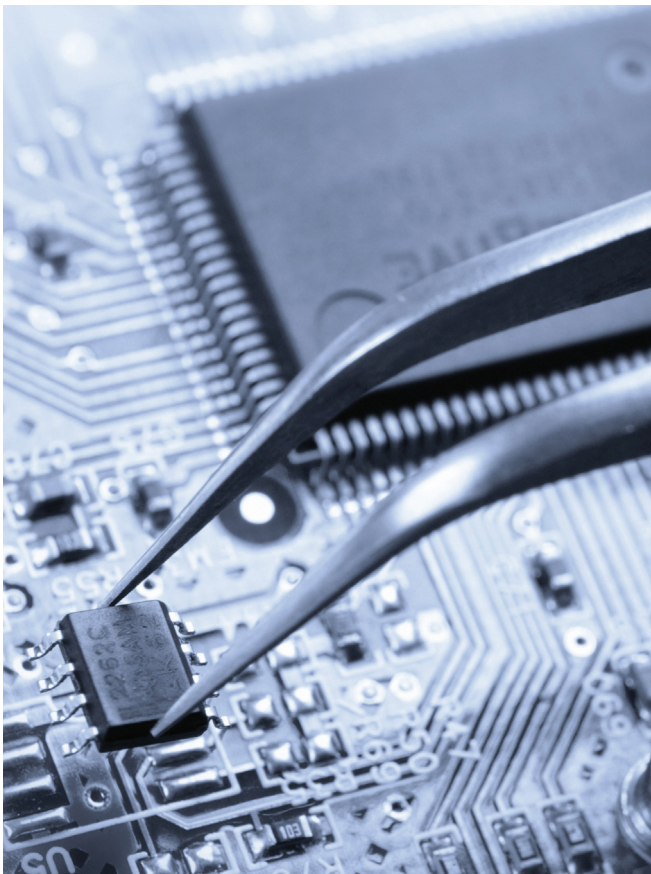


**SUNWAY**  
UNIVERSITY



A CLASS ABOVE

# RESEARCH PROFILE 2022



School of  
**ENGINEERING &  
TECHNOLOGY**

<https://university.sunway.edu.my/set>



School of  
**MEDICAL &  
LIFE SCIENCES**

<https://university.sunway.edu.my/smls>

# About Us

Academics of the School of Engineering and Technology and School of Medical and Life Sciences are committed to conduct significant research with high impact in the fields of Science, Engineering and Technology. Many of them are recognised as the leading and most highly cited researchers in Malaysia and globally. Our academics are recipients of multiple research awards and honours.



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# Preface

## DEANS' JOINT WELCOME

### Two High-Performing Schools

Academic research involves the creative and systematic process of generating new knowledge and applying its derivatives for the benefit of humankind, culture, society, and the physical environment. This compendium of scholar profiles of the School of Engineering and Technology (SET) and School of Medical and Life Sciences (SMLS) reflects our ambition to conduct fundamental research investigations to increase our body of knowledge while aiming also to translate the new findings into applied research, experimental development explorations as well as practical applications. The ultimate goal is the advancement of relevant branches of science, computing, engineering, health, education, ecology, social and public policies, etc., while simultaneously addressing the Sustainable Development Goals formulated by the United Nations. Research at our fast-growing Schools is driven by top-qualified and productive academic staff who enjoy the benefit of having efficient support provided by the highly professional admin, operation, and support teams of the Schools and the University as a whole. It is also backed by extensive resources generously offered by the Jeffrey Cheah Foundation and by the ongoing success in securing competitive external research grants. All of these highly dynamic and productive research activities are conducted through the Academic Departments and Research Centres of our two Schools:

#### School of Engineering and Technology

- Department of Computing and Information Systems
- Department of Engineering
- Graphene and Advanced 2D Materials Research Group
- Research Centre for Applied Physics and Radiation Technologies
- Research Centre for Carbon Dioxide Capture and Utilisation
- Research Centre for Human-Machine Collaboration
- Research Centre for Nano-Materials and Energy Technology

#### School of Medical and Life Sciences

- Department of Biological Sciences
- Department of Medical Sciences
- Department of Nursing
- Department of Psychology
- Ageing, Health and Well-Being Research Centre
- Center for Virus and Vaccine Research
- Research Centre for Crystalline Materials

### Building on the World-Class Research Infrastructure

Both SET and SMLS benefit from the first-class facilities and outstanding support provided by Sunway University and the Jeffrey Cheah Foundation. These include the multitude of generous scholarships and fellowships, research and visiting award schemes, focused infrastructure and project grants, distinguished professorial and endowment appointments, and partnerships with the most prestigious universities in the world such as the University of Cambridge; University of Oxford; Lancaster University; Harvard University; University of California, Berkeley; Massachusetts Institute of Technology, to mention a few. As a result, the Schools have made significant contributions to the overall University research scholarship through extensively publishing books, book chapters, refereed journal papers and conference reports of high impact that are indexed by the Web of Science, Scopus, Xplore, and other leading databases. Many of our researchers are also involved in industry-sponsored research and consultancy projects. All of these efforts have resulted in the rapid propelling of Sunway University to be amongst the respected group of high-ranked research-intensive universities in Asia and globally.

## Creating a Rich Research-Teaching Nexus

Sunway University's mission embraces a steadfast devotion towards the discovery, advancement, sharing and application of knowledge to meet the needs of the society and global community. As a world-class university with an increased focus on research intensity and impact, our explorations are increasingly embedded into the undergraduate and postgraduate curricula of SET and SMLS, thus creating a rich milieu for research-informed teaching. This enhanced research-teaching nexus at Sunway University aims to engage the next generation of learners in robust research enquiry and capture their interest. In tandem, our postgraduate research student community continues to grow steadily and at a rapid pace. It is fast-becoming an important part of the vibrant research ecosystem of Sunway. Our spacious teaching premises, laboratories, and project development studios as well as dedicated research centre facilities are equipped with cutting-edge advanced systems, apparatuses, and tools that enable our students to have a truly global-immersive research experience during their studies. In fact, the Malaysia Digital Economy Corporation (MDEC) recently recognised SET as Malaysia's Best Faculty of the Year.

## Fostering Interdisciplinary Research with Impact

This joint two-school research portfolio captures Sunway University's dedication to innovative and transformative research that benefits the academia-industry-society-government-environment quintuple helix. Our research endeavours are strategically aligned to the Shared Prosperity Vision 2030, the 12th Malaysian Plan as well as the 10-10 Malaysian Science, Technology, Innovation and Economy Framework. They are formulated to harness the existing potential and new opportunities for the inclusive socio-economic development of the country. In fact, this joint compendium between both the schools reflects the growing need for interdisciplinary collaborations to produce high-impact outcomes that provide new and improved understanding and insights into various local and global issues and challenges. The expanding breadth and depth of our research activities provide a fertile opportunity for fostering new collaborative opportunities. As a result, our staff members are strongly engaged in numerous public-private partnership projects and collaborations while successfully attracting significant competitive research funding.

## Joining Forces for Better Tomorrow

The Schools are really proud of what has been achieved together thus far. And with great optimism, we are looking forward towards scaling new research heights in the future. Please join us in this exciting journey. We are truly open to fruitful collaboration, research links and exchanges, joint research publications and presentations, collaboration in research supervision and grant applications, development of theoretical and applied industrial projects, and all other research-related activities that would be of mutual interest and benefit to our collaborating partners as well as add true value to the world.

Best wishes.

### **Professor Abhi Veerakumarasivam**

Dean  
School of Medical and Life Sciences (SMLS)  
10 May 2022

### **Professor Serge Demidenko**

Dean  
School of Engineering and Technology (SET)  
10 May 2022



# Welcome BY ASSOCIATE DEANS

Recognising Sunway University's vision to be a world-class university, it is important that we strive to conduct inter- and multi-disciplinary research delivers impact and helps achieve the United Nations Sustainable Development Goals (SDGs).

In order to promote collaborative research with Sunway academics involved in areas related to science and technology, the School of School of Engineering and Technology and the School of Medical and Life Sciences have decided to jointly showcase individual research portfolios.

Our exceptional scientists, of whom some have been listed in the World's Top 2% Scientists produced by Stanford University, have expertise in disciplines such as engineering, physics, computer sciences, life sciences, chemistry, environmental conservation, biology, planetary health and psychology.

In 2021, both schools were the frontrunners in spearheading the University's research excellence. Academics from both schools contributed 71% of the University's publications in SCOPUS and Web of Science, and garnered over 50% of the University's annual research funds from external grants. In 2022 and beyond, we expect both schools to continue playing key roles to achieve the University's research strategy and be the 'rocket fuel' that propels the University to greater heights in the local, regional and international science and technology research arena.

Ultimately, strong research partnerships are key when it comes to tackling global challenges, solving practical problems and improving local livelihoods and the environment. We strongly believe that there are tremendous benefits from working in teams instead of silos. This is illustrated by the identification of priority research areas within each school, the creation of inter-disciplinary research clusters within the University, and the formation of partnerships with reputable institutions outside the University, both locally as well as internationally (e.g. UK, USA, France, China etc.)

We thank all of the academics from our schools who contributed their research portfolios and we hope that readers of this handbook will be keen on contacting our relevant academics to form meaningful research collaborations with.

## **Professor Gopalasamy Reuben Clements**

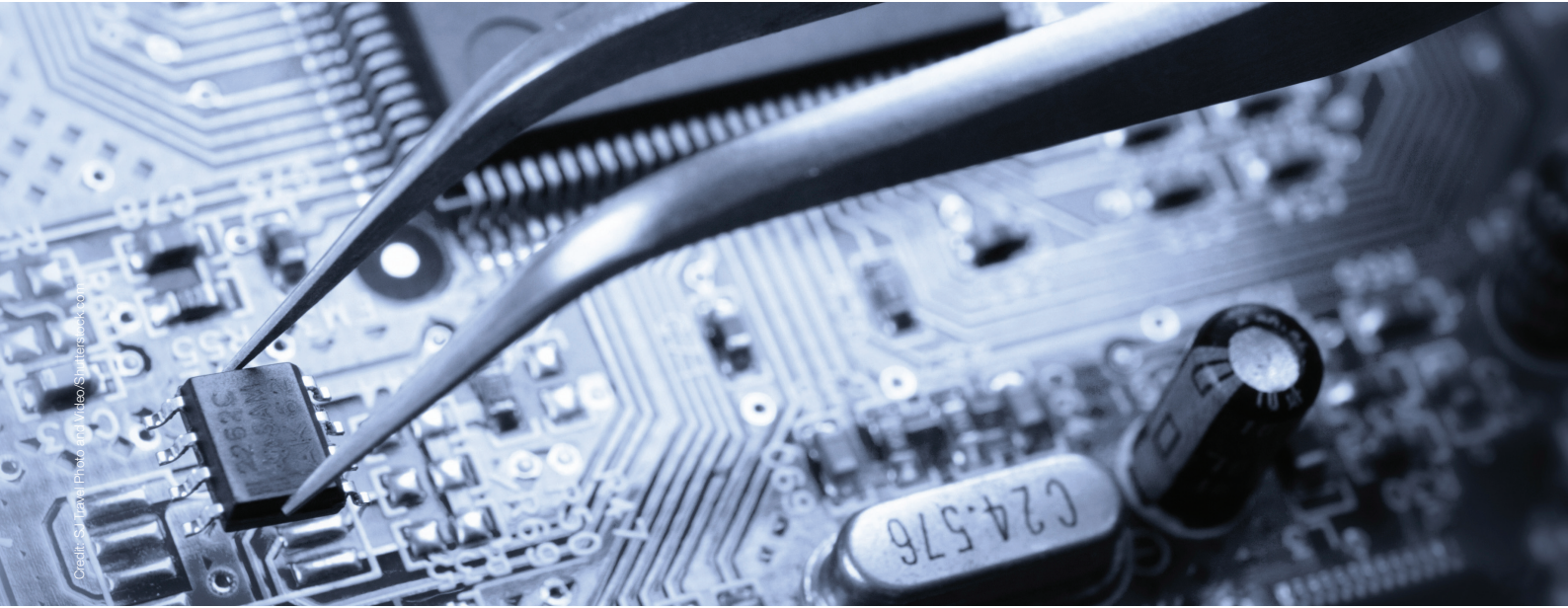
Associate Dean  
(Research and Postgraduate Studies)  
School of Medical and Life Sciences  
10 May 2022

## **Professor Mohamed Kheireddine Aroua**

Associate Dean  
(Research and Postgraduate Studies)  
School of Engineering and Technology  
10 May 2022





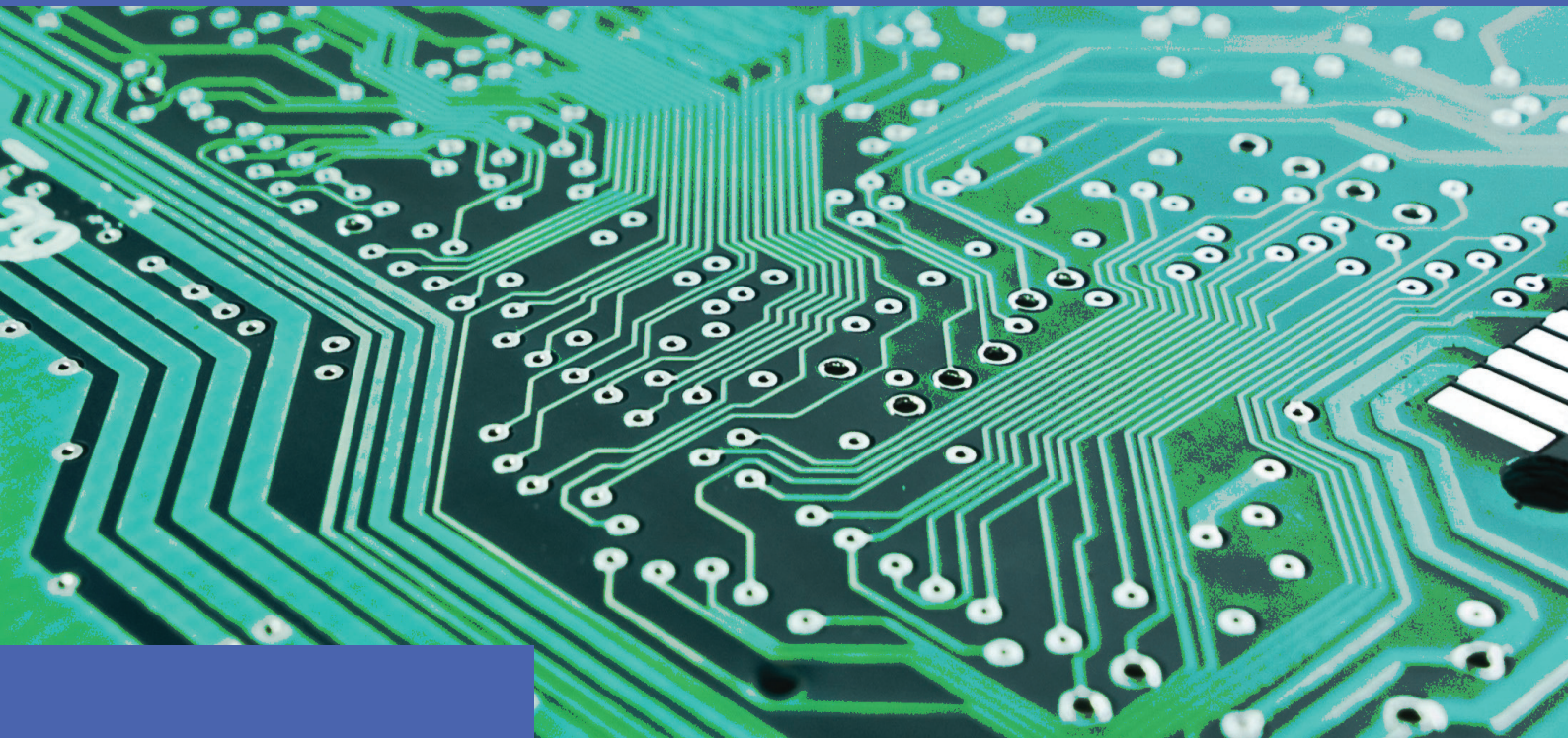


Credit: Shutterstock / Photo: Shutterstock.com

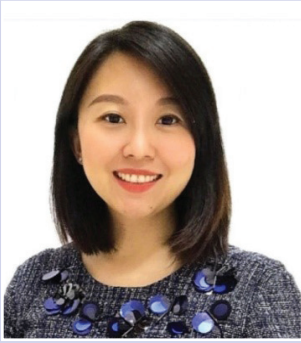
School of  
**ENGINEERING &  
TECHNOLOGY**







Department of  
**COMPUTING &  
INFORMATION SYSTEMS**



**Prof. Angela Lee Siew Hoong**

Professor  
Associate Dean (Employability)  
Head, Department of Computing & Information Systems  
Postgraduate Certificate in Academic Practice, Lancaster University  
Business Analytics Specialization Course, Wharton School of the University of Pennsylvania

**Research interests:**

1. Healthcare Analytics
2. Technology Adoption
3. Sentiment Analysis
4. Data Visualization
5. Machine Learning

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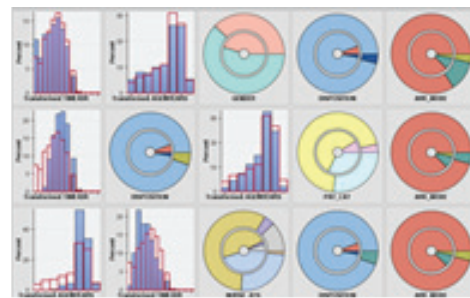
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## Urban Digital Healthcare Analytics

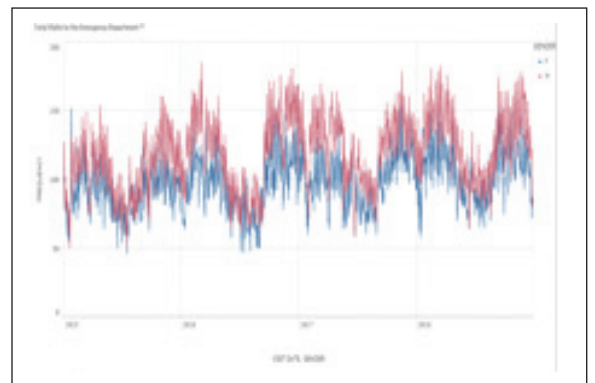
Urban Digital Healthcare Analytics is the technique of gaining insight into urban dynamics by combining new types of data with computer methodologies. As data becomes more readily available, we can ask new and often challenging questions about cities, their economies, how they interact with the local and global environment, and much more based from the data perspective. The purpose of urban digital healthcare analytics is to use data science to address key difficulties that cities are still dealing with. Minimal research and analysis have been done in the area of urban digital healthcare

analytics. Healthcare analytics able to focus on offering insights of hospital management, diagnoses, costs, services feedback, pandemic diseases and many more. With the ability to piece together all the medical data, hospital officers are able to provide real time information, better services and improves existing procedures. On top of this the study on the health and wellbeing of urban aging populations is important too when comes to smart cities planning. Predictive analytics powered by smart sensors, as well as the intelligent collection of lifestyle data, can considerably enhance the quality

of care provided to aging population. Even modest patterns that form over the course of an ageing patient's everyday existence can lead to larger insights into everything from normal health issues to detecting when a life-threatening incident is approaching. For example, people tend to have slower activities before a stroke. If we have prior data, we may be able to save their lives before a stroke occurs. Through this research, data visualization, text mining and machine learning will be applied in sourcing the solution.



Patient segmentation



Frequency of diagnoses correlates with costs



**Dr Selina Low Yeh Ching**

Senior Lecturer  
Associate Dean (Education)  
B.Sc, M.Sc, PhD

**Research interests:**

1. Statistical modelling
2. Statistical methods in data science
3. Monte Carlo methods
4. Statistics education

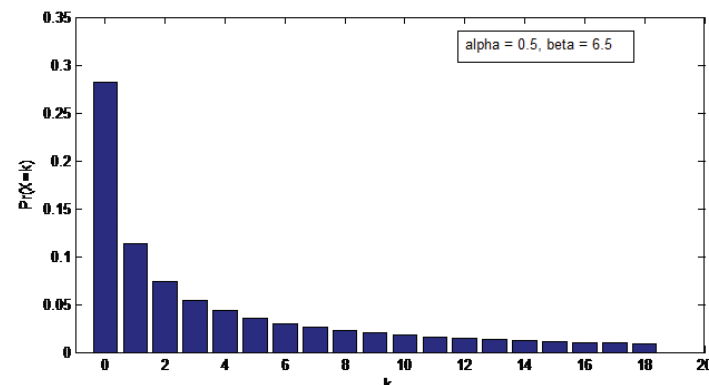
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## A Family of Regression Models for Count Data

Poisson and negative binomial regression models are commonly used in modelling count data which are not correlated. However, due to grouping of subjects among other reasons, correlated count data arise frequently in statistical analysis. Random effect models such as random effect Poisson (REP) and random effect negative binomial (RENB) models have been proposed in the literature for modelling correlated count data. Nevertheless, REP is only suitable for modelling data with equal mean

and variance whereas RENB is restricted to data where the variance is a quadratic function of the mean. On the other hand, statistical models such as generalized Poisson, inverse trinomial and strict arcsine models are commonly used in modelling count data with very long tails because of their nature whereby variances are cubic function of the mean. Newly developed random effect models for overdispersed correlated count data would significantly improve regression modelling in healthcare and insurance, amongst others.



Modelling of count data with long tails

## Scalable Private Overlay Reappearing Network for Information sharing



### Dr Chin Teck Min

Assistant Head, Department of Computing & Information Systems  
PhD in Computer Science

### Research interests:

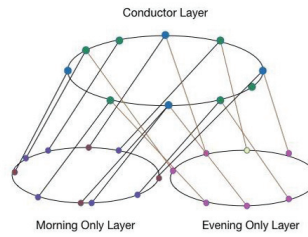
1. Distributed System
2. Overlay Network

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Information sharing is an important activity in human lifestyle. The shared information includes photos, videos, sounds, text and other electronic documents to inform other's about certain events, stories and happening surrounding the person. An overlay network for distributed information sharing system is designed to improve privacy, reliability and efficiency in heterogeneity environments (computers, network capability, and working hours).

My research is focusing on the overlay network that exhibits reoccurrence characteristic where node will be arrived and leave the networks in a constant pattern. My research aims to achieve faster convergence speed and efficiency in term of network resource usage.



Multi-layer structure of the SPRON overlay network

## Smart Optical Systems

5G communications systems and beyond have revolutionary bandwidth and latency requirements to support the diversity of cyber-physical applications for smart cities. To simultaneously cater to the bandwidth, latency and mobility demands of 5G subscribers, the convergence of optical fiber and free space optical networks has emerged as a prominent solution. Free-space optics technology presents huge unregulated optical spectrum as an alternative to optical fiber cables and may be deployed rapidly. Heterogenous optical networks offer a cohesive experience for Internet-of-Things, with optical fiber networks as backhaul backbones and free-space optical networks as capillaries to subscribers and portable devices. New multiplexing schemes based on space and artificial intelligence are important for increasing the degrees of freedom in optical networks, for enhanced signal detection, sensing, visual communication and security. These projects have been funded by the Fulbright Foundation, Malaysian Ministry of Education and Telekom Malaysia.



