transitions are shown in Table 1. The maximum number of possible transitions in a single clock cycle is shown to be three for Binary encoding and one for grey encoding in the following table. This is because each transition between states in the encoding only affects one bit. Using this strategy in the creation of Finite State Machines can reduce power usage (FSM).

**TABLE 1.** A Comparison of Coding Style

St	B	G
0	00 0	000
1	001	001
2	010	011
3	011	010
4	100	110
5	101	111
6	110	101
7	111	100

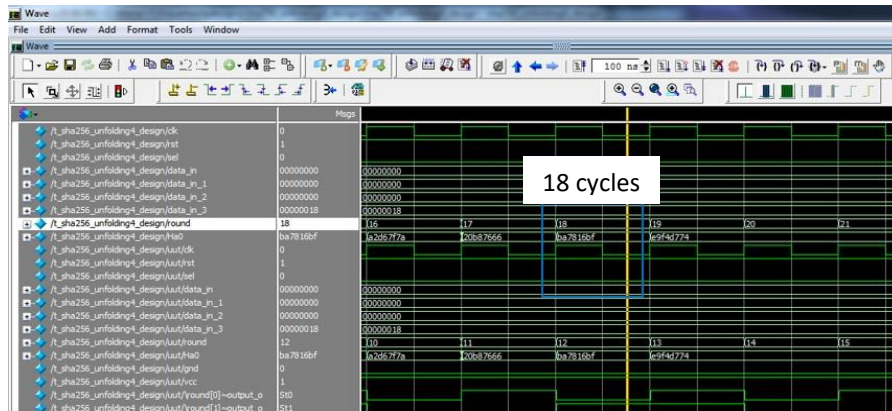
### RESULTS AND DISCUSSION

For this power measurement, the Power Analyzer was utilised from Altera Quartus II. It is a technique for power analysis that employs simulation to deliver the most precise power estimation possible [19]. I/O thermal power, static thermal power, and dynamic thermal power dissipation are the three subcategories of total thermal power dissipation. Verilog code was used to successfully build SHA-256 designs. Using Arria II GX Altera Quartus II, the SHA-256 designs were both synthesized and implemented. The frequency, size, and power consumption of SHA-256 designs were studied. ModelSim was used to simulate the SHA-256 designs in terms of functional and timing simulations. SHA-256 designs were classified into two categories: SHA-256 unfolding design with Binary encoding, and SHA-256 unfolding with Gray encoding. The outcomes demonstrated the impact of unfolding transformation using factor 4 of the SHA-256 architecture. PowerPlay Power Analyzer was used to perform power analysis to validate the effects of switching activity in state encoding on the SHA-256 designs.

#### High Throughput SHA-256 Unfolding Techniques

The SHA-256 designs for both Binary and Gray encodings have been successfully developed and tested. The Altera Quartus II was used to compile the Verilog-coded designs. ModelSim was used to simulate and test the design's functionality and timing. The throughput of these designs was calculated using Eq. 6. When compared to SHA-256 with factor 2, SHA-256 with factor 4 increased throughput by 15.88%. The timing simulation results for the first 32-bit MSB of unfolding SHA-256 with factor four are shown in Figure 2. It is clearly shown that the number of latencies reduce from 64 cycles to 18 cycles.

$$\text{Throughput} = (512 \times \text{FMax}) / \text{Number of Cycle} \tag{6}$$