### Prof. Angela Amphawan

Professor  
PhD (Oxford),  
Fulbright (MIT),  
SMIEEE, FCMi

### Research interests:

1. Optical fiber
2. Free-space optics/LiFi
3. Wireless communications
4. Internet-of-Things
5. Artificial intelligence
6. Optical sensors
7. Optical projection

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**Dr Athirah Mohd Ramly**  
Lecturer  
PhD

**Research interests:**

1. Wireless communication
2. Non-orthogonal multiple access
3. Beyond 5G & 6G
4. A.I/Machine Learning

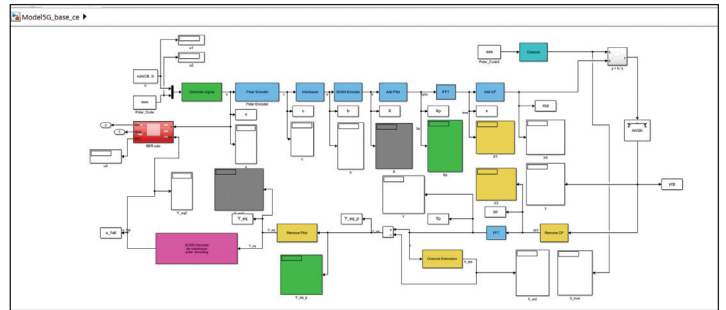
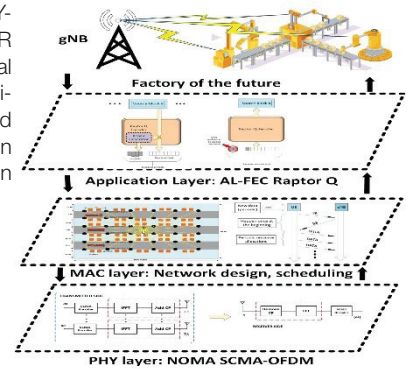
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## Machine Learning with Cross OSI Layer Approaches in Autonomous Factory Deployment for Ultra-Reliable 6G Mobile Communications

6th Generation (6G) systems must support a diversified set of applications in a variety of situations, as described by 5G. Furthermore, as the smart sector grows, 6G will be able to satisfy the rising need for human-to-machine and machine-to-machine communications, particularly as robotics and autonomous vehicle/drone systems evolve. A huge number of heterogeneous data streams has created a massive computational complexity and thus, indirectly increases the end-to-end (E2E) latency, while decreasing reliability. Unfortunately, owing to various basic constraints in the design of the existing network architecture and communication protocols, today's communication falls short of meeting such demanding standards. This necessitates a rethinking and redesigning of network design and protocols in order to effectively harness current technological breakthroughs in the future smart factory. To address these issues, ML techniques are proposed in a cross OSI layer approaches in an autonomous factory deployment for Ultra-Reliable Communication (URC) in 6G networks. The methodology

involves a swarm intelligence algorithm that is proposed at physical layer to optimize the channel estimation errors at the E2E (sub-1ms delay) network systems, employing a convolutional neural network to optimize the inter-packet rate accuracy at cross-layer PHY-MAC layers (Packet error rate, PER =  $10^{-8}$ ) and lastly, adversarial autoencoders (AAE) with semi-supervised learning is introduced and optimized for anomaly detection in an indoor factory 6G communication network.



**Charis Kwan Shwu Chen**  
Lecturer  
MSc in Computer Technology

**Research interests:**

1. Energy efficiency in 5G networks
2. Sustainability development for smart city
3. Green computing

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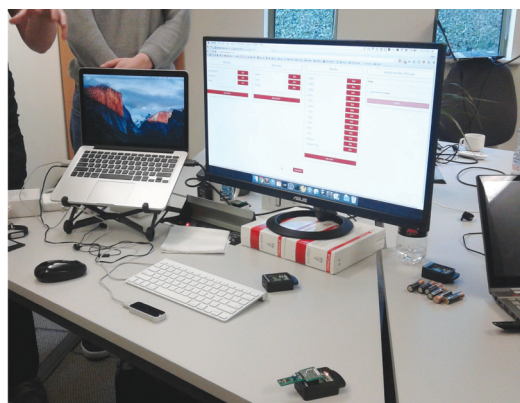
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## Sustainability Development for the Deployment of Small Cell Networks to Achieve Energy Efficiency

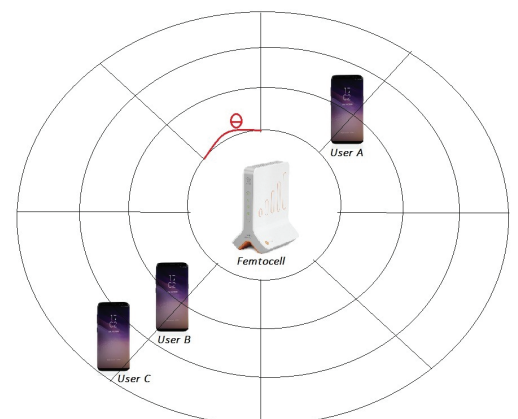
Energy efficiency is emerging as one of the key performance indicators for the next generation wireless communication systems. The motivation behind energy efficiency arises due to the current increasing energy cost of running their access networks. The total number of subscribers and the amount of traffic volume in cellular networks have increased exponentially. 5G networks will be the next generation of wireless

network communication. In 5G networks, the width and depth of user services are expected to be enhanced significantly. For this implementation to take place, the trend is towards the utilization of small cells. The growing importance of energy efficient networks with high data rate requirement is a major concern for network operators. In order to provide networks of high data rates with good signal quality, small cells are deployed.

But these cells can increase energy consumption if not equipped with some intelligent power saving or distribution mechanism. Thus, the purpose of this research is to find out a green way to deploy the small cell networks with energy efficiency to boost the signal in 5G networks.



Computer devices to test-up application



Small Cell Network Model for Energy Efficiency

## An Interaction Model for Understanding Data Protection in the Globalized Digital Age



**Dr Chua Hui Na**  
Associate Professor  
PhD, MSc

**Research interests:**

1. Applied Machine Learning
2. Data Mining
3. Infodemic Analytics
4. Information Security/Privacy

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Data security are thorny issues in today's globalized digital age due to the cross-border big data flow. These issues are bound to varying impact on related stakeholders with government tightening on data protection regulations; organizations forcing for the regulations' compliance; and individuals becoming more aware/protective of their personal data rights. In this research project, Stakeholder Theory is adopted to investigate how each stakeholder acts and reacts to the data protection regulations. This research is set to ask how governments enforce data protection to safeguard the interest of various stakeholders, what Information Systems (IS) implementation approaches adopted by organizations to ensure data protection, and how individuals' perception of data protection influence their attitude in using IS and personal information disclosure. Moreover, this research is aimed to find out how does the interaction among the stakeholders continue to

shape and reshape their relationship structure. To achieve the objectives, multiple data collection and analysis techniques are applied. The methods for data collection and analysis are mainly focussing on data mining process and machine learning techniques. This research project will contribute to valuable insights into different stakeholders' practices and their interaction model within the Information Systems ecosystem.

**Funding:**

- This research is the continuation of previous work supported by the Malaysian government FRGS grant [FRGS/1/2015/SS03/SYUC/02/1].
- The current research is supported by the Malaysian government FRGS grant from year 2019-2021.

**Publications:**

Publications related to the research project can be found in [https://scholar.google.com/citations?hl=en&user=PJic7awAAAAJ&view\\_op=list\\_works&sortBy=pubdate](https://scholar.google.com/citations?hl=en&user=PJic7awAAAAJ&view_op=list_works&sortBy=pubdate)

## Applied Cryptography, Blockchain Technology, IoT, Security & Privacy, Wireless Communication and Computer Networks



**Dr Houshyar Honar Pajoo**  
Senior Lecturer  
Higher Education Academy (Fellow), IEEE, MSc, MEng, PhD

**Research interests:**

1. Applied Cryptography
2. Cyber Security
3. Blockchain Technology
4. Computer Networks
5. ML and AI Planning Approaches into Cybersecurity

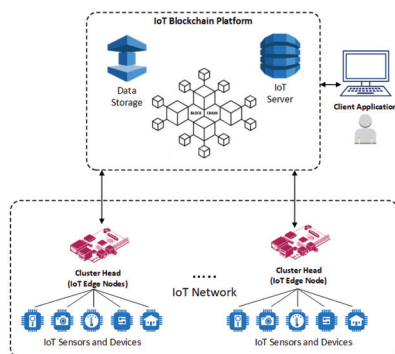
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In the modern digital world, cryptography finds its place in countless applications. However, as we increasingly use technology to perform potentially sensitive tasks, our actions and private data attract the interest of ill-intentioned actors. Due to the possible privacy implications of cryptographic flaws, new primitive designs need to undergo rigorous security analysis and extensive cryptanalysis to foster confidence in their adoption. At the same time, implementations of cryptographic protocols should scale on a global level and be efficiently deployable on users' most common devices to widen the range of their applications. Blockchain technology

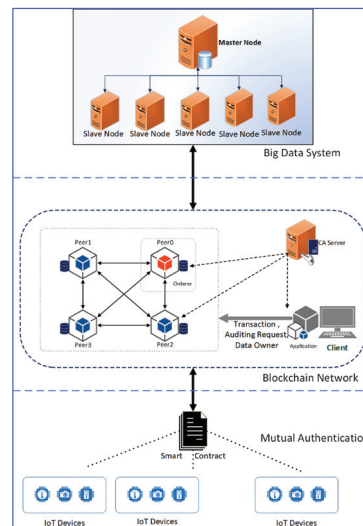
is currently spreading across various areas of modern information and communication technology, especially related to computing, informatics, and communications. Blockchain technology has emerged as one of the most promising, with numerous applications. Machine learning (ML) and cryptography have many things in common, for instance, the amount of data to be handled and large search spaces. The application of ML in cryptography is not new, but with over 3 quintillion bytes of data being generated every day, it is now more relevant to apply ML techniques in cryptography than ever before. In general, machine learning automates the creation

of analytical models in order to continuously learn and adapt to the massive amounts of data being fed as input. ML techniques can be used to indicate the relationship between the input and output data created by cryptosystems. A private cryptographic key can be made using ML techniques like boosting and mutual learning.



Conceptual framework of the integrated IoT blockchain platform.

IoT Big Data provenance scheme using blockchain on Hadoop ecosystem





**Dr Lee Chien Sing**

Professor  
PhD  
UPM, UM, MMU  
Fulbright Visiting Scholar  
(2008/2009)

**Research interests:**

1. Design
2. Design thinking
3. Computational thinking
4. Information Systems
5. Data mining

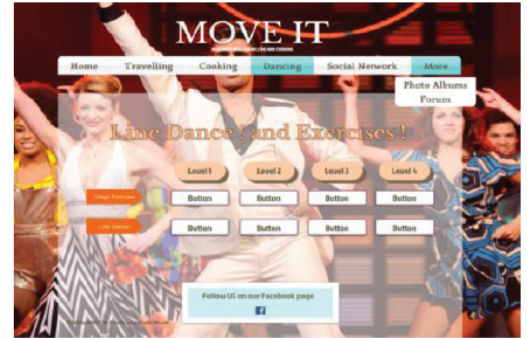
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## Developing community-based engagement in Smart Cities: A design-computational thinking approach

Smart Cities development has progressed rapidly with Internet of Things (IoT), ambient intelligence and increasingly, crowdsourcing. Engaging the community thus plays a key role in developing meaningful communal growth along with other stakeholders. This paper briefly presents a pilot study on developing computational perspectives for community-based engagement and innovations in Smart Cities for the young and thereafter, to explore possibilities of engaging seniors in self and community development,

and the young and old in community-based engagement and possibly in the future, the development of viable values-based innovations in information systems.



Leap Motion-enhanced game/wrist exercise



Join It community engagement portal



**Ts. Dr Lee Yun Li**

Associate Professor  
PhD, MEng, BIT(Hons) SE

**Research interests:**

1. Computer Vision & Image Processing
2. Human Computer Interaction
3. Pattern Recognition
4. Augmented Reality
5. Interactive Arts

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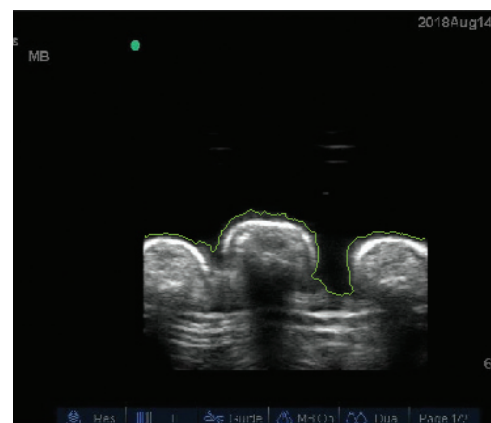
## Ultrasound Images Analysis, Data Visualization Techniques and Augmented Reality Applications

Medical specialist derives visual indications and information based on their interpretation of multiple medical images collectively with the support of numerous heuristics and rules in their thought processes that lead to the final identification of the examination of the diagnosis and treatment procedures. Furthermore, medical image acquisition highly depends on the skills and experience of a user. The image quality is affected by various factors such as noise, artifacts, and others. In this

research project, image processing techniques are adopted in ultrasound image analysis to extract and compile the feature representation for scene interpretation. This research aims to improve the efficiency and accuracy in the process workflow of the diagnosis and treatment procedures.

Recently, the population of the elderly has increased tremendously. This leads to cognitive decline issues to increase rapidly when the elderly is at a risk in functional decline, loneliness, depression, and

others. There are many potential research outputs that may delay cognitive decline among the elderly such as a game. This research work utilizes Augmented Reality (AR) technology to design a pet game to offer 2C: Cognitive and Companion by utilizing cards as input tools to interact in a real environment with virtual contents. This work has been demonstrated and tested on user acceptance towards pet game using AR technology.



Ultrasound image analysis using image processing techniques



Pet as a companion to the elderly, where feeding foods game as cognitive training activities

## Augmented Reality 3D Cubes Puzzle Bingo Game for the Elderly



### Lim Woan Ning

Senior Lecturer  
MEng (EE), BCompSc (Hons),  
CTFL

#### Research interests:

1. Virtual Reality
2. Augmented Reality
3. Machine Learning
4. Image Processing
5. Education Technology

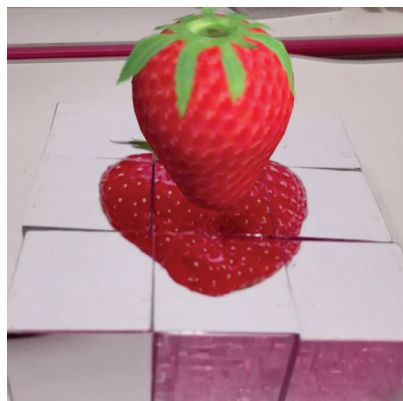
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The pace of population aging is increasing dramatically over years. Living longer as well as living well is the goal of many people. Studies show that mobile gaming can enhance the cognitive abilities and psychomotor skills of the elderly at the same time give the elderly sense of enjoyment and reduce the feeling of loneliness. Augmented reality technologies have been used to enhance traditional games and the results are positive. An Augmented Reality 3D cubes Puzzle Bingo game targeted the elderly was developed by adapting the idea of rubric cubes and the puzzle and bingo board game features. The game has proved that it is possible to enrich the gaming experience enjoyed by the elderly. The findings show that the game was well accepted by the elderly, the level of difficulty is enough to capture their attention and the content is relevant and able to trigger their curiosity. This research also reveals a good acceptance of augmented reality in gaming by the elderly.



3D puzzle cubes



Strawberry model in augmented reality



### Dr Ling Mee Hong

Senior Lecturer  
PhD, MSc, BSc (Hons)

#### Research interests:

1. Applied artificial intelligence
2. Trust and reputation
3. Reinforcement learning
4. Cognitive radio networks
5. Security

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## Addressing Security Vulnerabilities of Artificial Intelligence

The field of artificial intelligence (AI) is in the area of sustainable development and it has made a significant impact in the development of digital era, with impressive revolutions governed by theories and information technology. With this upward trend of growth in the 21st century, however, the need to address security issues in AI is relevant in order to experience a greater chance of success in implementation.

Cybersecurity is the main concern for today's digital world and the impact of AI in this area is uncertain. While AI has been seen to automate the detection of threat, assures complete error-free cybersecurity services, and provides the defenders protection and being resilient even against a series of attacks, the downside of AI is unknown since most of the features of AI are still uncovered which may lead to vulnerabilities regarding its usage. While the defenders leverage on AI to countermeasure attacks, the attackers likewise may also exploit AI to their benefits. Hence, the need

to investigate its effectiveness in security is vital.

Reinforcement learning (RL) is a branch of artificial intelligence that has been well investigated to show system performance enhancement. Yet, the investigation into the security aspects of RL is at its infancy. RL enables the agents to observe and learn about the dynamic operating environment without any guidance from their supervisors, and to make decisions on action selection in order to achieve optimal or near-optimal system performance.

Our research primarily focuses on the use RL to detect malicious agents that launch artificial intelligent attacks and to prevent the system from achieving suboptimal action, prolonged convergence rate or failure to converge and spread of inaccurate or manipulated information.





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PhD in Software Engineering

**Research interests:**

1. Empirical Software Engineering
2. Blockchain
3. Requirements Engineering
4. Big Data Analytics
5. Internet of Things

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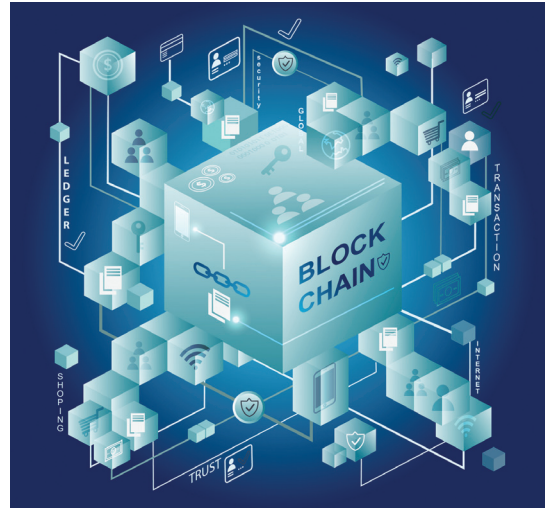
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## Empirical Evaluation of Performance and Scalability of Blockchain Platforms

Although Blockchain was initially applied to digital currency, i.e. Bitcoin, it has the potential to revolutionize other sectors such as smart cities, healthcare, insurance, education, supply chain management etc.

Even though giant industrial players (like IBM, SAP, Intel etc.) have recently dedicated a substantial amount of effort and money into establishing different Blockchain platforms, such as Bitcoin, Ethereum, and Hyperledger to satisfy needs of newly developed applications, there are still some technical challenges that require to be further investigated. An extensive review on the Blockchain researches has shown that two research gaps, namely performance and scalability, are biggest concerns in adopting Blockchain platforms in any business and despite their significance, they have not been sufficiently addressed by the Blockchain research community. Hence, to improve the maturity of the whole body of research in this field, thorough and hands-on evaluation

of performance and scalability of Blockchain platforms is a pressing need. This stimulated us to conduct this research project with the main objective of evaluating Blockchain platforms in terms of performance and scalability, through an empirical study.



Blockchain Technology



**Dr Muhammed Basheer Jasser**  
Senior Lecturer  
BEng (Hons), Msc, Ph.D(SEng)

**Research interests:**

1. Formal Methods
2. Safety-Critical Systems
3. Theorem Proving
4. Model Checking
5. Artificial Intelligence
6. Evolutionary Algorithms

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## A Methodology for Management, Verification, and Optimization of Safety-Critical System Models

Safety-critical systems use software to meet their functionalities. Failures in these systems lead to a very high impact on the environment in which the systems are used. For that, modelers follow specific standards and techniques to avoid failures.

Formal methods allow the modelling and verification of systems. The specifications in formal methods could be viewed as mathematical models, which represent the intended behaviour of the systems and they are used to model safety-critical systems such as intelligent transportation systems. Event-B is a formal method, which is based on Action Systems. An action system describes the state space of a system. iUML-B is a formal

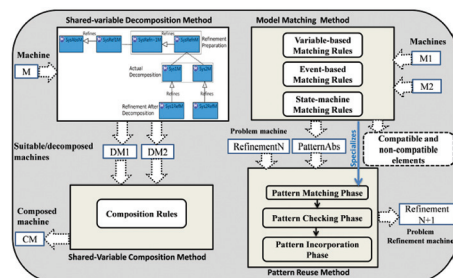
language that embeds diagrams in the Event-B models. In other words, iUML-B provides a collection of diagrammatic editors for Event-B.

As the real-life scenarios become more complicated, the formal models are gaining complexity. This raises the need of methods to reduce this complexity and manage those models. Decomposition, composition, model matching and pattern reuse are proposed in the context of model-driven software engineering to manage the models and deal with their complexity.

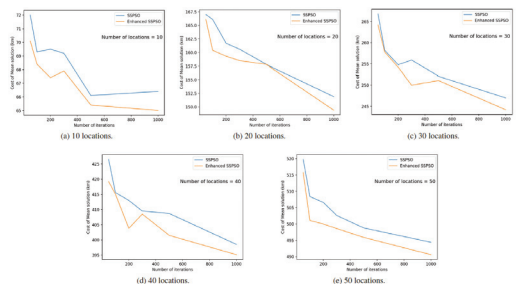
In our research, we provide a methodology including a package of metrics and methods to support managing, modelling and verifying safety-critical systems in general

and focusing more on iUML-B and Event-B formal models. In addition, we are working on employing formal methods in verifying critical properties in many areas such as blockchains and context-aware systems.

Another research area, in which we work, is artificial intelligence and evolutionary computation in which we design new algorithms and deep learning models to solve real-world problems in smart cities (e.g. intelligent transportation systems). Combining formal methods and artificial intelligence, we employ formal verification and artificial intelligence to verify the system models' correctness and safety and optimize their performance.



Formal Methods - A Research Operational Framework



Performance of an Optimization Algorithm in a Delivery System



**Muthukumaran Maruthappa**  
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BSc, MCA, PGCAP

**Research interests:**

1. Machine Learning
2. Image Processing
3. Emerging Databases
4. Mobile Programming

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## Knowledge based pregnancy complications analysis using ultrasound images with deep learning techniques

Pregnancy is a complex process where pregnant women go through a lot of stages from getting pregnant and until delivery. Statistics on causes of death Malaysia 2018 shows the maternal mortality rate is one of the highest in Malaysia (at 26%). According to the World Health Organization (WHO), every day 830 women die from pregnancy-related complications. During pregnancy, ultrasound is the main method to measure fetus measurements, heart rate, and complications.

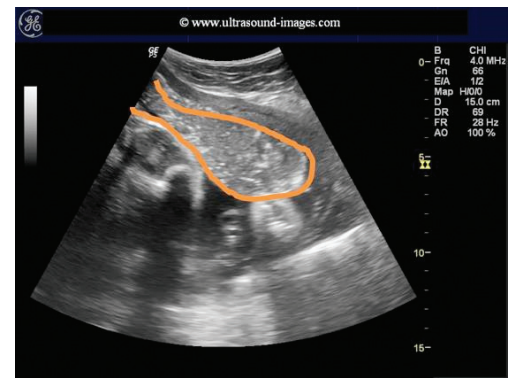
However, it is a time-consuming process and often not screened for all complications. Besides, ultrasound observation by Obstetrics & Gynaecology (O&G) consultant is subjective on some complications. Furthermore, the number of prenatal check-ups varies between private and government hospitals.

In this research, we explore the novel construction of a knowledge base related to pregnancy complications and apply image processing techniques to address

the ambiguities in diagnosing and to reduce the problem of technical-dependent scanning pregnancy-related complications. We hope our studies will make a significant contribution to medical health systems.



Ultrasound screening image



Placenta calcification analysis



**Dr Richard Wong Teck Ken**  
Senior Lecturer  
BEng (Hons) (USM), DPhil (Oxon.)

**Research interests:**

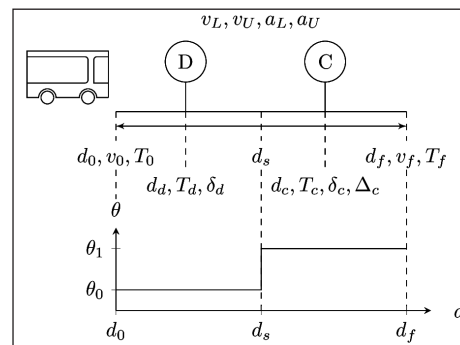
1. Applied Artificial Intelligence
2. Smart Transportation System
3. Robotics

**Contact details:**

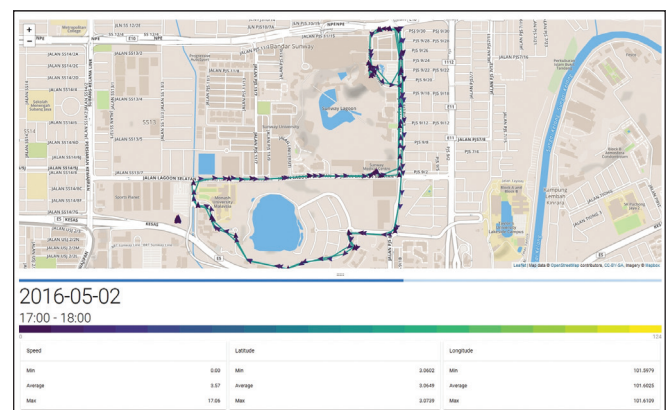
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## AI, Robotics, Smart Transportation Systems

Smart city is a city that leverages technology to achieve efficient utilisation of the city. Living in a smart city, the residents will be able to commute, schedule, and live efficiently from the aspect of energy and time. A smart city enables higher convenience for the residents while allowing the efficient use of resources. A visitor to the smart city would be able to utilise the city as efficient as the residents. To achieve this, we need to understand the user (residents, visitors) behaviours and the utilisation patterns of different facilities/infrastructure before the appropriate solutions can be designed, developed, and deployed to assist the users. One of the most vital systems in a smart city is the transportation system. As most users commute every day, a smart transportation system which allows the users to commute and plan their journey efficiently would largely benefit the society. My research interest focuses on the application of AI in robotics and smart transportation systems to support the progression towards achieving a smart city. More specifically this includes and not limited to the areas of data acquisition, information formulation, user behaviours recognition, and operational optimisation.



Formulation of a bus route with multiple stops and a slope change.



Visualisation of the GPS data of a bus



**Dr Saad Aslam**  
Senior Lecturer  
PhD

**Research interests:**

1. Machine Learning.
2. Device-to-Device Communication.
3. Wireless Networks / Wireless Communication/ Mobile Cellular Networks.
4. Clustering Algorithms & Optimization.
4. Distributed Systems.
5. Smart Energy-Efficient Buildings.

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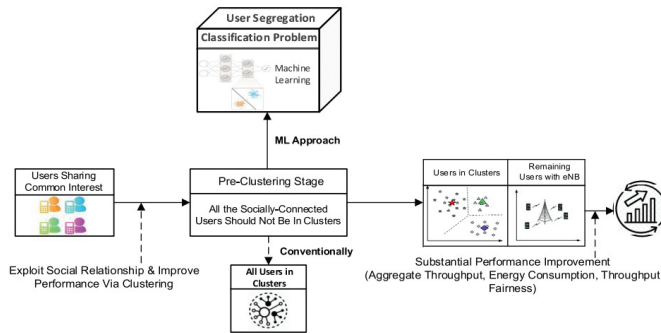
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## Machine Learning Assisted Solutions /Optimizations for Engineering Problems with emphasis on Wireless Networks, Mobile Cellular Communication and Smart Energy-Efficient Buildings

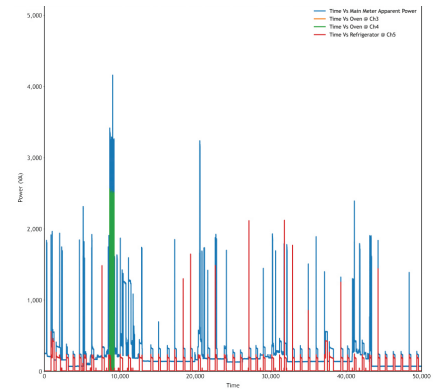
Machine Learning (ML) provides complete solutions for various engineering problems and therefore, finds new applications and assists current research developments. ML brings many new and innovative approaches to computing technologies; improving the quality of systems, and presenting green/energy-efficient solutions. The ML-assisted solutions and optimization techniques for wireless communications have grown

tremendously and represent current trends in related academia, research, and industry. ML is a promising tool to tackle big challenges in wireless communications imposed by the ever-increasing demand for capacity, coverage, compatibility, and quality of experience. To meet these requirements, researchers are particularly focused on the development of Next Generation Wireless Networks (e.g. 6G) assisted by ML.

There are numerous open research problems that can be addressed via ML. It presents various opportunities for academia, professionals, researchers, scientists, manufacturers, network operators, software developers, and graduate students to enhance their research skills while providing befitting solutions to the given problems.



An architecture based on Machine Learning to improve the D2D-Enabled wireless networks.



Machine Learning Application for providing energy-efficient solutions for Smart Buildings.



**Ir. Dr Steven Eu Kok Seng**  
Senior Lecturer  
BEng, MSc, PhD, PEng CEng, MIMechE

**Research interests:**

1. Autonomous Mobile Robot Navigation System
2. Unmanned Aerial Vehicle (UAV) based Remote Sensing
3. Self-Learning Robotic Arm

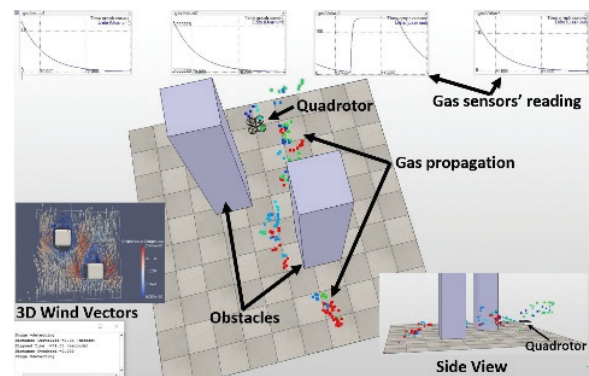
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## Scrutinizing the Potential of Robotic Technology to Improve Sustainability and Quality of Life

Robotic technology has undergone significant growth in recent years and it is undoubtedly that robots will be the key factor of economic growth in the next decades. In addition, robots can also help in improving sustainability efforts, such as fighting climate change, improving recycling and making manufacturing more sustainable.

Our research focuses on applying robotic technology to fight environmental pollution issues. We are working towards the solution of using unmanned aerial vehicles (UAV) based remote sensing to monitor air pollution and the emissions of the banned chemical gases from factories.



UAV based chemical plume tracing



UAV based Remote Sensing

# Detection and Recognition of FOREX Repetitive Patterns using Machine Learning Techniques



**Ts Dr Yong Yoke Leng**  
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**Research interests:**

- 1. Big Data Analytics
- 2. Machine Learning
- 3. Image Processing
- 4. Time Series Data Prediction

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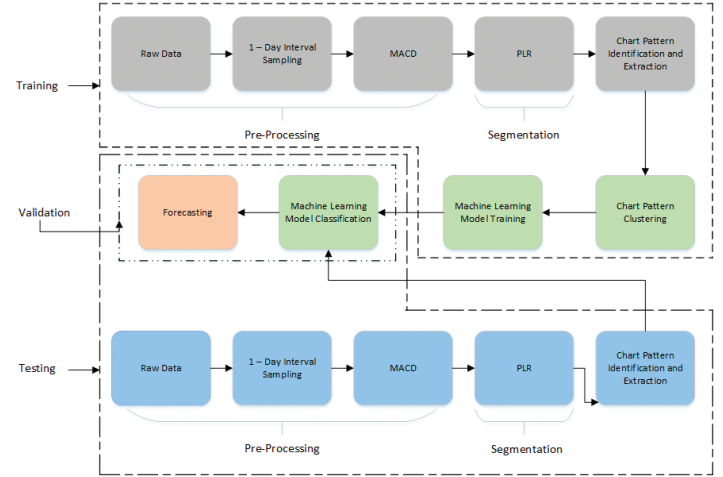
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The FOREX market has grown into one of the largest financial markets in the world over the years. This has prompted not only an increase in the number of traders participating in the FOREX market increases but the development of a plethora of analysis methods to aid traders in forecasting the currency exchange price. The widespread acceptance of integrating computational methods alongside conventional trading analysis has enabled the development of an Intelligent Chart Monitoring System (ICMS) algorithm for currency exchange price analysis and forecasting. Focusing on the use of charting-based analysis as well as the assumption that FOREX price moves in trend and that history repeats itself, the ICMS algorithm performs detection and recognition of repeating chart patterns by only using two basic trigonometric chart patterns as a reference.

The novelty of the proposed Intelligent Chart Monitoring System (ICMS) algorithm depicted below could be viewed from two different perspectives. Firstly, it can extract repetitive chart patterns to detect trends within the currency exchange price. The second contribution is the

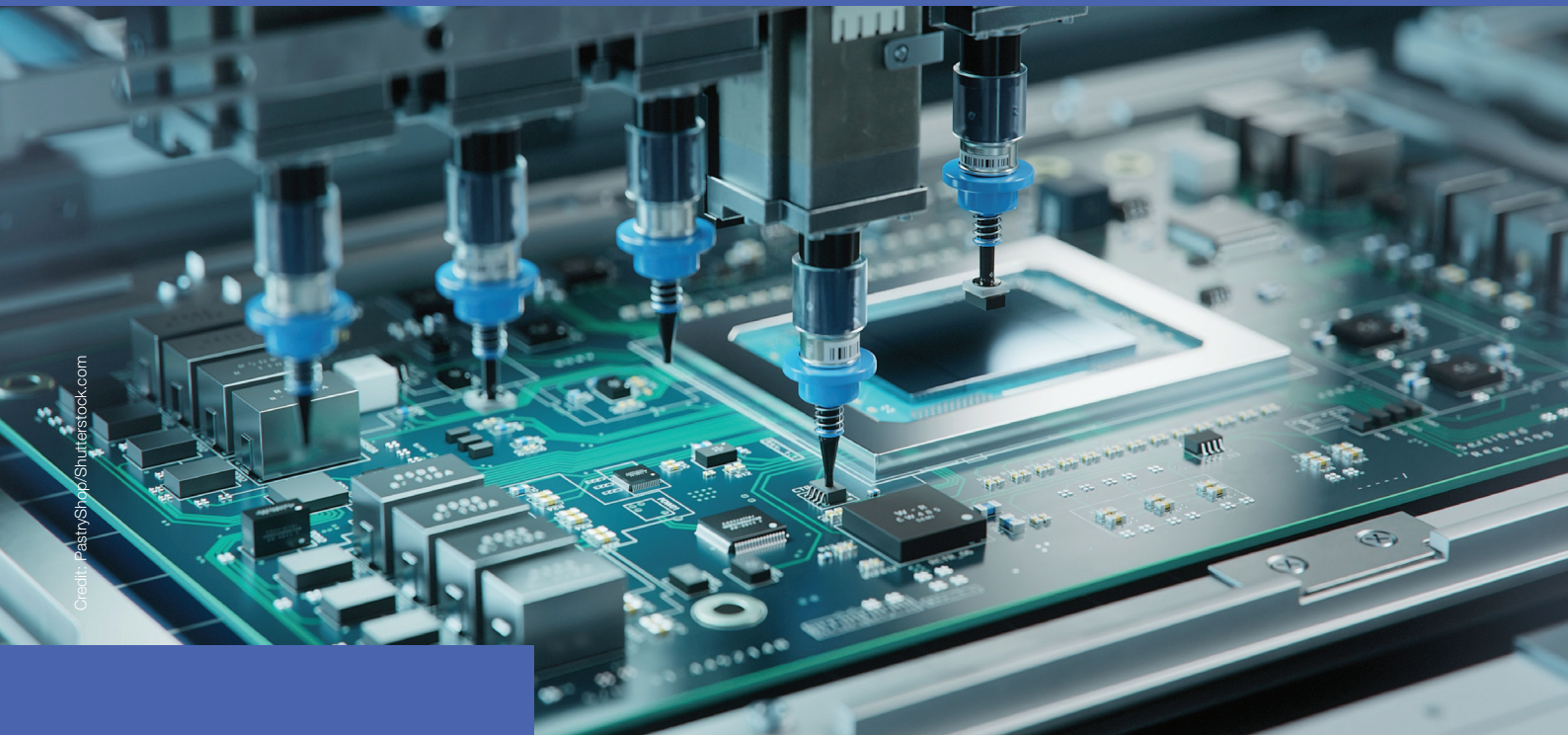
ability to use these chart patterns to recognise partially formed trends and forecast future trends. The framework consists of three (3) major implementation phases, namely the training, validation, and testing phase. The training phase is crucial for the machine learning models to learn the various repetitive chart patterns extracted from the FOREX

historical data. Following that, the validation phase focuses on the classification and forecasting module whereby partial chart patterns  $\geq 50\%$  developed are used for classification and forecasting. The testing phase focuses on the use of testing data whereby forecasting is conducted using chart patterns extracted from the testing data.



Intelligent Chart Monitoring System Processing Pipeline.





Credit: PastryShop/Shutterstock.com

## Department of **ENGINEERING**



**Prof. Serge Demidenko**  
 Professor  
 Dean, School of Engineering and Technology  
 CEng, FIET, FIEEE, PhD

**Research interests:**  
 1. Semiconductor Testing  
 2. Electronic Design  
 3. Signal Processing and Data Analysis  
 4. Instrumentation and Measurements

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## Instrumentation, Measurement, Signal Processing and Data Analysis for Semiconductor Electronic Testing

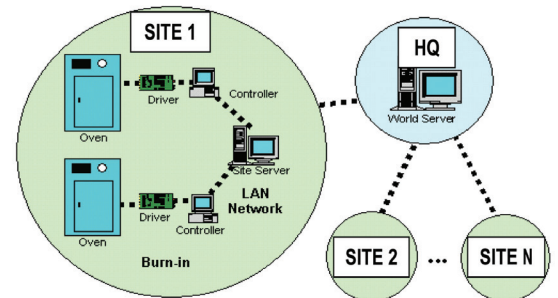
Testing plays a crucial role in ensuring functionality, quality and reliability of manufactured semiconductor devices and systems. Various types of complex testing procedures are performed at different stages of the production process from the initial wafer fabrication to final assembled semiconductor products. They require the employment of the state-of-the-art automatic test equipment, dedicated instrumentation and measurement hardware and software

tools, specialist signal processing methods, and sophisticated data analysis systems. This often results in the testing becoming the biggest contributor to the final cost of the produced semiconductor products. The primary mission of the semiconductor production testing has traditionally been seen as segregation of good units-under-test from the defective (entirely or partially failed) ones. With the on-going fast technological progress in electronics technology, this paradigm is

rapidly changing. The industry has approached an inflection point whereby test-enabled diagnostics and yield learning become crucial for further progress in semiconductor manufacturing. Processing and analysis of the gigantic volumes of production test data by means of mathematics, statistics, computer and information science including artificial intelligence have become a challenging task of paramount importance.



At Freescale Semiconductor (NXP) with project students



Integrated burn-in test environment architecture



**Ts. Dr -Ing. Lau Sian Lun**  
 Professor  
 Associate Dean (International)  
 Head, Department of Engineering  
 BEng (Hons), MSc, Dr.-Ing.,  
 P.Tech, SMIEEE, MIET

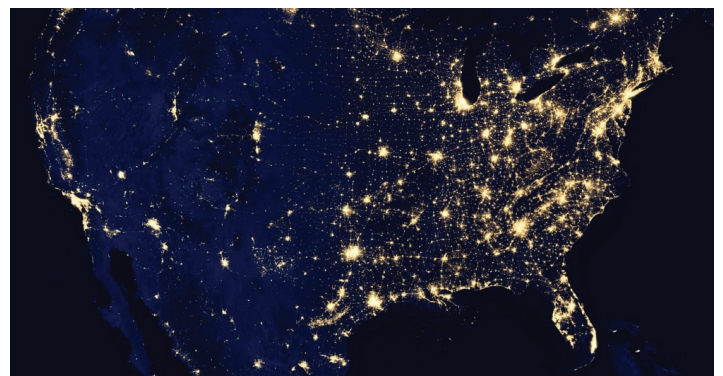
**Research interests:**  
 1. Smart and Sustainable City  
 2. Ubiquitous Computing  
 3. Context Awareness  
 4. Machine Learning

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## Empowering People in a Smart and Sustainable city with Digital Technology

Imagine a future city where digital technology is created not to dictate how one should live his life, but to empower him to live in the city more efficiently, safe and, more importantly, sustainable. With the ability to acquire more data through sensors and systems, as well as the integration of artificial intelligence and cloud computing, digital technology will continue to be essential to build future cities that are smart and sustainable.

Our research focuses in exploring technology and approaches that can be used to develop new solutions that address sustainability issues in a future city, ranging from transportation, human-machine interaction, machine intelligence to wearable applications. We build prototypes to demonstrate innovative ideas and technology that empowers people in their everyday activity in a modern city.



An inter-connected and self-aware world



Collaboration between Human and Machine

## Advance treatment processes of industrial and chemical wastewater for water sustainability



**Ir. Abdul Aziz bin Omar**  
Associate Professor  
MSc (Env)  
BSc Chem Engineering  
BSc (Chemistry)

### Research interests:

1. Water and wastewater treatment engineering
2. Chemical Process Engineering
3. Engineering Education

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Industrialisation gives rise to the generation of extremely toxic and refractory wastewaters and is demanding increasingly efficient treatment technologies. Small scale industries are also increasing and expanding. They change their processes according to markets. Therefore, the composite wastewater strength also changes regularly. These changes in the parameters of the composite wastewater makes it difficult to maintaining the two important parameters – COD and BOD, of the treated waste water.

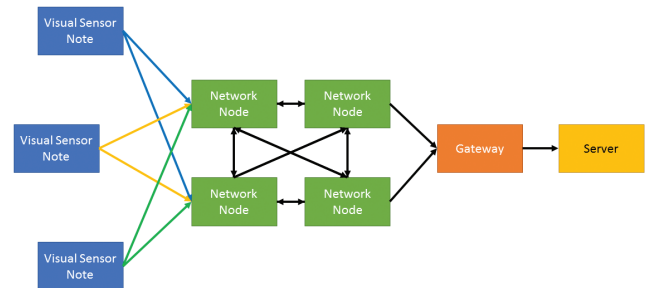
As an example, diethyl amine (DEA) is a widely used solvent in cleaning off the oils, soaps, shampoos, cleaners, polishers, cosmetics, pharmaceuticals and others in

the chemical industry. During processing, high concentrations of DEA in solutions are released into the water system. Conventional wastewater treatment processes are inefficient for the removal of DEA and similar types of toxic and hazardous pollutants from wastewater. Treating high concentration of DEA has been found effective by using the Advanced Oxidation Process (AOP), a technique used for the treatment of stable highly organic compounds. AOPs are technologies based on the intermediacy of hydroxyl radical and other radicals to oxidize recalcitrant, toxic and non-biodegradable compounds to various by- products.

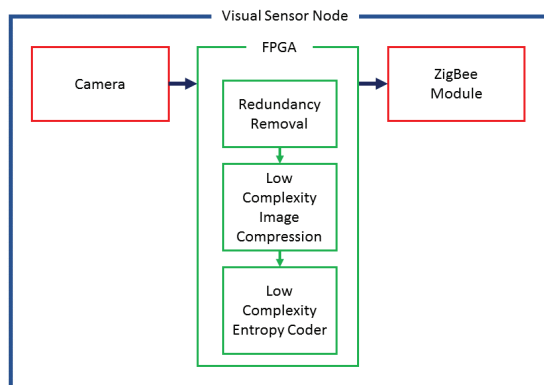
## Low-complexity Image Compression for Visual Sensor Networks

The use of image sensors in the Visual Sensor Networks (VSN) has increases the range of potential applications. Image sensors are able to provide more information that can be used for detection, identification, and tracking. However, the use of image sensors in VSN also brings with it a whole different set of challenges, due to the high amount of image data generated from the image sensors. The situation becomes more challenging when multiple image sensors are used to provide different viewpoints of the scene.

The aim of this research is to reduce the number of data that is required to be transmitted within the VSN. Research has shown that the energy taken for data transmission is higher than the energy taken for data processing. It is a better to reduce the amount of data that need to be transmitted, because most of the devices in the VSN are powered by battery. This can be achieved by removing the redundancy in the images using different approaches.



A typical setup of a Visual Sensor Network (VSN).



The simplified block diagram and the operation of the proposed approaches.



**Dr Chia Wai Chong**  
Senior Lecturer  
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### Research interests:

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2. Embedded Systems
3. Sensor Networks
4. Mobile Applications

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**Dr. Matthew Teow Yok Wooi**  
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**Research interests:**

1. Electronic Design
2. Scientific Computing

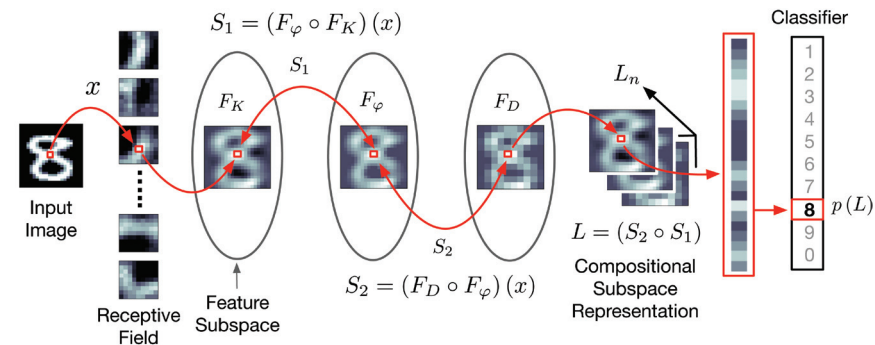
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## Unboxing Convolutional Visual Feature Learning

The present AI research pointed that convolutional neural networks (CNN) have significantly shaped modern computer vision development. However, despite the success, it is widely acknowledged that understanding how CNN perceives the physical world's visual activity is computationally intricate. Therefore, this research introduces a compositional subspace representation method to model the convolutional visual feature learning in CNNs. The proposed framework provides a subspace-oriented affine functional modelling to represent the deep convolutional visual layers in

CNNs, which uses a compositional subspace-to-subspace successive mapping in a functional chain space to represent the visual activity perceived by CNNs. This method allows learned visual features in the primitive subspace to be mapped onto the abstractive complex subspace to form a hierarchical and modular, high-dimensional visual representation for further pattern recognition. It also provides a tractable mathematical framework to strengthen the knowledge gap on CNN's convolutional visual feature learning.