**FIGURE 2.** SHA-256 design waveform timing simulation using a factor 4

## Simulation-Based Power Estimation of SHA-256 Design

Based on simulations for both unfolding factor 4 configurations, binary and grey encodings, Figure 3 shows power calculation for SHA-256. This diagram depicts the three components of power dissipation. Dynamic power results from the on/off nature of the signal, while static power is the result of leakage currents. Despite the fact that I/O power takes into account all of the parameters that describe the off-chip board trace at each I/O pin [19]. To provide the most precise power analysis, the PowerPlay Power Analyzer considers the physical placement, routing, and logic configuration of the design itself. In other words, it provides accurate power consumption estimation. When used with accurate design data, it is accurate to within 10% [19]. PowerPlay power analyser tools make precise power forecasts when compared to actual silicon. According to Figure 3, the dynamic thermal power dissipation for SHA-256 unfolding factor 4 with gray encoding reduces to 43.4% when compared to Binary encoding. This is because SHA-256 unfolding with gray encoding architecture involves signal toggling. Thermal power dissipations for input/output (I/O) and static components both rise. As previously stated, SHA-256 unfolding design now only requires 18 cycles as opposed to 64. As a result, this affects the overall power usage, and more specifically the I/O power usage, of the SHA-256 unfolding design.

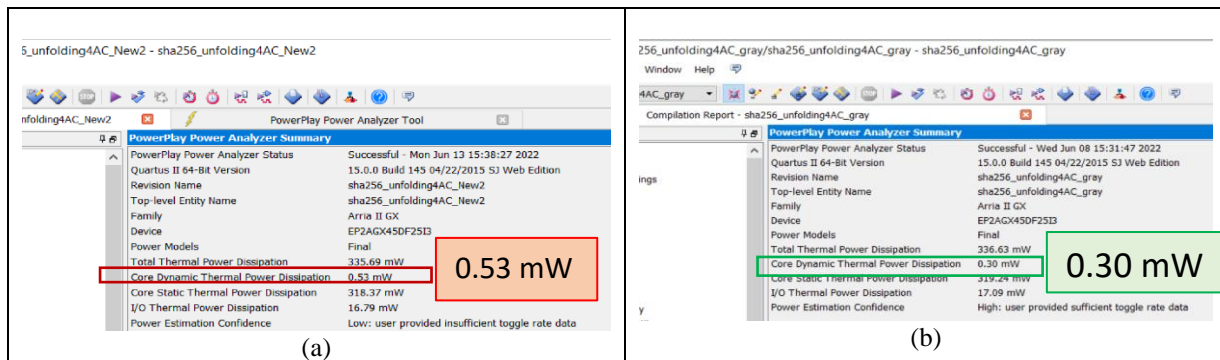


FIGURE 3. PowerPlay Power Analyzer result of SHA-256 Unfolding with (a) Binary Encoding and (b) Gray Encoding

## CONCLUSION

In conclusion, two types of unfolding SHA-256 designs, such as SHA-256 Binary and Gray encoding, were successfully designed using Verilog HDL. In accordance with Power Analyzer, implementing gray encoding can reduce dynamic thermal power dissipation. Besides, it delivers precise power estimation based on simulation. Based on this investigation, SHA-256 Gray encoding reduces dynamic power dissipation by approximately 43.4 percent compared to SHA-256 Binary. Furthermore, SHA-256 Gray encoding can be categorized as a fast, and area- and power-efficient implementation of the SHA-256 architecture. By lowering the SHA-256 design latency, unfolding transformation boosts the throughput of SHA-256 unfolding designs. Resource sharing and retiming are two techniques that can be used to boost the design's maximum frequency soon. Combining the comparable non-linear function with different hash functions enables resource sharing. This approach reduces the area required for implementation and achieves a high maximum frequency. In addition, retiming can be used to lessen the design's latency. When the delay can be decreased by relocating the register, this method raises the maximum frequency of designs.