Convolutional visual feature learning using compositional subspace representation for a character "8".



**Prof. Ir. Ts. Dr. Satesh Namasivayam**  
Professor  
BEng (1st Class Hons),  
PhD (London), PEPC PTech,  
CIT (HRD)

**Research interests:**

1. Additive Manufacturing
2. Engineering Education
3. Thermo-fluids

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## Additive Manufacturing, Thermo-fluids and Engineering Education

My research areas are broadly clustered to address Goals 4 and 9 of the current UN Sustainable Development Goals i.e. Quality Education as well as Industry, Innovation & Infrastructure respectively.

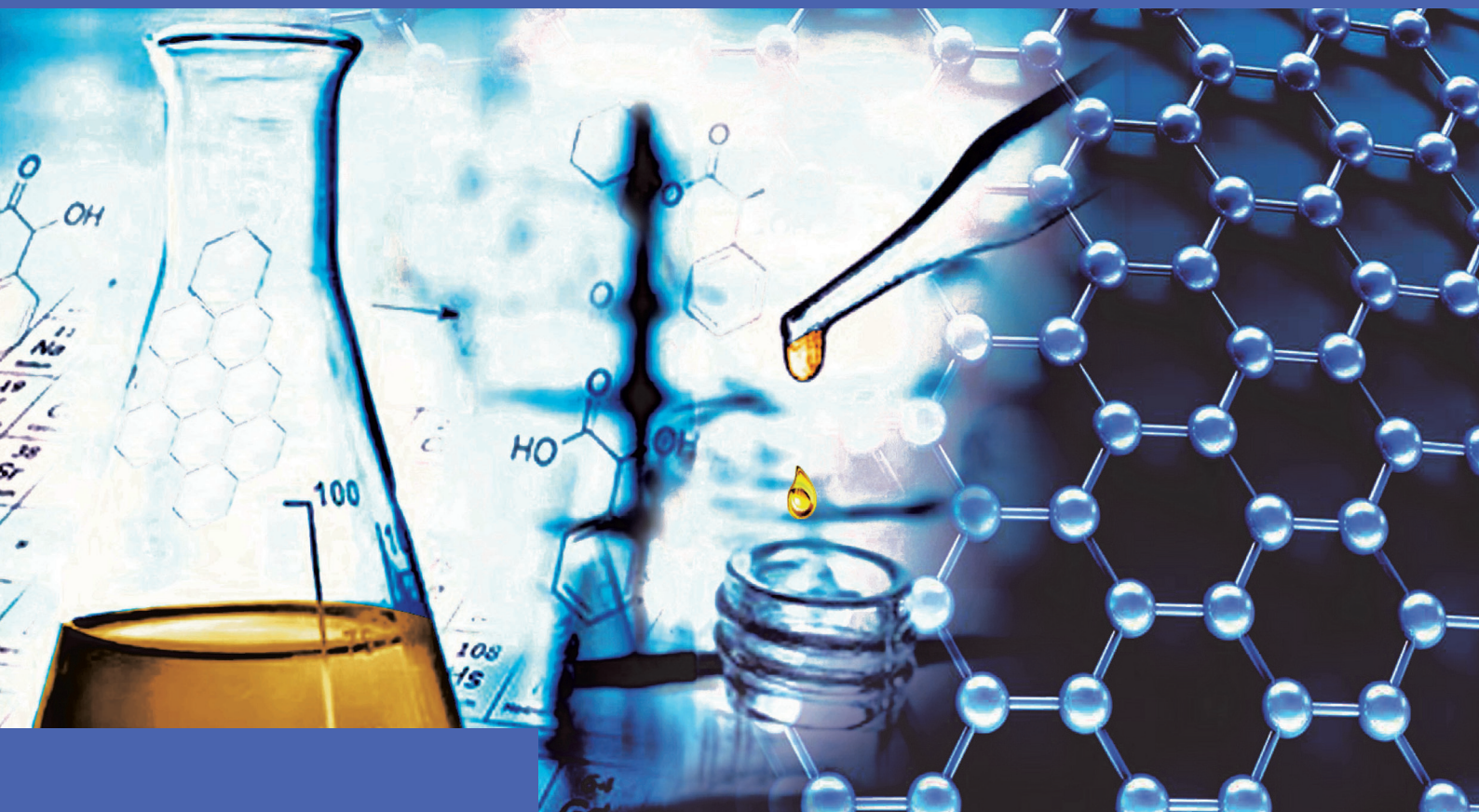
**Goal 9:** As an expert in Thermo-fluids Engineering, I work on enhancing the overall efficiency and effectiveness of engineering systems. My work focuses on numerical and experimental testing of systems that are used for a variety of applications. I am working on developing an optimal aerodynamic fairing for human-powered vehicles as well as on examining the effect of flooding on rail infrastructure. In addition to the above, I am currently working on a project relating to additive manufacturing. Specifically, I am looking at ways to 3-D print polymer materials infused with carbon- nano-tubes (CNTs) in a sustainable manner, such that these smart nanomaterial's may be used for various applications, namely as acoustic sound absorbers and

engine mountings for automobiles. In addition to this project, I am working on developing a consistent, effective and efficient "recipe" for concrete reinforced with polymer and agricultural waste.

With respect to 3-D printing, I was responsible for designing and maintaining one of Malaysia's largest 3-D printing facilities within a private university – illustrated in the figure below. My work also focuses on enhancing the efficiency of the condenser, by attempting to model the engineering processes occurring within it, thus allowing for design engineers to develop an efficient design, which in turn enhances the overall efficiency of the plant.

**Goal 4:** In relation to Engineering Education, my work focuses on the measurement of learning outcome attainment as well as the impact of various pedagogies (primarily project-based learning) on learning outcome attainment and employability. I have developed an algorithm to measure learning outcome attainment and have performed various studies,

examining the impact of project-based learning on enhancing learning outcome attainment and its effectiveness in developing and nurturing future engineers. In addition to this I have been involved in redesigning engineering modules (or subjects) and programmes to encourage flexible learning and the implementation of blended learning techniques – such as "flipped classrooms".



## GRAPHENE & ADVANCED 2D MATERIALS RESEARCH GROUP



**Prof. Mohammad Khalid**  
 Professor  
 Head, Graphene & Advanced 2D  
 Materials Research Group  
 PhD, MSc, BE, PGCHE, FHEA

**Research interests:**  
 1. 2D Materials Synthesis  
 2. Heat Transfer Fluids  
 3. Energy Harvesting,  
 Conversion and Storage

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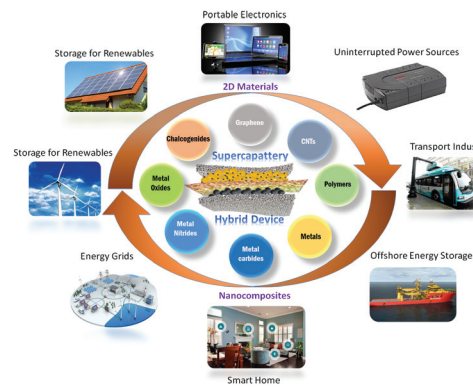
## 2D materials for Heat Transfer, Energy Harvesting, Conversion and Storage Application

Our research is primarily focused on developing two dimensional (2D) layered materials that have shown potential in a variety of energy related, heat transfer and lubricant applications. 2D materials will play a pivotal role in manufacturing smart devices for energy storage applications due to van der Waals interlayer bonding, large surface area, and the ability to tailor material properties through heterostructure formation. Our aim is to study these 2D materials for

- 1) developing cost-effective, clean and durable alternative energy devices.
- 2) developing heat transfer fluids for efficient heating and cooling applications.



2D Materials in Heat Transfer fluid research



2D Materials for Energy Harvesting, Conversion & Storage



**Dr Amirul Aizat**  
 Post-Doctoral Research Fellow  
 MMIC, Ph.D, BSc.

**Research interests:**  
 1. Nanofiber-based materials  
 2. Pseudocapacitor materials  
 3. Electrospinning  
 4. Supercapacitors  
 5. Rechargeable batteries

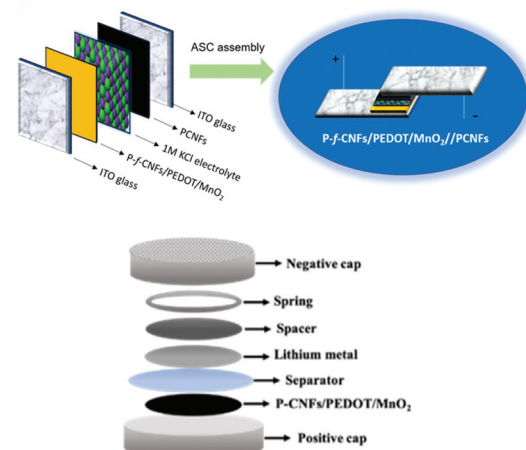
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## Development of two-dimensional (2D) materials for renewable energy storage devices.

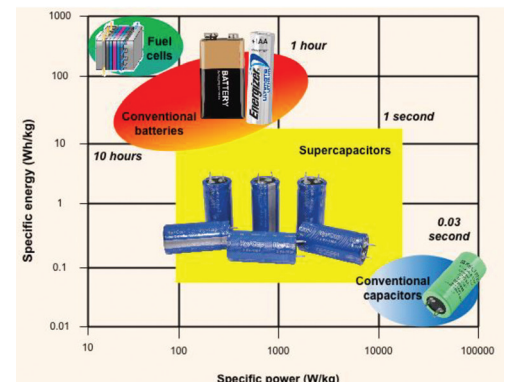
My research interest covers synthesis and characterization of electro-active materials/2D materials for energy conversion and storage devices including the fabrication of hybrid materials composed of conductive carbon and pseudocapacitive materials. These materials displaying an excellent electrochemical property which could be an important candidate for next generation supercapacitors

and lithium-ion batteries (LIBs). Therefore, my aim is to:

1. Develop an ideal 2D material which has low cost, abundant resources, as well giving high specific capacitance/specific capacity.
2. Solve the energy/power density issues by developing a supercapattery device using the optimized 2D materials.



Fabrication of supercapacitor and lithium-ion battery devices.



Graph of specific energy versus specific power for different types of energy storage devices



**Dr Jayesh Cherusseri**  
Senior Research Fellow  
MSc., MTech., PhD., MRSC

**Research interests:**

1. Supercapacitors
2. Metal-ion Batteries
3. Biosensors
4. Thermoelectrics
5. Wearable IoBs (Internet of Bodies)

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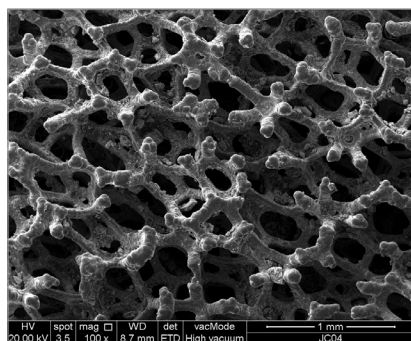
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## Flexible Electrochemical Energy Conversion-Storage Integrated Devices for Wearable Electronics

Wearable technologies consist of an ocean of electronic devices that can be integrated with the human body either as an on-body device (such as a smart patch temperature sensor) or as a secondary device that can be connected to various body parts from wrist-wear, eye-wear, head-wear, foot-wear, neck-wear, body-wear and more. Based on reports, the wearable technology market will see over threefold growth from USD115.8 billion in 2021 to USD380 billion by 2028. The wearable electronic

devices necessitate flexible and wearable energy storage devices to supply them with power for their long operation hours. Lithium-ion batteries and supercapacitors are the two major and more promising electrochemical energy storage systems among the various others. Supercapacitors are different from conventional capacitors in their charge storage mechanism, where they use electrolytes, as in the case of batteries. However, lithium-ion batteries are least preferred for wearable electronic devices as

they are unsafe, hazardous to the environment, costly and rigid. On the other hand, supercapacitors are promising candidates for wearable technologies, owing to their fascinating qualities like long life cycle, quick charge and discharge rates, improved energy density and wide working potential range. Supercapacitors can deliver power instantaneously to the IoB device connected with it and helps the person to monitor a particular function associated with his body.



Scanning electron microscope image of nanostructured supercapacitor electrode



At Microwave Reactor for MXene Synthesis with students

## 2D Energy Materials for Energy Conversion and Storage Applications

My research focuses on developing new 2D material composites for energy-related applications such as solar energy, supercapacitors, and electrochromic applications. My research interests also include exploring new 2D energy materials composites for bifunctional or trifunctional applications such as electrochromic supercapacitors, photovoltaic supercapacitors, and thermo-electrochromic supercapacitors. My aim is to develop new 2D energy material composites with high electrical conductivity, high specific capacitance, high specific power, high cycling stability, and high power conversion efficiency using green synthesis routes.



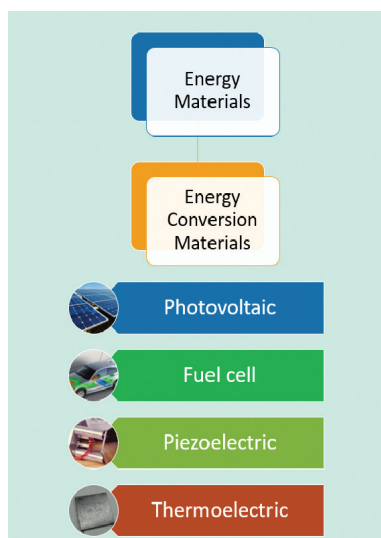
**Dr Muhammad Norhaffis Mustafa**  
Post-Doctoral Research Fellow  
PhD, MSc, Bsc

**Research interests:**

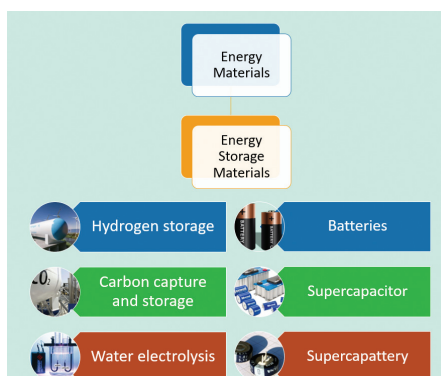
1. 1D/2D/3D Nanomaterials
2. Electrochromic
3. Solar Cell
4. Supercapacitors

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Energy materials for Energy Conversion Application



Energy Materials For Energy Storage Application

## 2D Heterostructured Nanomaterials for Electrochemical Applications



**Dr Numan Arshid**  
Senior Research Fellow  
Post-Doc, Ph.D, MInsP

**Research interests:**

1. 2D Materials
2. Electrochemical Sensors
3. Electrochemical Energy Storage Devices

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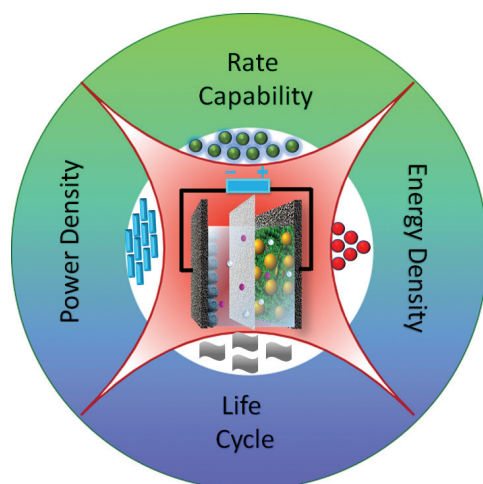
My area of research is focused on the development of heterostructured nanomaterials for electrochemical applications, such as electrochemical sensors and hybrid electrochemical energy storage devices.

1. Develop an ideal 2D material which has low cost, abundant resources, as well giving high specific capacitance/specific capacity.

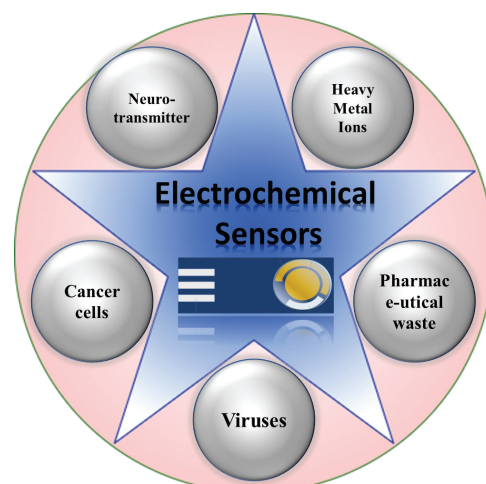
The main focus in electrochemical sensor is to tailor the surface properties of 2D materials to

fabricate disposable screen-printed electrodes for on-site detection of biological analytes and wastewater pollutants including heavy metal ions.

My expertise for electrochemical energy storage (EES) device is fabrication of 2D heterostructured nanomaterials-based electrodes for supercapacitors. The main focus is to raise the Rate Capability and Energy Density of the device.



Hybrid Electrochemical Energy Storage device



2D Materials-Based Disposable Screen Printed Electrodes



Credit: V. Olesen Production/Shutterstock.com

Research Centre for  
**APPLIED PHYSICS &  
RADIATION  
TECHNOLOGIES**



**Prof. David A Bradley**

Emeritus Professor  
Distinguished Professor  
Head, Research Centre for Applied Physics & Radiation Technologies  
FIPEM, FinstP, PhD

**Research interests:**

1. Dosimetry
2. Radiation applications in medicine and industry
3. Environmental impact
4. Materials science

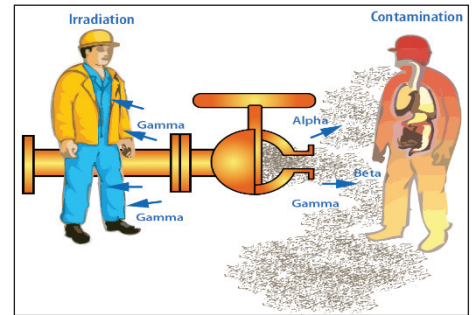
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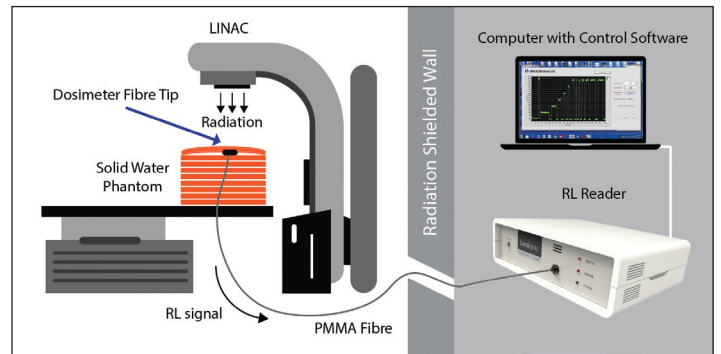
## Radiation in Medicine, Industry, Materials Science and the Environment

Radiation techniques play a major role in societal developments and well-being. Group activities concentrate in large part on physical methods and studies in medicine, industry and the environment, examples from within the former including synchrotron-based characterisations of osteoarthritic and diabetic changes in affected tissues, also novel analytics focusing on recognising early signs of breast cancer. In the extractive industries (oil, gas and minerals), investigations concern the metrology of naturally occurring radioactive materials (NORM) including analyses of the impact of NORM by-products introduced into the biosphere. Our involvements in passive radiation detection have pioneered the use of glass and carbon-based systems, with collaborative work proceeding in fabrication of thermoluminescent and radioluminescent devices for quality assurance of clinical radiation treatments and diagnosis, also in clearance of materials arising from the decommissioning of industrial and other facilities. In radiation therapy, such devices are intended to allow for more effective tumour targeting and avoidance of

surrounding healthy tissues. Spin-off investigations in areas of materials and surface science, combining with radiation damage and hardness studies, are among some of the growing areas of activity of the Centre.



NORM Exposure



Radioluminescence Dosimetry in Medicine



**Dr Chew Ming Tsuey**

Senior Lecturer  
PhD

**Research interests:**

1. Radiobiology
2. Diagnostic Cytology
3. Nuclear Medicine
4. Oncology and Pathology
5. Preventive medicine

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## 2D Heterostructured Nanomaterials for Electrochemical Applications

Cancer remains the leading cause of death globally. Radiotherapy is one of the treatments of choice for more than 50% of all cancer patients and has contributed to at least 40% cure rate. Besides, dosimetry and radiation protection, radiation biology is also vital for effective radiotherapy. Radiation biology is a medical science that involves the study of biological effects of ionizing radiation on living tissues.

Radiation sciences research of radiotherapy is to improve overall survival for cancer patients. In addition, nuclear medicine research for diagnosis and therapy, improving cancer patients' care management (predictive and prognostic) and quality of life, including radiation protection for staff.

Other fields of interest include pathology, implement screening for high incidences of cancers such as colorectal cancer in the community, and preventive medicine for non-communicable diseases such as hypertension, diabetes and cardiovascular diseases (cardiometabolic diseases), and clinical trials.

These projects are funded by Sunway University internal, Sunway Medical Centre and collaboration grants, and are conducted in collaboration with local and international Institutions/industries.

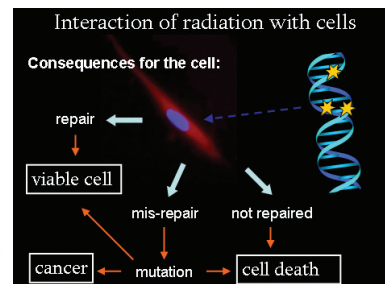


Fig. 1 Interaction of radiation with cells

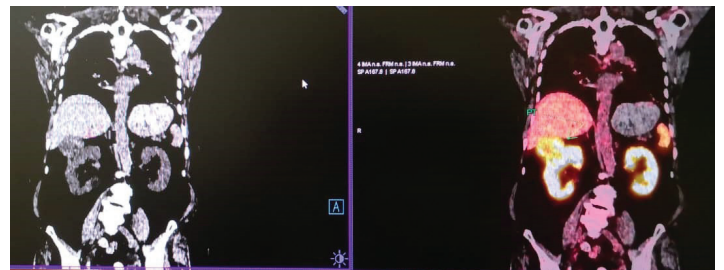


Fig. 2 Ga68-PSMA PET-CT clear cell renal cell carcinoma

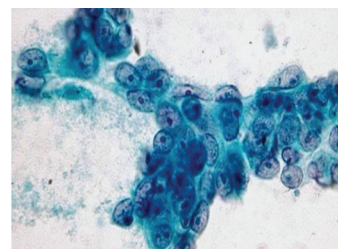


Fig. 3 Lung adenocarcinoma

**Personalized Medicine - New Definition**



"Here's my sequence..."  
New Yorker, 2007



**Dr Lam Siok Ee**

Research Fellow  
PhD (Applied Physics)  
MSc (Medical Physics)

**Research interests:**

1. Radiation dosimetry (radiotherapy & diagnostic radiology)
2. Luminescence
3. Carbon-rich materials

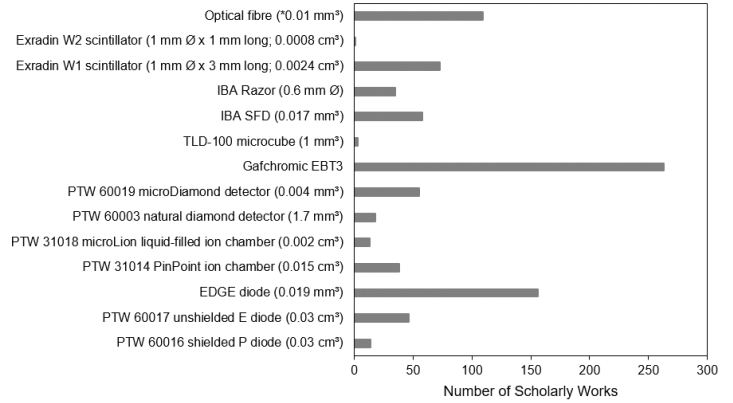
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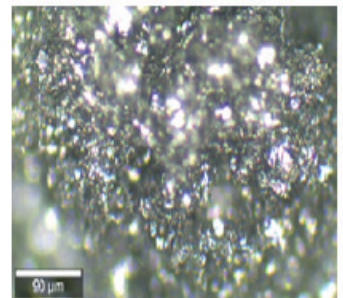
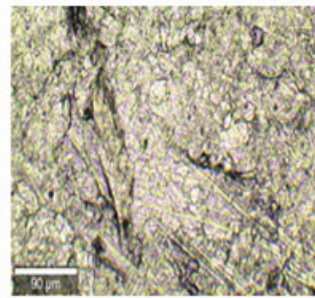
## Radiation dose evaluation system in radiotherapy and diagnostic radiology

The advent of complex radiation therapy techniques and diagnostic procedures necessitates a need to optimize radiation dose delivery against the best clinical outcome. As such, the use of potential dosimeters with tissue equivalence, high spatial resolution and sensitivity, and water-resistance etc. would be investigated in current and near future research, examining the media as a sensitive probe for radiation dosimetry. Also, the state-of-the-art analytic techniques would be used to investigate an improved radiation dose evaluation system, including the associated radiation damage studies.

A survey of small-size dosimeters in radiotherapy over the past decade (2010 – 2019)



Lam, S.E.\*, Bradley, D.A., Khandaker, M.U. (2021). Small-field radiotherapy photon beam output evaluation: Detectors reviewed. *Radiation Physics and Chemistry*, 176, 108950.



Images of crystalline (left) and porous (right) carbon media acquired using WITec a300RA confocal Raman microscope



**Prof. Mayeen Uddin Khandaker**

Professor  
Associate Editor  
Radiat. Phys. and Chem.

**Research interests:**

1. Nuclear and Radiation Physics
2. Radiation Dosimetry
3. Synthesis of h-BN for neutron sensing
4. Radioactive and heavy metals in food and Environ

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## Cyclotron production of radionuclides for medical and industrial applications

An accurate knowledge on excitation functions of charged-particles induced nuclear reaction is important for practical applications such as medical radioisotope production, testing of nuclear reaction model codes, thin layer activation analysis, industrial applications of radionuclides, etc. Radionuclides can be produced in several ways, but charged particle-induced reactions facilitates high specific activity and no carrier added (NCA) production of radionuclides. The availability of cyclotrons and particle accelerators in an increasing number of countries together with the updated technology made it possible for the precise measurement of excitation functions of light-ion-induced reactions.

This research program focuses on the production technologies of non-conventional PET, SPECT, and theranostic radionuclides using AVF cyclotron facility at Japan. Production of the radionuclides of interest via cyclotron allow sophisticated preparation for use without any significant loss of activity. Excitation

functions and thick-target yields of the desired radionuclides are measured using ion beams delivered from AVF cyclotron. The target material, beam current, beam energy window, and chemical separation procedure are optimized for practical productions.

These projects are funded through Sunway University internal and collaboration grants and conducted in collaboration with various local and international Institutions.

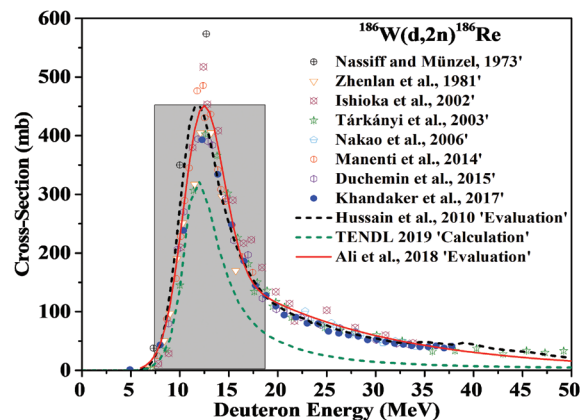


Fig. Excitation function and selection of optimum energy window for the production of theranostic <sup>186</sup>Re







Research Centre for  
**CARBON DIOXIDE  
CAPTURE & UTILISATION**



**Dr Mohamed Kheireddine Aroua**

Professor  
Associate Dean (Research and Postgraduate Studies)  
Head, Research Centre for Carbon Dioxide Capture & Utilisation  
B.Eng.,DEA, Ph.D.

**Research interests:**

1. CO<sub>2</sub> Capture and Utilisation
2. Absorption/Absorption
3. Electrochemical Processes
4. Water treatment

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## Green Processes and Advanced Technologies for CO<sub>2</sub> Capture and Utilisation

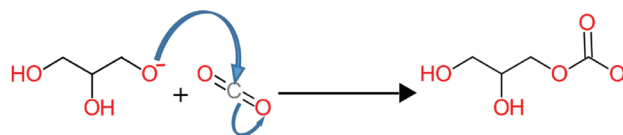
Research on carbon dioxide capture and its utilisation are areas of current and future interests due to environmental concerns about global warming as well as the technological problems associated with CO<sub>2</sub> presence in natural gas, biogas and process gas streams. At the research Centre for Carbon Dioxide Capture and Utilisation (CCDCU), we are focussing on developing green processes to capture CO<sub>2</sub> and advanced technologies to transform CO<sub>2</sub> to useful chemicals and fuels.

In our work novel CO<sub>2</sub> capture agents based on Deep Eutectics and natural substances are used as solvents for CO<sub>2</sub> absorption as well as surface modifiers to functionalise biomass based adsorbents to separate CO<sub>2</sub>. We also take advantage of the synergic effects between these green solvents and nanoparticles to develop advanced technologies with enhanced performance and environmental efficiencies for CO<sub>2</sub> capture.

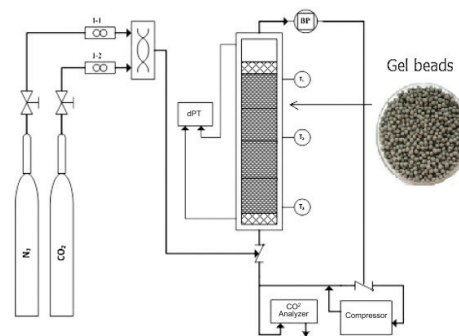
Advanced electrochemical processes are also used to transform the captured CO<sub>2</sub> to useful chemicals. Recently, we have demonstrated for the first time the electrosynthesis of the peroxydicarbonate anion (C<sub>2</sub>O<sub>6</sub><sup>2-</sup>

) by the reaction of CO<sub>2</sub> with the superoxide ion (O<sub>2</sub><sup>-</sup>) through the in-situ electro-generation of O<sub>2</sub> in an ionic liquid.

These projects are funded through Sunway University internal and collaboration grants and conducted in collaboration with various local and international Institutions.



Formation of Glyceroxide in CO<sub>2</sub>-Glycerol\_Amine Systems



Experimental set-up for CO<sub>2</sub> adsorption



**Dr. Arifuzzaman Rahat**

Research Fellow  
B.Sc (Hons), M.Sc, PhD

**Research interests:**

1. Low Dimensional Energy Nanomaterials,
2. Modification/Hybridizations of Emerging Nanomaterials,
3. Energy Storage and Conversion,
4. CO<sub>2</sub> capture and Utilization.

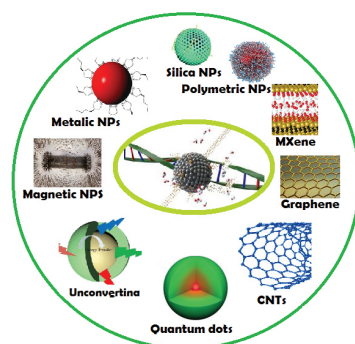
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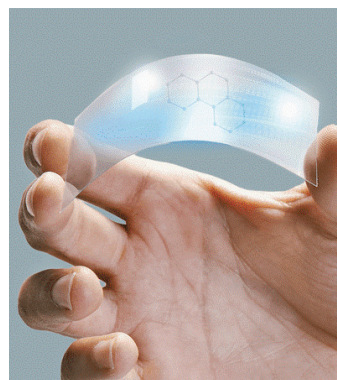
## Emerging nanomaterials for and Sustainable Energy Efficiency, CO<sub>2</sub> Capture and Utilization Applications

Realizing the importance of green technology due to ever rising social and environmental pressure for net zero-emission economy, I am synchronizing my research to tackle the challenge of integrating CO<sub>2</sub> capture with its utilisation. On the other hand, due to the rapid economic growth, global energy consumption is growing rapidly. Many countries have implemented renewable energy sources, among them solar thermal energy becoming dispatch-able around the world. Highly effective nanofluids, thermal interface materials (TIMs) and nanohybrids are very useful for efficient storage and heat transfer in energy harvesting system such as photovoltaic (PV)/concentrated solar power (CSP) as well as large scale CO<sub>2</sub> capture and utilization. Implementation of emerging nanomaterials such as Graphene and MXene with high thermo-electric conductivities, wide range of energy storage capacity can possess high compatibility in hybrid nanofluids and TIMs. Besides, metal/non-metal and oxide incorporated Graphene/MXene provide opportunities to tune required properties. Among the

current research Graphene/MXene coated Iron-oxide nanofluids/TIMs/nanohybrids for high heat transfer and vast energy storage via CSP and capturing and conversion of CO<sub>2</sub> are the main focus. Through these researches our goal is to contribute to the global sustainable development for the upcoming near future.



Emerging nanomaterials



Graphene



Carbon Capture and Utilization



**Dr Farihausnah Hussin**  
Senior Research Fellow  
PhD in Chemical Engineering

**Research interests:**

1. Carbon-based materials (such as activated carbon, biochar)
2. CO<sub>2</sub> capture and utilisation
3. Green solvents
4. Wastewater treatment

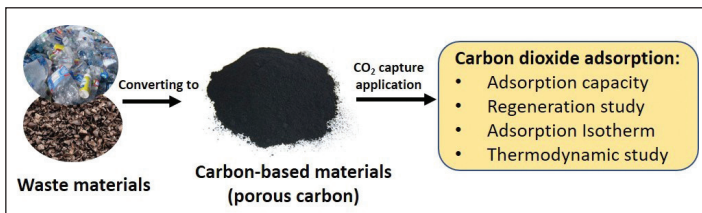
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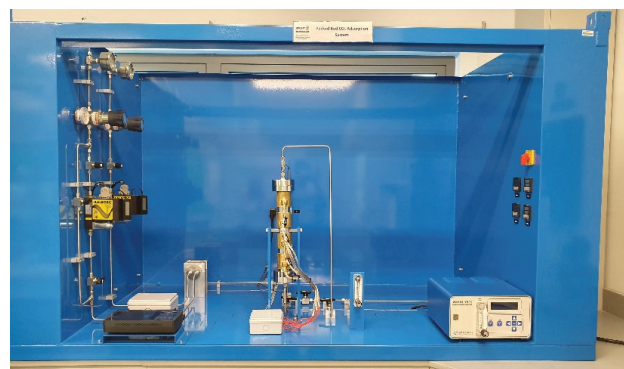
## Development of porous adsorbents derived from waste material for CO<sub>2</sub> capture

The tremendous demand and consumption of energy in the world these days has caused the rise of greenhouse gases emission, particularly carbon dioxide (CO<sub>2</sub>), which contributes to global warming. It has now become a major environmental issue that needs to be tackled globally. The adsorption technology has been recognised as a promising alternative to capture CO<sub>2</sub>. The main challenge in successfully commercialising adsorption technology is the development of effective and low cost adsorbents. Our research activity primarily explores the potential of waste material (such as agricultural waste, plastic waste and etc.,) as adsorbents for CO<sub>2</sub> capture. In this research, new approaches involving the modification of low-cost waste materials as adsorbents with green solvent functionalisation agent are studied. The project will have a high impact on environment protection and serves as a useful guideline to enhance the process to be more economically efficient for CO<sub>2</sub> capture. This project directly addresses the CO<sub>2</sub> capture

technology needed to support the UN Sustainable Development Goal under climate action (SDG 13). In addition, this work also supports the Malaysian government towards reducing carbon emission intensity.



Carbon dioxide capture application



Packed-bed adsorption column



**Dr Mohd Azlan Kassim**  
Research Fellow  
PhD (Physical Chemistry)

**Research interests:**

1. Carbon dioxide capture and utilisation
2. COSMO-RS modelling
3. Liquid thermophysical characterisation

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## Development of Novel Deep Eutectic Solvents Based on Polyamines for CO<sub>2</sub> Capture

Despite being widely utilized for CO<sub>2</sub> absorption in the industries, alkanolamines still pose environmental drawback such as equipment corrosion, solvent loss via evaporation, thermal and oxidative degradation during the regeneration cycle. Other promising alternative is the use of ionic liquids as absorbent due to their unique physical properties and tunability for functionalization. However, the cost of using ionic liquids is too high for a viable industrial application. Deep Eutectic Solvents (DESs) exhibit similar properties as ionic liquids and can be synthesized using cheaper raw materials signifying the feasibility of the process which is sustainable and economical. Akin to ILs, DESs can be fractionalized with amine functionality by incorporating amine groups into the structure during the synthesis process. This would form a compound with physical properties of fractionalized ionic liquids with a lower cost and chemical reactivity similar to blends of amines with will further increase CO<sub>2</sub> solubility and absorption rate.



Fig.1 High Pressure CO<sub>2</sub> Absorption Setup

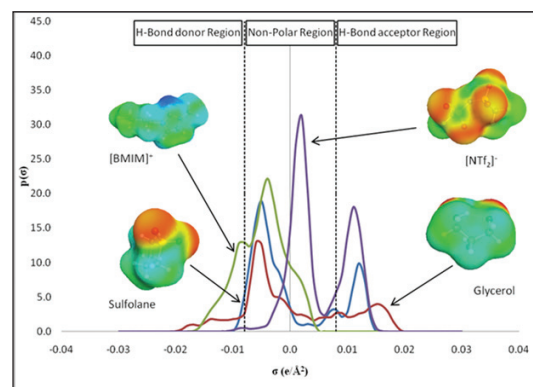


Fig.2  $\sigma$ -profile of solvents predicted by COSMO-RS model.





Credit: William Bradberry/Shutterstock.com

Research Centre for  
**HUMAN-MACHINE  
COLLABORATION**



**Prof. Yap Kian Meng**

Professor  
Head, Research Centre for Human-Machine Collaboration  
MSc, PhD, EC 1&2, Ts, BEM, SMIEEE, MIET, CEng

**Research interests:**

1. Sensory Technology.
2. Assistive haptic and odour technology for blinds
3. Odour, sensors & distributed Haptic Applications
4. Customized robotic, AR & VR applications
5. Odour sensing and tracing using drone technology monitoring system.

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## Haptics, odour, sensors and multi-modal communication in Smart Human-Machine Collaborations

Technology plays a vital role in the future of humanity, be it to colonize new planets, to prolong life, or to make life easier and create new possibilities. Synthesis of human machine collaboration, which is important in enabling better outputs and fine tuning crucial collaborations between human and machine. This can be applied to many areas, especially as we move into the era of the fourth industrial revolution, where time is now marked by breakthroughs in robotics, artificial intelligence, the Internet of Things (IoT) and self-driving vehicles.

Different types of tactile/haptic feedback have been used either

alone or combined with audio feedback in several different areas of assistive technology for individuals who are Blind and Visually Impaired (BVI). Haptic over the Distributed Virtual Environment (DVE) in HCI environment plays an important role in multi-sensory feedback data such as voice, audio and force over the fixed and wireless network.

Drones can be used in sensing and tracking for application in tsunami surveillance and monitoring system. It will capture images, video, location, speed, direction and height of tsunami waves. Another application is in the detection of leaking natural gas in remote area.

Research Centre for Human-Machine Collaboration (HUMAC) aims to be the nation's main technology hub and to demonstrate its commitment to sustainable development e.g. SDG3, 4, 8, 9 and 11.

H.O.M.E. Lab (Funding & publications):  
<https://university.sunway.edu.my/sci-tech/facilities/HOME-lab>

HUMAC RC:  
<https://university.sunway.edu.my/HUMAC>



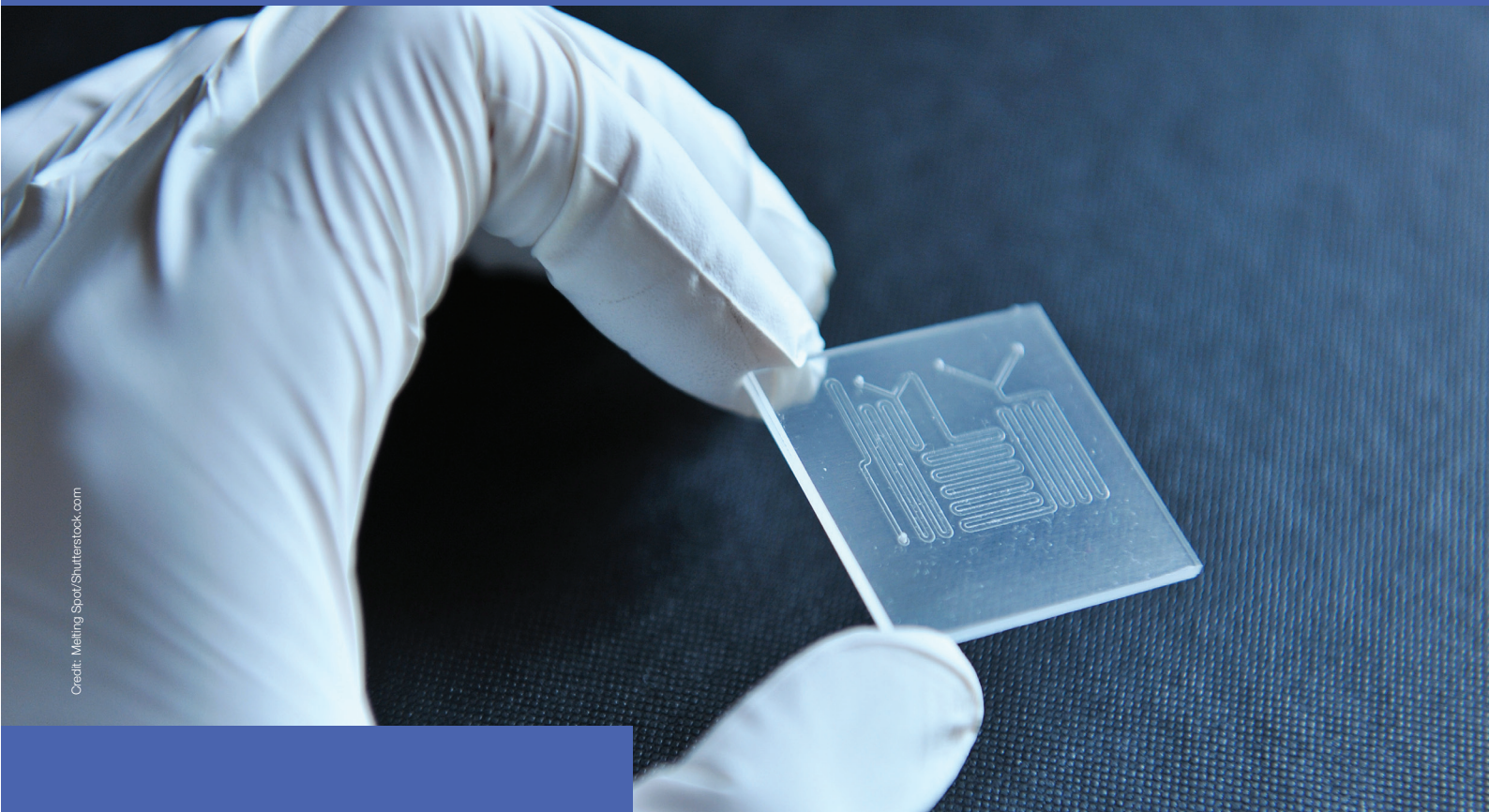
Assistive haptic and odour technology for blinds



Robotic sensing and tracking Application

### List of SET and SMLS academics associated with the Centre

- Dr Chia Wai Chong
- Dr Chin Teck Min
- Prof. Lau Sian Lun
- Assoc. Prof. Dr Lee Yun Li
- Lim Woan Ning
- Assoc. Prof. Dr Lin Mei-Hua
- Dr Richard Wong Teck Ken
- Dr Steven Eu Kok Seng
- Dr Yong Yoke Leng



Credit: Melting Spot/Shutterstock.com

Research Centre for  
**NANO-MATERIALS &  
ENERGY TECHNOLOGY**





**Prof. Saidur Rahman**

Distinguished Research Professor  
Head, Research Centre for Nano-  
Materials & Energy Technology  
PhD, MEngSc, BSc

**Research interests:**

1. Nano-materials
2. Renewable energy
3. Nanofluids/Heat transfer
4. Energy storage

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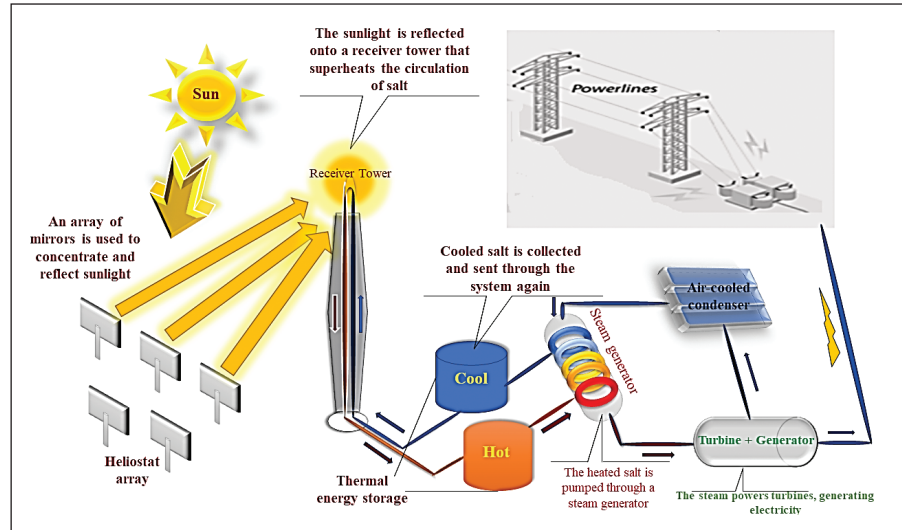
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## Nano-Materials in harnessing solar energy and energy storage capability

As we move towards building a sustainable world, we turn to various renewable resources for energy including the sun. We use solar energy to power our heaters, electronic devices and even vehicles. The idea of using solar energy is hardly new as attempts at developing solar technologies began as early as the late 19th century. Different types of nanomaterials such as oxide, nitride, carbide ceramics, ceramics, metals, semiconductors,

hybrid, carbon allotropies and magnets form the various materials used in different applications. Nanotechnology is improving the efficiency, performance and life span of various solar energy applications such as flat plate, evacuated tube, concentrated collector, water heater, solar still, solar pond, solar desalination and solar thermoelectric cell. The unique properties of various nanomaterials can indeed be used to increase the efficiency of renewable

energy technology. Nano-materials can be used to improve energy storage capability due their unique features. These projects were funded by High Impact Research Grant, FRGS, ERGS and currently funded by Sunway internal grants



**Prof. Adarsh Kumar Pandey**

Professor  
Associate Dean (Engagement)  
PhD

**Research interests:**

1. Solar Energy
2. Renewable Energy
3. Nano-enhanced phase change materials
4. Hybrid Photovoltaic Thermal (PV/T) Systems
5. Dye Sensitized Solar Cells

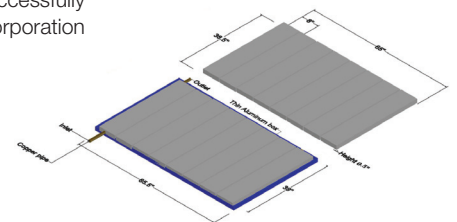
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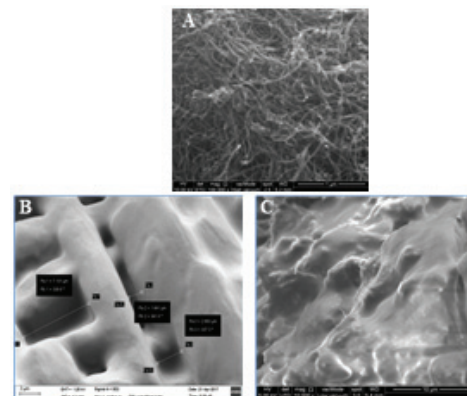
## Nanomaterials & Thermal Energy Storage for Solar Energy

The 7th Sustainable Development Goal (SDG) as envisaged by the United Nations (UN) has covenanted to provide access to affordable, reliable and sustainable energy for all. Renewable energies are the only capable and adept candidates to provide a credible solution to achieve this goal. However, all the renewables suffer from a major shortcoming that their availability and supply is quite intermittent and sporadic by nature causing a disconnect between the demand and supply. Solar energy which is globally accepted as the most promising source of renewable energy retains the same limitation. The only credible solution to this problem is a well-engineered and efficacious energy storage system. Whereas electrical energy produced by solar photovoltaic (PV) modules can be stored and utilized using the well-established technology like batteries effective storage of thermal energy supplied by solar thermal collectors (STC) and photovoltaic thermal (PVT) modules is still a challenge. Phase change materials (PCMs) possess good thermal storage capacity due to their high latent heat capacity and studies confirm that use of PCMs for

building applications, PVT systems, and temperature control of PV etc. are technically viable if some issues like thermal conductivity or phase stability of the materials could be properly addressed. The low thermal conductivity of PCMs, especially of the organic ones can successfully enhanced through the incorporation of nanoparticles.