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## REFERENCES

1. F.R. Henriquez, N.A. Saqib, A.D. Perez, C. K. Koc, "Cryptographic Algorithms on Reconfigurable Hardware", Springer series on Signal and Communication, 2006.
2. Panda, P.R., Silpa, B.V.N.; Shrivastava, A Gummidipudi, K. "Chapter 2:Basic Low Power Digital Design", Power-efficient System Design, Springer Science Business Media, LLC, 2010
3. Parhi, K. K., "VLSI Digital Signal Processing Systems: Design and Implementation, John Wiley & Sons, Inc.", 119-140, (1999).
4. Bharat S.R. , Lingampally S. , Sriram M. , and Varun G., "Comparative Study of Sha-256 Optimization Techniques, IEEE World AI IoT Congress 2022, pp 387 – 392, (2022).
5. Padhi, M., Chaudhari, R., "An optimized pipelined architecture of SHA-256 hash function", 7th International Symposium on Embedded Computing and System Design (ISED), 1- 4, (2017).
6. Kahri, F., Mestiri, H., Bouallegue, B., Machhout, M., "Efficient FPGA hardware implementation of secure hash function SHA-256/Blake-256", IEEE 12th International Multi-Conference on Systems, Signals & Devices (SSD15), 1-5, (2015).
7. Michail, H., Athanasiou, G., A. Kritikakou, C. Goutis, A. Gregoriades, V. Papadopoulou, "Ultra high speed SHA-256 hashing cryptographic module for IPSec hardware/software codesign", International Conference on Security and Cryptography (SECRYPT), 1- 5. (2010).
8. Michail, H., Milidonis, A., Kakarountas, A., Goutis, C., "Novel high throughput implementation of SHA-256 hash function through pre-computation technique", 12th IEEE International Conference on Electronics, Circuits and Systems, 1-4, (2005).
9. Phan, V. D., Pham, H. L., Tran, T. H., & Nakashima, Y., "High Performance Multicore SHA-256 Accelerator using Fully Parallel Computation and Local Memory", IEEE Symposium in Low-Power and High-Speed Chips (COOL CHIPS), (2021).
10. Kester, Q. A., Henry, B., "A Hybrid Data Logging System Using Cryptographic Hash Blocks Based on SHA-256 and MD5 for Water Treatment Plant and Distribution Line", International Conference on Cyber Security and Internet of Things (ICSIoT), (2019).
11. Bensalem, H., Blaquièrre, Y., Savaria, Y., "Acceleration of the Secure Hash Algorithm-256 (SHA-256) on an FPGA-CPU Cluster Using OpenCL", 2021 IEEE International Symposium on Circuits and Systems (ISCAS), (2021).
12. He, Z., Wu, L., Zhang, X., "High-speed Pipeline Design for HMAC of SHA-256 with Masking Scheme", 12th IEEE International Conference on Anti-counterfeiting, Security, and Identification (ASID), (2018).
13. Zhang, X., Wu, R., Wang, M., Wang, L., "A High-Performance Parallel Computation Hardware Architecture in ASIC of SHA-256 Hash", 21st International Conference on Advanced Communication Technology (ICACT), (2019).
14. Wu, R., Zhang, X., Wang, M., Wang, L., "A High-Performance Parallel Hardware Architecture of SHA-256 Hash in ASIC, ICACT Transactions on Advanced Communications Technology (TACT)", Vol. 8, Issue 5, (2020).
15. Li, J., He, Z., Qin, Y., "Design of Asynchronous High Throughput SHA-256 Hardware Accelerator in 40nm CMOS", IEEE 13th International Conference on ASIC (ASICON), (2019).
16. Li, W., Zhu, Y., Tian, L., Nan, T., Chen, X., "FPGA-based Hardware Acceleration for Image Copyright Protection System Based on Blockchain", 7th IEEE International Conference on Cyber Security and Cloud Computing (CSCloud)/2020 6th IEEE International Conference on Edge Computing and Scalable Cloud (EdgeCom), (2020).
17. Kieu-Do-Nguyen, B. , Hoang, T. , Pham, C. , Pham-Quoc, C. , "A Power-efficient Implementation of SHA-256 Hash Function for Embedded Applications", International Conference on Advanced Technologies for Communications, pp 39 – 44 (2021)
18. Chen, Y., Li, S., "A High-Throughput Hardware Implementation of SHA-256 Algorithm", IEEE International Symposium on Circuits and Systems (ISCAS), (2020).
19. Altera Corporation, "FPGA Power Management and Modeling Techniques", White Paper, 101 Innovation Drive San Jose, CA 95134., December 2010. Access on [https://www.altera.com/en\\_US/pdfs/literature/wp/wp-01044.pdf](https://www.altera.com/en_US/pdfs/literature/wp/wp-01044.pdf)