PCM Integrated PV/T System



Morphology of Nano-Enhanced Phase Change Materials



**Dr Norulsamani Abdullah**  
Post-Doctoral Research Fellow  
PhD

**Research interests:**

1. Catalysis
2. Advanced Nanomaterials
3. Energy Storage and Conversion

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## Synthesis, Characterization, Electrochemical Measurement and Optimization of Composite-based Advanced Materials in Catalysis Process for Energy Storage and Conversion Application

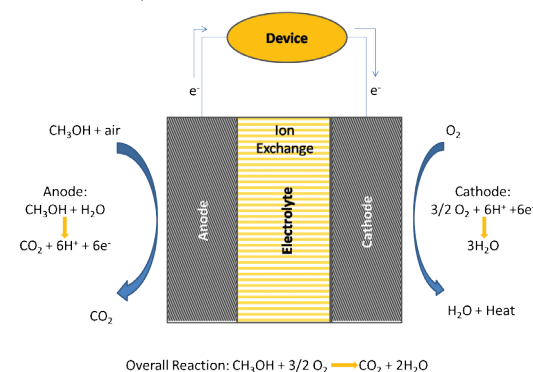
Environmental issues are getting worse day by day which are mostly caused by human activities including activities related to energy. As is known, energy is the backbone of the daily life of today's generation, but environmental and health aspects need to be emphasized to produce a sustainable life. Based on this awareness, more environmentally friendly energy technologies (energy storage and conversion) have been explored, including combustion-free and carbon-free technologies, such as batteries, flow batteries, fuel cells, hydrogen

storage and more. However, the commercialization of this technology faces various obstacles including performance, durability and cost issues. All these problems involve the main component called as catalysis process which is the core of the reaction for energy storage or conversion process. Among the materials that highlight the unique properties required for this system are advanced 2D materials. This material has a hydrophilic surface and high metallic conductivity, promising good performance in catalysis and energy applications. In addition, it

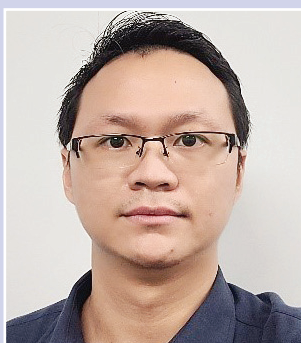
is also chemically and mechanically stable and the surface of this material can be functionalized with various chemical groups. Crystals of this material are all in a closed hexagonal structure that can create a 'hot spot' on the surface of the catalyst and thus can help electrocatalytic activity. All these properties open up more space and opportunities in the process of realizing more efficient and environmentally friendly energy storage and conversion.



At Laboratory of RCNMET with team members



Overall mechanism for Energy Conversion (Fuel Cell) application



**Dr Tan Kim Han**  
Research Fellow  
PhD

**Research interests:**

1. Nanomaterials
2. Composites
3. Energy Storage

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ext 7600/7616

## Development of 2D-nanomaterials & composites as conductive fillers and thin-film related products for energy storage applications.

At present, the great diversity of electronic devices especially mobiles phones, wearable gadgets, portable medical devices for the monitoring purpose & etc. become more common and irreplaceable in human daily life activities. A huge amount of data & information transfer involved in the aforementioned devices have been assisted by the communication network technology of 5G as well as the planned 6G. A need of power resources with rechargeable ability to drive the devices is necessary and essential for their usage efficiency. The recent discovery of 2D-nanomaterials from transition metal carbides & nitrides called MXenes attract tremendous attention & interest from the research community. Their nature of high conductivity (up to 20x10<sup>3</sup> Scm<sup>-1</sup>) combined with redox ability, structural flexibility with good strength & stiffness, scalable solution syntheses, sufficient environmental stability leads to the energy storage related applications. Their chemistry compatibility due to the transition metals' surface termination offer

great tunability in optimizing both conductivity & electrochemical properties as these properties depend on the type and position of terminations. However, surface functionalization in controllable manner remains a challenge. Although the precursor material is commercially available in the market with considerable price, it's necessary to develop economical, environmentally friendly, safe, scalable synthesis methods of these 2D-nanomaterials to critically fulfill the applications requiring a large amount of nanomaterials such as grid-scale energy storage or reinforcement for composites. In addition, the vast choice of transition metals & different surface termination configurations (types and position of surface terminations) facilitate continuous effort in developing new MXenes and their potential composites in order to further enhance the materials' conductivity, electrochemical, & stability performance for the energy storage applications.



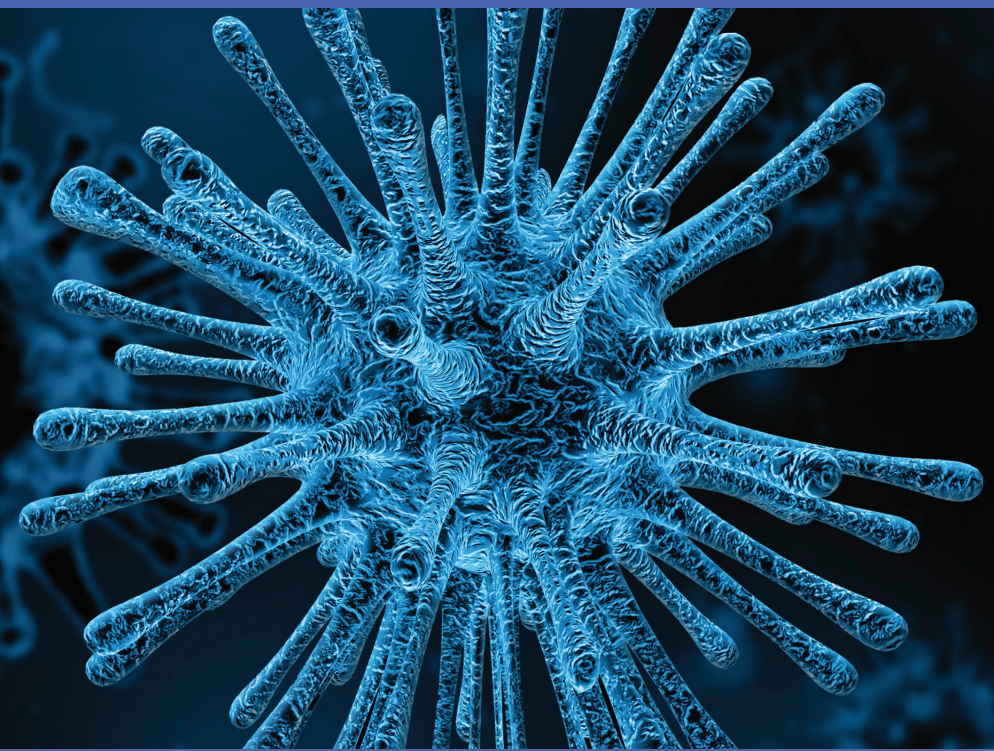


Credit: Pop Tika/Shutterstock.com

School of  
**MEDICAL &  
LIFE SCIENCES**



Image by Gerd Altmann from Pixabay



Department of  
**BIOLOGICAL SCIENCES**



**Dr Kavita Reginald**  
Associate Professor  
Head, Department of Biological Sciences  
Ph.D. (Immunology)

**Research interests:**  
1. Allergens and hypersensitivity  
2. Genetics of Asthma and Atopy  
3. Hypoallergenic vaccines

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## Allergy and Immunology

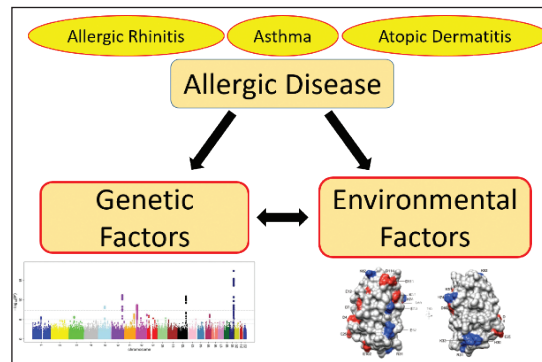
Allergic diseases are a global health problem affecting up to 25% of the world's population and represent a heavy burden for both the patients and the health care system. My research group is focused on understanding the genetic and environmental factors that trigger allergic reactions, as well as finding cures for allergies. My specific research foci are:

- 1. Understanding the linkage between phenotypes and allergic diseases.** Specifically, my team aims to: 1) identify genotypic markers that are high-risk factors of allergic diseases; and 2) functionally characterize the gene candidates to gain a better understanding of the mechanisms underlying allergic diseases.
- 2. Allergen characterization.** The binding of the Immunoglobulin-E antibody to an allergen and its subsequent cross-linking on mediator cells (such as mast cells) causes the symptomology of allergies. My research team aims to characterize the local Asian population for the prevalence of clinically important allergens, characterize the immunological properties and epitopes of these allergens.

- 3. Developing allergy vaccines.** Specific immunotherapy using allergy vaccines has been shown to be the only long-lasting therapy for allergies, as it is able to change the way the immune system recognizes and reacts to allergens.



Dr Reginald's Research Team



Factors influencing allergic diseases



**Dr Abhi Veerakumarasivam**  
Professor  
PhD (Oncology)  
Chair, International Network for Government Science Advice Asia  
Co- Chair of ASEAN Young Scientists Network

**Research interests:**  
1. Cancer Diagnostics & Therapeutics  
2. Healthy Ageing & Well-being  
3. Science Leadership & Policy

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## Medical Genetics and Science Leadership

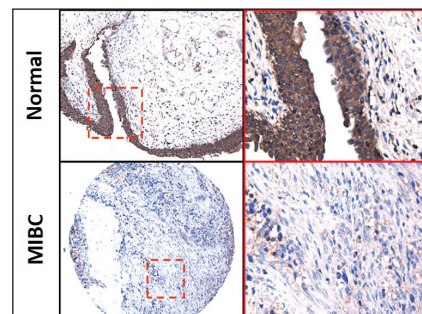
Prof. Veerakumarasivam's research group works on clarifying the spectrum of genetic changes in cancer and the development of new diagnostic and therapeutic modalities. In collaboration with Sunway Medical Centre, he is focused on introducing latest genetic technologies to improve the management of various diseases.

Prof Veerakumarasivam dedicates significant effort in leading various national and international initiatives

on understanding, landscaping and promoting science excellence, engagement and impact in the region. He is actively involved in shaping the University's focal interests in promoting healthy ageing and pandemic resilience.

Prof Veerakumarasivam champions the application of science advice and evidence-informed policy making in the region and truly believes that the greatest challenges that we are facing in the 21st century

can only be addressed through an interdisciplinary approach that promotes effective communication and policies that support the translation of scientific discoveries and enabling technologies to improve the quality of life and promote social justice.



Identification of cancer biomarkers that improve the management of cancer patients.



Prof Veerakumarasivam promotes greater inclusive representation and leadership in the ASEAN region.



**Dr Amar Daud Iskandar Abdullah**

Senior Lecturer  
Programme Leader,  
BSc (Hons) Biology with  
Psychology  
PhD in Neuroscience  
MSc in Cell Biology  
BSc (Hons) in Biotechnology

**Research interests:**

1. Traumatic Brain Injury
2. Neurodegenerative Diseases
3. Cell Death in Human Diseases
4. Healthy Ageing
5. Planetary Health

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## Understanding key pathways involved in brain diseases; how can we limit the brain damage?

Acute and chronic brain disorders remain the leading cause of death and permanent disability worldwide. Current treatments are inadequate, with the majority of potential therapeutics failing in clinical trials. The failure of potential therapeutics can partly be attributed to the complexities of the secondary damage and that the pathways involved in the neuronal cell death in the diseased brains that are not fully understood. Over the past decade it has become clear that the central nervous system (CNS) can exhibit features

of neuroinflammation with chronic neuroinflammatory responses identified in many brain diseases. It is important that ways are found to control this neuroinflammation as controlling neuroinflammation will limit the damage and could improve the outcome in patients with brain disorders. My research interest focuses on the mechanisms of cell death seen in neural injury and the effect that neuroinflammation contributes to neural cell death utilizing both animal models and cell culture assays.



**Dr Lim Wei Ling, Audrey**

Associate Professor  
PhD (Medicine, Nursing and  
Health Sciences)  
BSc (Hons) Biotechnology

**Research interests:**

1. Neurodegenerative diseases
2. Early-life stress
3. Natural product screening

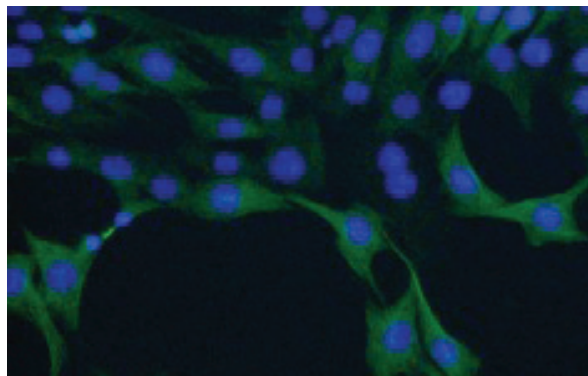
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## Understanding brain development and neurodegeneration in search for potential therapeutics

The brain is susceptible to multiple insults across developmental stages, including neurodevelopmental disorders, infection, stress, trauma and injury, as well as ageing. There is great interest in the neuroscience field to understand mechanisms that influence the development and disease progression in the brain, along with the discovery of novel drugs and management modalities. My research interest focuses on experimental modelling of neurodegenerative diseases using stem cells and neuronal cells as cellular models to understand biological events contributing to neurodegeneration. Building on these platforms, I further explore various pharmacological compounds and natural products that could protect neuronal cells from death and degeneration. I am also interested to understand the effects of early-life stress and neurodevelopmental disorders on brain function and behaviours

using animal models. A better understanding of molecular events and mechanisms underlying brain development and neurodegeneration could contribute towards identifying potential treatment strategies for neurodegenerative diseases and brain-related disorders.



HT22 mouse hippocampal neuronal cells as cellular models to understand mechanisms underlying neurodegeneration and screening of natural products.





**Dr Ayaz Anwar**

Senior Lecturer  
PhD, PDRF

**Research interests:**

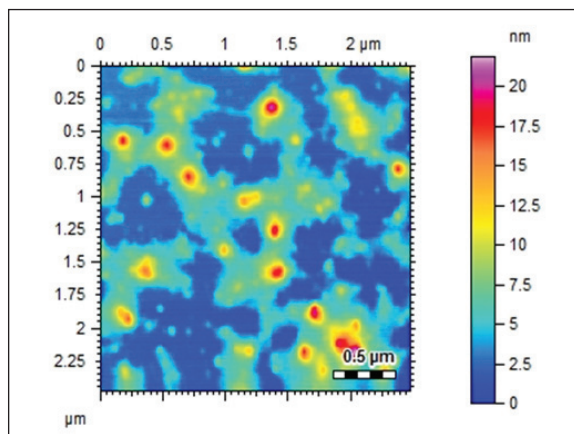
1. Nanomedicine
2. Medicinal Chemistry
3. Antimicrobial Agents
4. Infectious Diseases

**Contact details:**

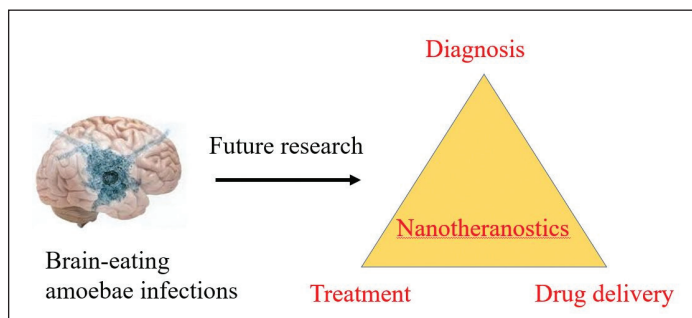
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## Antimicrobial Chemotherapy against Human Pathogens including Free-Living Amoebae and MDR Bacteria

Infectious diseases are the second leading cause of mortality worldwide. The ever-increasing incidence of drug resistance in human pathogens has contributed significantly to the disease burden despite the recent advances in healthcare sector. The antimicrobial drug discovery research needs a paradigm shift to tackle multi-drug resistance in pathogens and finding new compounds and materials. Nanomedicine has emerged as a silver lining avenue for antimicrobial research for its broad applications in diagnosis, treatment and drug delivery. Our research focuses on the synthesis of a variety of medicinally important scaffolds of organic compounds and functional nanomaterials. The synthesized compounds and materials are designed for their antiparasitic and antibacterial applications against free-living amoebae and MDR bacteria. We also have a broad interest in the development of therapeutic and diagnostic probes within one platform which is known as theranostics against brain-eating amoebae. Our lab is funded by Sunway University and FRGS. We are hopeful to put a positive impact on the society through our scientific contributions.



Drugs conjugated with metallic nanoparticles



Theranostics against brain-eating amoebae



**Dr Babu Ramanathan**

Senior Lecturer  
PhD

**Research interests:**

1. Peptide vaccines
2. Antiviral drugs
3. Next generation sequencing
4. Dengue immunopathology
5. Epitope mapping

**Contact details:**

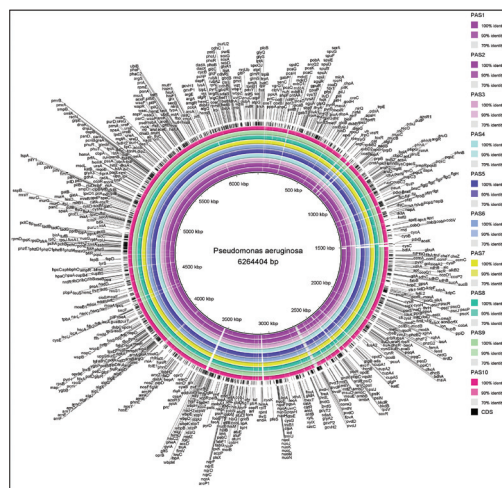
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## Microbial Resistance, Vaccines and Antivirals

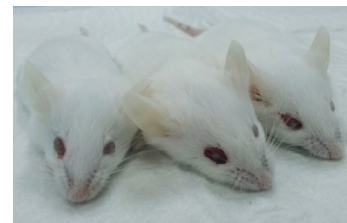
Dengue is a growing threat globally and protection against all four dengue serotypes is a public health priority. Most dengue infections are either asymptomatic or mild and self-limited, but there are "warning signs" that are suggestive of which patients who may progress to severe disease and require strict medical management. Severe dengue may manifest as significant plasma leakage, haemorrhagic complications, and/or severe organ impairment. However, to date,

no universal vaccine or antiviral therapeutics are available for dengue. My research focuses on gaining insights in peptide-based vaccines and antivirals for infectious diseases, particularly the Dengue virus and Enterovirus 71. With the use of reverse vaccinology and *in silico* sequence- and structure based epitope prediction strategies, I attempt to identify potential neutralizing antibody B-cell epitopes and cytotoxic CD8+ T-cell epitopes of dengue virus. These epitopes

are evaluated as a multi-epitope synthetic peptide vaccine against dengue in animal models. My research team is also employing an antiviral screening platform for potential antiviral molecules against dengue and Enterovirus 71. I am also focusing on studying antibiotic resistant single nucleotide variants in multi-drug resistant bacteria through the use of next generation whole genome sequencing.



Next generation whole genome sequencing reveals the single nucleotide polymorphic variants in the antibiotic resistant genes of *Pseudomonas aeruginosa*



Mice model for evaluation of peptide vaccines

## Genetic Engineering and Experimental Evolution of Microalgae



**Dr Chen Jit Ern**  
Senior Lecturer  
PhD, BA

**Research interests:**

1. Algae biology
2. Genetic engineering
3. Phylogenetics
4. Retrotransposons
5. Heat tolerance

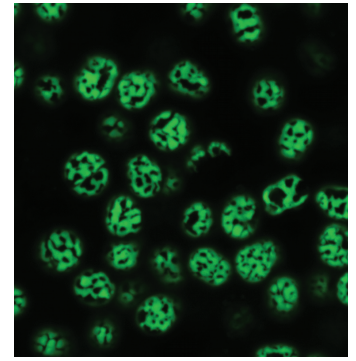
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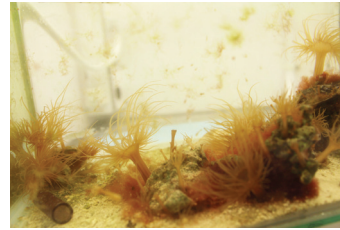
Dr Chen Jit Ern completed his BA and PhD at the University of Cambridge working on identifying and characterising genes involved in lipid metabolism in diatoms and the green algae. After this, he took up a Post-Doctoral position in KAUST, Saudi Arabia, where he worked on the genetic transformation of the dinoflagellate *Symbiodinium microadriaticum*, the algal symbiont of corals, with the aim of identifying and isolating genes associated with increased heat-tolerance.

His main scientific interests are the use of molecular genetics and experimental evolution methods to answer questions related to algal metabolism and physiology, such as heat tolerance, viral resistance and secondary metabolite accumulation, and to compare these traits across microalgae from various evolutionary lineages. In addition, he is also interested in the phylogenetics and biodiversity of algae groups, as well as the capability of transposable elements to drive faster-than-expected rates of evolution in clonally propagating algae.

Dr Chen's current research is focused on further developing methods to understand the molecular basis of heat-tolerance in *Symbiodinium* as well as to use experimental evolution to isolate algal strains with new physiological characteristics. He is also a Research Fellow in the Jeffrey Sachs Center on Sustainable Development, where he coordinates and lectures several modules of the Master in Sustainable Development Management program.



Fluorescence microscope image of free-living *Symbiodinium microadriaticum*, showing reticulated structure of *Symbiodinium* chloroplast.



Experimental aquarium for long-term environmental stress studies

## Understanding Antibiotic Resistance and the Search for New Antibacterial Agents



**Dr Chew, Jactty**  
Associate Professor  
Associate Dean (Education)  
PhD in Dentistry  
BSc (Hons) Biotech

**Research interests:**

1. Bacterial antibiotic resistance
2. Antibacterial development

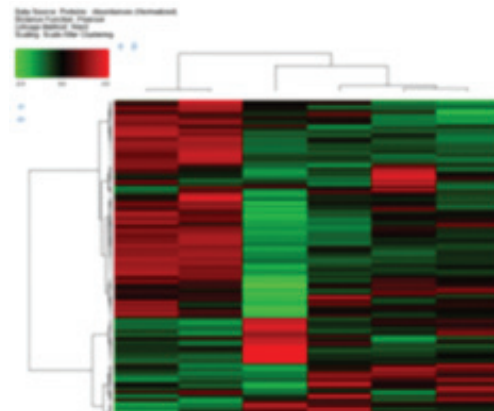
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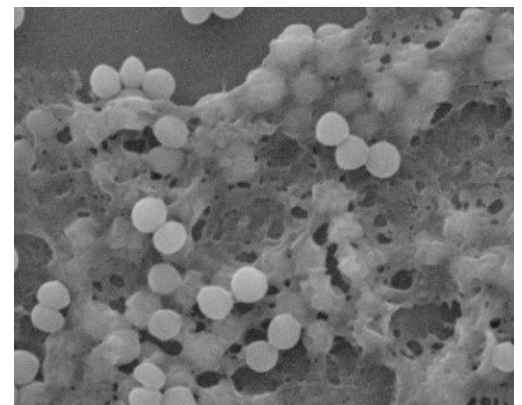
The rapid emergence of antibiotic resistant bacteria (ARB) is now a global threat; limiting antibiotic treatment options and putting patient safety at risk. Existing data predicts that without interventions, ARB will lead to 10 million deaths annually by 2050. This statistic highlights the crucial importance of an in-depth understanding of ARB transmission, antibiotic resistance mechanisms and adaptations, and the development of new antibacterial agents in the fight against ARB.

My research activities focus on:

- 1) understanding antibiotic resistance and adaptations of multidrug resistant bacteria; and
- 2) antibacterial characterisation of new synthetic and natural antibacterial agents in collaboration with experts in the fields



Heat map of differentially expressed proteins between antibiotic-treated and control groups



Development of new antibacterial agent effective in killing antibiotic resistant bacteria



**Dr Gopalasamy Reuben Clements**

Professor  
Associate Dean of Research and Postgraduate Studies  
PhD (Conservation Science)  
MSc (Biology)  
BSc (Biology)

**Research interests:**

1. Nature-based solutions
2. Ecology and conservation of threatened biodiversity
3. Conservation finance
4. Responsible forestry
5. Biostatistics

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## Developing nature-based solutions to conserve Malaysia's threatened biodiversity and mitigate climate change

What species lives there, why, and how can we help conserve them? These are questions that have always intrigued me as a student of biology. I developed a keen interest in ecological and conservation research after years of working in one of Earth's hottest biodiversity hotspots – Malaysia. During expeditions that brought me to poorly explored rainforests, caves and swamps in this megadiverse country, I began to realize how little we know about the biodiversity around us and how quickly we are

losing them as a result of habitat destruction. Therefore, any research that I do must contribute towards the protection of threatened biodiversity in Malaysia. I now mainly work in the 288,000-hectare Kenyir Watershed in the State of Terengganu, which lies within one of Malaysia's national priority areas for tiger conservation and is recognized as a globally important Tiger Conservation Landscape. Since 2011, my research team has helped: 1) determine the effectiveness of wildlife crossing structures for the Malay tiger and

other large mammals; 2) understand tiger population trends; 3) reducing wildlife crime; and 4) create protected area legislation, which was used to create the 30,000-hectare Kenyir State Park (an area the size of Penang Island). As this park requires long-term funding to support its management, my research now aims to develop nature-based solutions to sustainably manage this area, not just for the conservation of threatened biodiversity, but for climate change mitigation to improve our planet's health.



3 large carnivores that we have researched on in the Kenyir watershed



The 30,000 ha Kenyir State Park in the State of Terengganu that my team helped create and where my team is innovating nature-based solutions to protect threatened biodiversity and mitigate climate change, which is vital for prevention of the next pandemic and improvement of planetary health.



**Dr Jane Gew Lai Ti**

Senior Lecturer  
PhD, MSc, BSc (Hons) Chemistry

**Research interests:**

1. Colloid and Surface Chemistry
2. Drug Delivery
3. Green Chemistry
4. Plastic Pollution

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## Green Development of Drug Delivery Systems and Sustainable Biomaterials

My main area of research and work is Nanotechnology in Chemistry. My thesis was on the "Study of Albumin and Anti-SNAP25 Mixtures on Lipid Monolayers using the Langmuir Blodgett Technique". I am currently researching on drug delivery and antimicrobial nanocoating together with various research partners, with a primary focus on the Sustainable Development Goals using green solvents for chemical synthesis and extractions to alleviate concerns revolving around the use of hazardous organic solvents, as well as to reduce the use of organic solvents in chemical processes.

## Protein-Protein Interactions and Signal Transduction Mediated by Tumor Suppressor and Pro-apoptotic Proteins



**Dr Jeff Tan Kuan Onn**

Professor  
PhD

### Research interests:

1. Cancer Cell Biology
2. Epithelial biology (Skin biology)
3. Natural Product Research
4. Experimental Therapeutics (Anti-Cancer Drugs)
5. Gene Therapy and Virology

### Contact details:

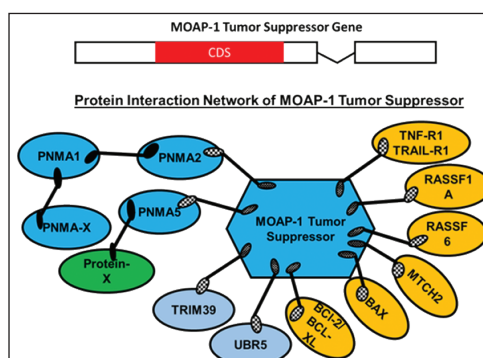
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Tumor suppressors are molecular regulators that function to regulate cellular signalling pathways, including cell cycle and cellular proliferation. Expression and activation of tumor suppressors can lead to the inhibition of abnormal cell behaviour, such as cancerous growth and cellular transformation, leading to induction of apoptosis or programmed cell death. MOAP-1, a novel tumor suppressor which we discovered through yeast two hybrid screening of protein expression library, induces apoptotic cell death in cancer cells and interacts with

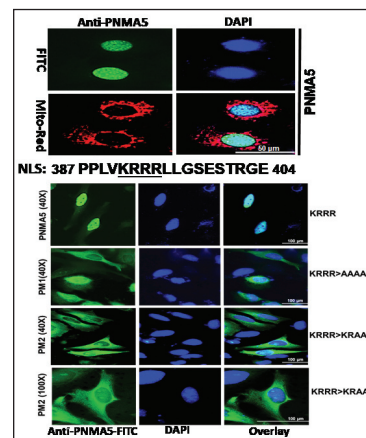
other tumor suppressor and pro-apoptotic proteins to promote activation of apoptosis signalling through the mitochondrial signalling pathway, resulting in mitochondrial dysfunction and apoptotic cell death of cancer cells. MOAP-1, also referred to as PNMA4, is a member of PNMA (Paraneoplastic Ma Antigens) family, which consists of at least 15 family members that are encoded by human genome.

Current research projects in Prof Jeff's lab focus on characterization of tumor suppressors and pro-apoptotic molecules to develop

better understanding on the protein functions as well as the development of gene therapy mediated by tumour suppressors and pro-apoptotic molecules for potential anti-cancer applications. They use cell and molecular biology techniques, stem cells, cancer stem cells and virus to investigate the cellular functions of tumour suppressors and pro-apoptotic proteins. Their research projects are funded by research grants, including FRGS (Ministry of Higher Education, Malaysia).



Protein Interactions and Cellular Signaling Pathways Mediated by MOAP-1 Tumor Suppressor



Identification of Nuclear Localization Signal (NLS) in PNMA5

## Molecular aspects of solid tumour malignancies (colorectal cancer)



**Dr Lau Tze Pheng**

Lecturer  
PhD (Molecular Oncology)  
BSc (Hons) Biomedical Science

### Research interests:

1. Molecular Oncology
2. Molecular pathology

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I am interested in molecular oncology and molecular pathology, especially on solid tumour malignancies. My research area is mainly focused on the molecular aspects of colorectal cancer, investigating into the susceptibility genes and gene expression profiles of different stages of colorectal tumours development. My current research interests are to characterize the intestinal microbiota composition of colorectal cancer patients of different ethnics, and how it is related to different incidence rates and clinicopathological features of colorectal cancer among patients of Malay, Chinese, and Indian ethnicity. Evidences have shown that genetic factors along with dietary and lifestyle factors may modulate the microbiome composition within our gut, which might then impact the colorectal cancer susceptibility, progression, prognosis, and therapeutic intervention.



**Dr Ong Seng Kai**  
Senior Lecturer  
PhD

**Research interests:**

1. Cancer genetics
2. Therapeutic development and discovery for pathogenic microorganisms

**Contact details:**

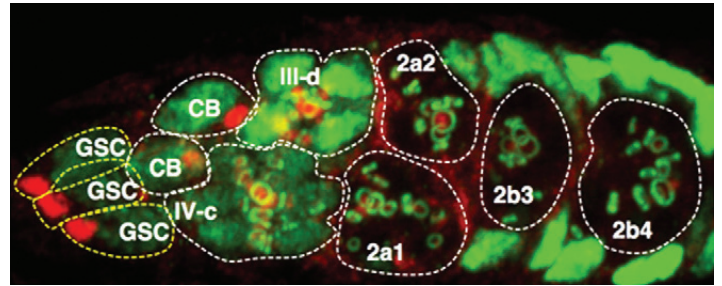
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## Eukaryotic Cell Reproduction and Development of Therapeutic targets for Pathogenic Amoebae

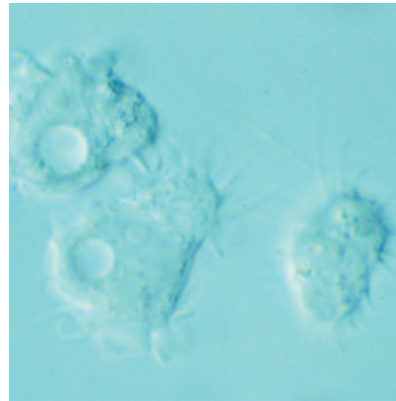
Cell reproduction is the hallmark for all kingdoms of living organisms. It can serve for i) growth in cell population and ii) replace damaged cells. There are different types of cell reproduction such as binary fission, mitosis and meiosis.

A protist such as amoeba is an eukaryotic organism that is neither an animal, plant nor fungus. Amoeba reproduces by undergoing binary fission; similar to asexual reproduction of a budding yeast. Also, amoeba can exist in either a trophozoite or a cyst stage but the exact mechanism of the transition remains elusive.

Our research primarily focuses on the underlying mechanism of amoebic cell reproduction and trophozoite-cyst transition. Thus, we hope our findings will improve the development and screening for therapeutic molecules against pathogenic amoebae.



Germline cyst formation and incomplete cytokinesis



Acanthamoeba (trophozoite)



**Dr Ravinder Kaur d/o Kirpal Singh**  
Lecturer  
PhD Ecology  
MSc Ecology  
BSc Conservation Biology

**Research interests:**

1. Ecology
2. Wildlife conservation
3. Nesting and breeding behavior of hornbills in Malaysia
4. Science communication

**Contact details:**

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## Research and conservation of endangered hornbills in Malaysia

Safeguarding endangered hornbills through continuous research, conservation and outreach initiatives. Also the Co-founder of Xploreagaia, an organisation that works towards creating nesting opportunities for endangered hornbills by restoring tree cavities and building artificial nest boxes for them. We also conduct awareness campaigns throughout Malaysia, especially in remote villages. Recently, conducting dietary analysis of Oriental Pied Hornbills through faecal samples with DNA barcoding with Sunway students to determine what fruits are being consumed by hornbills, to help develop a hornbill preferred food plant list (which will be used as a guide for reforestation efforts across Malaysia).

**Awards:**

2020 Marsh Christian Award Winner  
2017 Future Conservationist Award Winner (Conservation Leadership Program)



Collaborations on field with other local NGOs such as HUTAN



Finding a hornbill's feather



**Dr. Say Yee How**

Senior Lecturer  
Programme Leader, BSc (Hons)  
Biomedicine  
PhD (Cell and Molecular Biology)  
BSc (Hons) Biomedical Science

**Research interests:**

1. Nutrigenetics
2. Neoplasm
3. Neurodegeneration
4. Genetic Epidemiology

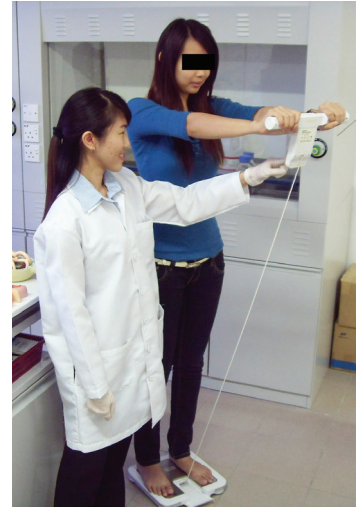
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## Investigating the roles of genetic variants in influencing eating behavior and predisposition to obesity

Obesity, a condition where excessive fat accumulates in the body, is a serious public health problem in Malaysia. Obesity also significantly increases the risk of non-communicable diseases. My research mainly focuses on nutrigenetics, the study on how we respond to our food or diet based on our genetic makeup. I am interested to investigate how certain gene variants are associated with the predisposition to obesity and its related behavioural factors among Malaysians. For example, gene variants in the dopamine receptor (DRD2) has been found to influence eating behaviour<sup>1</sup>, while another

variant in the fatty acid translocase gene (CD36) influences fat taste perception<sup>2</sup>. I am also interested in the functional genomics of obesity, the study of how gene variants contribute to different biological processes leading to obesity. Currently, I am researching on the environmental and psychological determinants of obesity, particularly on the "obesogenic" environment, an environment that promotes high energy intake and sedentary behaviour. I also envision to study the roles of Planetary Health Diet (a sustainable diet for better health and planet) and the gut microbial composition (microbiome) in obesity.



Recordings of anthropometric measurements (like weight, height, body mass index) and body composition using a bioimpedance body analyzer (like body fat and skeletal muscle percentages), are essential in obesity research.



To determine whether individuals carry certain gene variants that may predispose them to obesity or not, the Polymerase Chain Reaction (PCR) method is used, proceeded with further statistical analysis.



**Dr Ser Hooi Leng**

Lecturer  
PhD (Microbiology)  
BSc (Molecular Biology &  
Biomedical Science)  
BForensics (Forensic Biology)

**Research interests:**

1. Microbiome and human health
2. Microbial systematics and taxonomy
3. Bioprospecting and drug discovery from microbes and plants
4. Multidrug resistance organism

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## Microbes for mankind: What can we learn about their roles in contributing to human diseases?

Microorganisms are found practically everywhere, however not all of them are equal! Some may cause nasty diseases but there is a couple of them like *Lactobacillus* sp. which are known to have anti-inflammatory effects and improve our digestive system. In the early phase of my research journey, I have identified several novel bacteria that displayed antioxidant and anticancer effects that could be beneficial to mankind. That motivates me to study the role and potential impact of microbes on human health. The term "microbiome" is used to describe a collection of microbes living together.

Believe it or not, an adult man could carry trillions of bacteria in and out of the body, with majority of them residing in the gut. With emerging evidence showing the association between the imbalance in the gut

microbiome and human diseases, scientists now believe that we could study them to find biomarkers for specific diseases and ailments, as well as pharmacological targets in treatments and preventative measures.

For instance, microbiota transplant (e.g. specially prepared stool, vaginal fluid etc.) has been indicated to improve symptoms and/or restore microbiome balance in certain conditions like recurrent *Clostridioides difficile* infection, bacterial vaginosis and so on. My current research focuses on exploring microbial signatures in patients with chronic health conditions like allergy, especially on how we can make use of these information to manage disease symptoms and improve quality of life.

## Algae Biotechnology: A Contributor to Global Sustainability Development



### Dr Yow Yoon Yen

Associate Professor  
Programme Leader, MSc in Life  
Sciences  
PhD, BSc (Hons)

### Research interests:

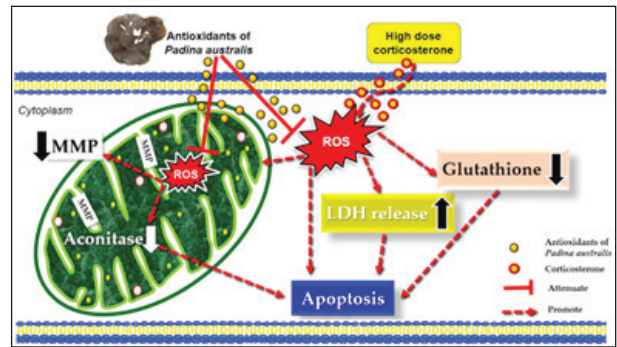
Application of algae biotechnology  
in neuroscience, cosmeceuticals,  
anti-microbial, and algal  
biomaterial.

### Contact details:

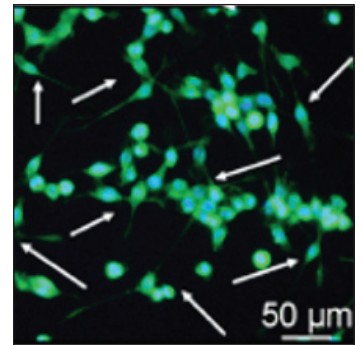
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I am an algae biotechnologist and my research group focused on developing of high-value products from algae. I am exploring the pharmacological effects of algae in areas including neuroprotection, cosmeceuticals and their anti-microbial effects against infectious diseases. I also interested in the study of molecular phylogeny and genetic diversity of algae, and invasive Pomacea apple snails in Malaysia.

In line with Sunway University's commitment to the United Nations Sustainable Development Goals (UNSDGs), I look forward to discovering how algae play a role in the SDGs with the promote well-being for all.



Brown alga *Padina australis* with in vitro antidepressant effect.



Red alga *Gracilaria manilaensis* with neurotogenic in prevention of neurological disorders. Arrows indicate neurite outgrowth.



# Department of MEDICAL SCIENCES





**Dr Chia Yook Chin**

Professor  
Head, Department of Medical Sciences  
MBBS, FRCP, FAFM

**Research interests:**

- 1. BP variability
- 2. Interleukin-6 and heart failure, chronic kidney disease
- 3. Salt sensitivity and BP

**Contact details:**

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## Hypertension and its related Cardiovascular Diseases

Cardiovascular disease (CVD) is the leading cause of death in the world and it is also the case in Malaysia. Modifiable risk factors for CVD include hypertension, hypercholesterolaemia and diabetes mellitus. In fact, hypertension is the leading contributor to mortality in the world.

There are effective medications for the treatment of hypertension where lowering of blood pressure (BP) reduces heart failure, stroke and myocardial infarction significantly.

However, in spite of available and effective treatment of hypertension, residual risks persist.

My research focuses on identifying factors beyond the mean blood pressure, which may account for some of the residual risks. Furthermore, because mean blood pressure has been shown to be independently associated with CVD mortality and morbidity, it is currently used as the target for control of hypertension.

My team of local and international collaborators (HOPE-Asia Network) are studying novel biomarkers, home blood pressure, blood pressure variability, effect of masked hypertension, sleep blood pressure and early morning blood pressure

surges as potential risk factors, and these additional risk factors may form the new targets for blood pressure control beyond the currently used mean blood pressure.

My research also includes diseases in older persons, in particular hypertension on cognition and CVD.



Blood Pressure Measurements May Measurement Month 2018



HOPE-Asia Network Investigators Meeting Shanghai April 2019



**Dr Chook Jack Bee**

Senior Lecturer  
PhD, MMedSc (UM),  
BBioMedSc (Hons, UM)

**Research interests:**

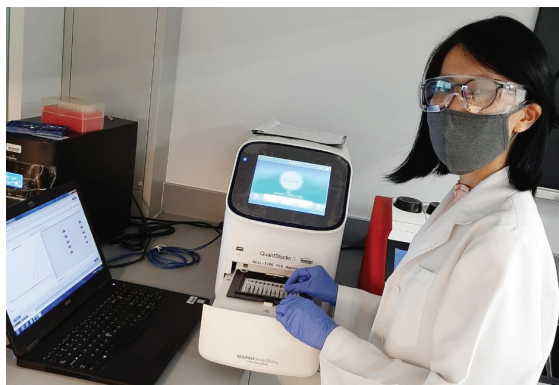
- 1. Molecular virology
- 2. PCR assay design
- 3. Chronic hepatitis B
- 4. Data analysis
- 5. Ethics

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## Molecular Virology: Detection and Genetic Analysis

I focused on the development of hepatitis B virus genotyping method and its correlation with disease profile for my Master's degree, and on the influence of viral and host characteristics on clinical outcome of hepatitis B for my doctorate. As a post-doctoral research fellow, I continued my research into hepatitis, focusing on the natural treatment and mutational analysis of hepatitis B virus. In 2019, I expanded my field of research to HIV and respiratory viruses. I also active in the assay development for quantitative and qualitative PCR assay for HBV, HIV and respiratory viruses, and has even patented these assays. Now I have extended my research into DNA methylation and microRNA profiling in communicable and non-communicable diseases. In my recent work, I did some technical analysis to predict new waves of COVID-19 in various countries.



Developing novel assay for quantification of hepatitis B virus DNA



Research collaboration with University of Malaya in respiratory virus project



**Dr Felicia Chung Fei-Lei**  
Associate Professor  
Programme Leader, BSc (Hons)  
Medical Biotechnology  
PhD, BSc

**Research interests:**

1. Cancer epigenetics
2. Mutational signatures in human cancers
3. Tumour organoids

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## Cancer Epigenomics and Toxicogenomics

Despite major advances in systemic therapy and screening strategies, cancer remains a pressing global health issue. My research work focuses on elucidating the mechanisms underlying cancer cell behaviour:

### 1. Epigenetic mechanisms of cancer

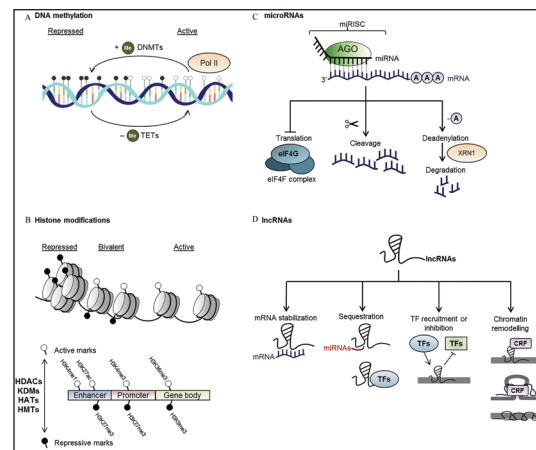
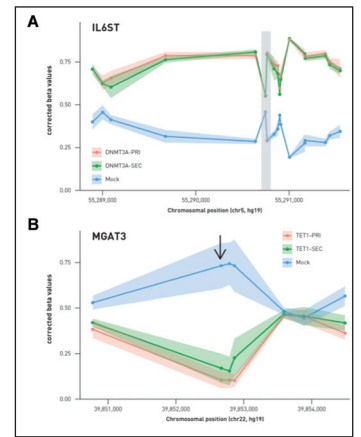
The epigenome refers to modifications to the genome that do not affect the DNA sequence, but influence when, where, and to what degree genes are expressed. Using CRISPR-dCas9 systems for epigenetic editing, we aim to elucidate how epigenomic changes can lead to alterations in cellular behaviour and investigate how these pathways can be exploited to better treat cancer.

### 2. Cancer toxicogenomics

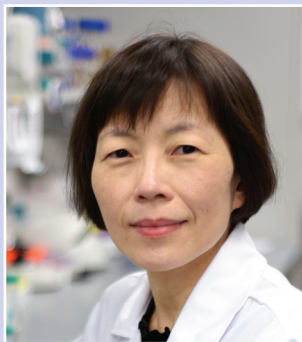
Advancements in genomic sequencing and computational algorithms have led to the characterization of mutational signatures, which are unique, tell-tale patterns of DNA mutations. By

analysing a patient's tumour DNA, it may be possible to work backwards from the pattern of DNA damage and deduce what factors caused an individual's cancer. Using this technology, we aim to investigate why certain cancers are more common in the Southeast Asian region compared to the rest of the world.

The development of effective epigenomic editing tools allow for targeted modulation of the epigenome (Adapted from Josipovic et al., 2019)



Diagrammatical summary of epigenetic modes of action (adapted from Chung & Herceg, 2020)



**Dr Hwang Jung Shan**  
Associate Professor  
Programme Leader, PhD & MSc in  
Medical Science  
PhD in Science

**Research interests:**

1. Toxin
2. Innate Immunity
3. Autoimmune Diseases
4. Transcriptomics and proteomics

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## Mechanism of Action of Cnidarian Toxins and Pathogenesis of Rheumatoid Arthritis

### Mechanism of action of cnidarian toxin

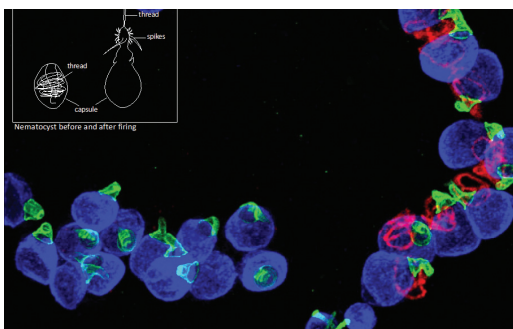
Cnidarians, including sea anemones, jellyfish and Hydra, are the largest phylum among venomous animals that produce toxins. However, cnidarian toxins have not been intensively studied and hence the major scientific challenge is to decipher the biology of these toxins. The primary objective of our study is to characterise a family of cnidarian toxins called HALTs (Hydra Actinoporin-Like Toxins).

We investigated how these toxins induce cell death in human cells and demonstrated its potential application in cancer therapy.

### Pathogenesis of rheumatoid arthritis

For years we are fascinated that rheumatoid arthritis (RA) is triggered when our immune system mistakenly sends immune cells to the joints. These immune cells produce a large quantity of inflammatory mediators that further recruit more

immune cells to the joints, causing aggressive inflammation. RA patients show common symptoms of stiffness, swelling and pain at joints and experience difficulties in their daily activities. In collaboration with hospitals, we analysed RA patients' samples and studied the roles of exosomal microRNA in RA pathogenesis. Besides, we are also interested in periodontal bacteria and its relationship with RA through complex interactions with the immune system.



Fluorescence image of *Hydra nematocysts*, stinging organelles that store various toxins for prey capture. Blue: capsule; green: proximal part of the thread; red: distal part of the thread



*Hydra manipapillata*, a freshwater organism with 0.5-1.0 cm in length and living in clean ponds and streams. This animal is well known for its remarkable regenerative ability



**Dr Ooi Pei Boon**  
Associate Professor  
PhD (Guidance & Counselling)

**Research interests:**

1. Counselling psychology
2. Community health and intervention
3. Cyberbullying and well-being

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## Addressing Public Health Interests and Psychological Wellbeing from the Counselling Lens

Counselling psychology is a branch of psychology where counsellors and clients work together to achieve optimum therapeutic alliance and outcomes. As a registered counsellor, my research focuses on identifying predicting factors related to cyberbullying and psychological wellbeing. I used Cognitive Behavioural Therapy (CBT) as one of the forms of tools and techniques in my counselling practice.

My team and I are the Master Trainers for the Media Heroes Programme - a cyberbullying intervention program that originated from Germany and has been validated and used in the Malaysian context. Our extended study now focused on cyberbullying incidents and psychological wellbeing among visually impaired youths in Malaysia.

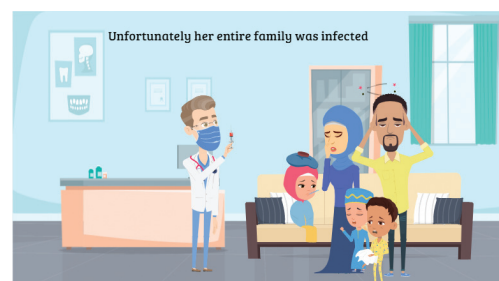
With the emerging public health concern, my team and I are, using the counselling psychology approach, now focusing on addressing the COVID-19 vaccine hesitancy among Malaysians focusing on the

underserved community (elderly and B40 groups in Malaysia). Key terms are being identified as the reasons for hesitancy and its' relationship with individuals' psychological wellbeing and quality of life are being examined.



Dr Ooi and the participants at the cyberbullying intervention program at schools

In the COVID-19 intervention programmes, Dr Ooi and team used videos designed based on the Health Belief Model to educate the public on the importance of getting the COVID-19 vaccination.



**Dr Ronald Teow Sin Yeang**  
Associate Professor  
PhD

**Research interests:**

1. Cancer therapeutics
2. Bioactive nanomaterials
3. Cancer biology

**Contact details:**

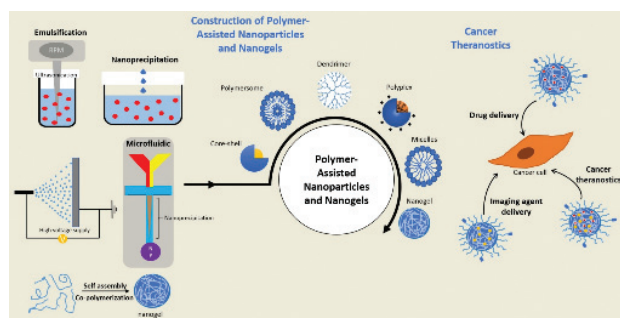
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## Development of Anticancer Nanomaterials towards Solid Tumours

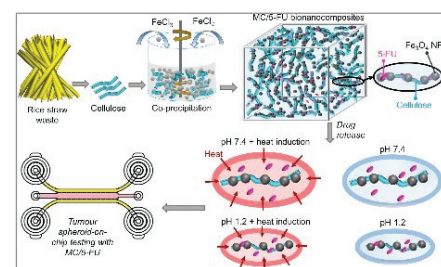
I am interested in exploring the anticancer potential of nanoscale biomaterials synthesized by our collaborators from various universities, locally and internationally. Some of the nanomaterials that I am actively working on include nanoparticles derived from local plants, fruits, and waste materials, biopolymers, nanocomposites loaded with anticancer drugs and so on. To select the most promising anticancer candidates, I utilize various models including in vitro

tumour 3D spheroids, transwell- and microchip-based coculture models to mimic the tumour microenvironment, and focus on the two aspects: drug-penetrating capacity and selective toxicity. I also plan to expand our work to animal models soon by collaborating with NIH Institute for Medical Research (IMR). I am also interested in delineating the mechanisms of the nanomaterial transport and delivery to the target site (in collaboration with University of Groningen) as well as understanding

how they drive the cancer-specific killing. To achieve this, I leverage on the central facilities of the university to carry out the mechanistic studies using techniques such as fluorescence-luminescence dual-mode target assay, immunofluorescence, flow cytometry, immunocytochemistry, western blot analysis and gene expression assays.



Overview of nanogels construction for anticancer applications <https://doi.org/10.3390/gels7020060>



Preparation of drug-loaded nanomaterial for colorectal cancer killing <https://doi.org/10.1016/j.carbpol.2021.118523>



Department of  
**NURSING**



**Dr Khatijah Lim Abdullah**  
 Professor  
 Head, Department of Nursing  
 DClinP (UK)  
 MSc in Health Services  
 Management (UK)  
 BSc (Hon) Nursing (UK)

**Research interests:**

1. Health professional education
2. Professional Nursing Issues
3. Women and Child health
4. Patient centred care

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## Women and Child Health, Health Profession Education and Professional Nursing Issues.

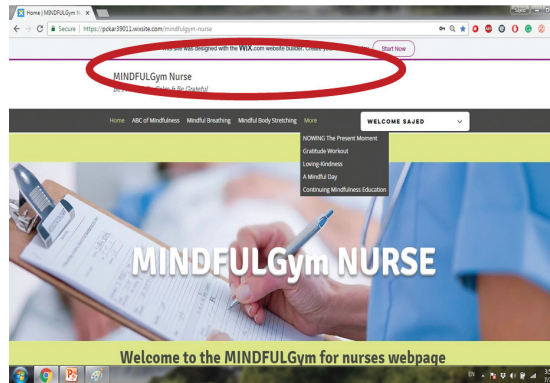
Making the world healthier for women and children has been accepted to have a transformative effect on a country economic and social development. As a trained midwife and neonatal nurse, my interest lies in family-centred care and the importance of patient preferences and values. My clinical expertise has also led to my passion for diverse research methods, notably qualitative research methods and mixed research methods. I

believe that success as researchers, depend not on the ability to analyse and number-crunch but on how we craft stories which resonate with our audience. It is only then that data becomes insight, becomes ideas, and becomes action.

My phenomenological doctoral thesis focused on parental experiences in neonatal transfer, which led to the examination on the preparation of the transfer process. Subsequent works have focused

on kangaroo care for mothers and the use of mindfulness in improving psychological distress.

I am a strong advocate for equality and inclusion in not only research activities, but also in teaching and actively champions diversity within nursing practice. My current research lies within two distinct but overlapping themes: health profession education and professional nursing issues.



Mindful Gym Nurse Website

Kangaroo Care Education Program



**Dr Noor Hasliza Che Seman**  
 Lecturer  
 Programme Leader, PhD Social  
 Science  
 Master Education in Nursing  
 Bachelor in Nursing (Monash)

**Research interests:**

1. Nursing education
2. Social Science and humanities
3. Healthcare professional

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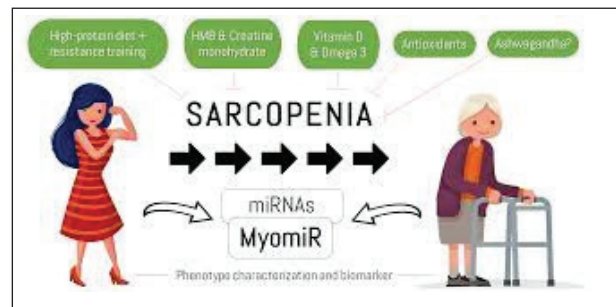
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## Nursing Education, Social Science and Humanities, Professional Nursing, Healthcare Professional

Nurses are the frontline providers of health care, and as such, are well-positioned to influence patient outcomes. My interest in research identifies how the institutional environments where nurses deliver health care, and the policies governing them, impact patient outcomes.

My doctoral thesis focuses on the influence of nosocomial infection on infection control practice and compliance among nurses in selected hospital evaluate knowledge, attitudes and practice towards compliance on infection control among nurses in clinical settings. This study brings rigorous, current, and relevant evidence prior to any implementation of policy affecting the public's health and healthcare.

My current research engages students in appraising healthcare delivery paradigms and professional nursing issues.



Urban Public Knowledge towards Sarcopenia: health education needs assessment



Infection control practice and compliance among nurses in selected hospital

Credit: Yurchanka Starha/Shutterstock.com



Department of  
**PSYCHOLOGY**



**Dr Woo Pei Jun**

Senior Lecturer  
Head, Department of Psychology  
PhD, M.A., B.A. in Psychology

**Research interests:**

1. Face perception in infants, children and adult
2. Parenting and its effect on children's development and well-being.
3. Children developmental disorders
4. Speech and language development

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## Experience Drives Human Face Processing System.

Infants have been shown to be sensitive to differential experience with own- and other-race faces. At a very early age, infants show a spontaneous preference for own-race faces over other-race faces. This ability to discriminate on own- and other-race faces is known as the other-race effect (ORE). It is suggested that ORE reflects individuals' racial experience. Little is known about how infants born and raised in a multiracial environment process own- and other-race faces.

I research on how infants, children and adults learning and recognition of familiar and unfamiliar faces changes in a multiracial environment.

My studies found that the face processing system is malleable during infancy and childhood. For example, I found that 3 to 4-month-olds Malaysian Chinese infants recognized own-race female faces due to regular exposure to female caregivers during their early years. However, this preference changed at 8-to 9-month-olds, when infants

are exposed to others race female faces (i.e. Malay). This contrasts with another group of British infants, who recognized female and male own-race faces. It appears that for infants born and raised in a multiracial environment, the face processing system may relate to infants' social and caregiving experiences. For Malaysian adults who are exposed to multiracial faces, no other race effect was found.



Dr Woo testing babies and explaining the study to a parent.



Dr Woo and her research collaborator, Dr Diana Tham and research assistant Samantha at the Sunway Baby Lab.



**Dr Alia Azalea**

Senior Lecturer  
PhD (Psychology)  
MA (I/O Psychology)  
BSc in Psychology

**Research interests:**

Industrial and Organisational Psychology related.

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## Career Adaptability among Fresh University Graduates in Malaysia

Career adaptability is a psychosocial construct that denotes an individual's resources for coping with current and anticipated tasks, transitions, and traumas in their occupational roles that alter their social integration. Individuals with high career adaptability may take measures to improve their career environment and prepare for upcoming changes in that environment. This factor is important as the labor market becomes more complex and unpredictable.

In collaboration with Dr. Lin Mei-Hua from Sunway University and

Dr. Michelle Lee Chin Chin from Massey University, New Zealand, we are looking at the cause and effect of career adaptability of fresh university graduates in Malaysia. We are particularly interested in looking at whether there are differences in the career adaptability model of individuals who are employed full-time, part-time or unemployed. With this knowledge, an intervention may be able to be planned to assist fresh graduates in the future to obtain and retain sustainable full-time employment.

## Living the Good Life: Psychological Perspectives



### Dr Alvin Ng Lai Oon

Professor  
Associate Dean of International  
Doctor of Psychology

#### Research interests:

1. Mental health literacy
2. Cross-cultural psychometric validation
3. Mindfulness-based interventions
4. Behavioural fluency in precision teaching
5. Suicide intervention.

#### Contact details:

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The central theme of my research interest is subjective well-being. The overall objective of my research areas is to identify determinants of subjective well-being and effective approaches in promoting mental health literacy. I am currently investigating psychometric validation of existing measurement scales to be used within the Malaysian population. These scales include the Autism Quotient Scale, Ruminative Response Scale, Mental Health Literacy Scale, Quiet Ego Scale, Interpersonal Needs Questionnaire, Suicide Stigma and Literacy, and Attitudes to Ageing Questionnaire. Apart from that, my interest also lies in interventional studies, particularly on two approaches: mindfulness-based cognitive and behavioural

approaches for wellbeing, and precision teaching with behavior fluency-building methods for performance enhancements. All these components of my research theme contribute to developing measurements of well-being and interventions that facilitate well-being to improve quality of life in the general public and clinical populations. Findings and issues from these studies form part of my health education contents in my public engagement activities within Malaysia and the Asian region, where I am also involved in advancing the development of cognitive and behavioural therapies.



Prof Alvin Ng with fellow board members of the Asian Cognitive Behavioral Therapies Association at the 9th World Congress of Cognitive and Behavioural Therapies 2019, Berlin, Germany, where he represented Malaysia and the ACBTA in updating the congress on the development of cognitive behavioural therapy research in the country and region. He also presented a student paper based on a final year project.



Prof Alvin Ng presenting at the International Conference on Cognitive Behavioural Interventions 2021, New Delhi, India (virtual), where he represented Malaysia to update on developments of cognitive and behavioural therapies research and development. He also presented a paper on public empowerment for improved access to mental health treatment in Asia, as well as had two of his students present their research.

## Physical and Social Environments Typical of Residential Care settings for Older People in Malaysia



### Dr Chee Kwan Foong

Lecturer  
PhD in Health Research,  
MA (Counselling Psychology),  
BA (Hons) Psychology,  
Registered and Licensed  
Counsellor: KB:00441; PA06026

#### Research interests:

1. Ageing research
2. Places, spaces, health and wellbeing
3. Counselling, mental health, health and stigmas

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### How would you feel about spending your last few years living here?



Figure 1: Tong Sim Senior Citizens Care Centre (2019) run by NGOs in Malaysia

By 2030 Malaysia will be categorised as an ageing nation, with older people comprising 13.6 percent of its population. This rapid growth in the ageing population has led to a rise in the number of older people relocating from the domestic home to institutional care homes.

As illustrated in Figure 1 above, the conditions in which older people live

in Malaysian residential care homes (RCHs) can leave a lot to be desired.

It is clear that a growing demand for residential care homes in Malaysia is occurring at a time when a lack of understanding is evident regarding the necessary quality of the care environment.

#### We aim to:

- 1) Gain in-depth knowledge and understanding of the care environment in Malaysian RCHs from the perspectives of older people and staff/care workers; and
- 2) Identify factors (both physical and social) contributing positively to a good care environment.

This study is investigating RCHs across different settings in Malaysia, including the public, private and Non-Government Organisations (NGOs) sectors, in the hope of improving the quality of care for older people.





## Parents and Teachers Affects a Child's Emotional Development



### Elaine Yong

Lecturer  
MSoc.Sc. in Human Development,  
BA (Hons) Psychology

#### Research interests:

1. Socio-emotional Development of Children
2. Parenting Practices
3. Educational Technology

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The home is essential for a child's emotional development. Parents who are emotionally responsiveness are more open to discussing and reasoning with their children; hence their children often display greater self-esteem and life-satisfaction.

On the other hand, parents who are strict and practices high levels of demandingness are more likely to have children who grow up with higher risk of reporting mental health issues such as depression, anxiety or stress. Additionally, when a family often have their meals together, the children report closer family ties and healthier family functioning.

Teachers are the next most influential people in a child's life. Relationships with instructors influences the motivation and learning experiences. My research findings demonstrate that students who are more connected with their instructors report higher intrinsic motivation, value their learning tasks and profess greater self-efficacy.

On the other hand, when students perceive their instructors anxiously, their exam performance is affected by test anxiety.

## Health & Well-being



### Dr Elizaveta Berezina

Senior Lecturer  
PhD

#### Research interests:

1. Behaviour change
2. Well-being
3. Quality of life
4. Health behaviour
5. Personality

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Mental and physical health are key factors that define the quality of life and life satisfaction. With increasing wealth across South East Asia, there has been a corresponding rise in health impairing behaviours such as tobacco use, unhealthy diets, inadequate physical activity that appear to cause approximately 60% of deaths in the region (Dans et al., 2011). Research in other countries has shown that there are clear links between these factors and unhealthy ageing and mortality (e.g. Ariyo et al., 2000; De Groot et al., 2004; Singh, & Siahpush, 2002; Warren et al., 2010), but there is little data available about the frequency of such behaviours in Malaysia and their relationships to health outcomes.

My research focuses on the relationships between social factors (like identity, social support, life engagement), personality, health related behaviours, and well-being that shows how it may be possible to promote well-being and minimise the factors leading to poor health outcomes and reduced well-being.

## A Glimpse inside the Secret of Success in Diabetes Blood Glucose Control from the Psychosocial Perspectives



### Dr Grace Yap Chin Choo

Lecturer  
PhD, MEd., BA

#### Research interests:

1. Health Psychology
2. Personality
3. Quality of Life
4. Altruistic Behaviours

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Type II diabetes is a metabolic disorder and a growing health concern worldwide. Asia is emerging as the “diabetes epicentre” nowadays. Despite diabetes management places a huge responsibility on the patients, existing studies have neglected the importance of how psychological factors play their role in the well-being of diabetic individuals particularly in Malaysia. Thus, it is of the researcher’s interest to distinguish the psychosocial factors that differentiate the good from the poor blood normalisation among diabetic individuals. Psychological factors such as personal attributes, emotion regulations, social supports, and health literacy against HbA1c were accessed among 181 Type II diabetic individuals in Malaysia.

Results indicated that diabetic individuals with good blood glucose control tend to exhibit higher self-efficacy, internal control, problem-solving skill, optimism and perceived social support while diabetic individuals with poor blood glucose control tend to experience stronger depressed feelings, anxiety and distress. Overall, diabetic individuals who achieved good blood normalization tend to show better psychosocial well-being.

Therefore, healthcare services for diabetic patients should include the psychological health component by educating them to regulate and achieve desired glucose level which may help in preventing other physiological and psychological complications.

## Public Health: Sexual and Reproductive Health in the Young Generation



### Jacqueline Gun Chin Hun

Senior Lecturer  
Masters in Counselling, BSc

#### Research interests:

1. Sexual and reproductive health
2. Smartphone use and quality of relationships
3. Well-being of working mothers

#### Contact details:

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In recent years, sexual health issues have received a great deal of research attention. Studies conducted in Malaysia revealed a high prevalence of sexual activities and a lack of sexual knowledge among the young population which can pose serious societal problems.

My research interests include family sex communication and both risky and safe-sex behaviour in young adults. These studies are part of sexual and reproductive health which lends information to enhance the implementation of comprehensive sex education programmes to empower the youth on their sexual rights.



**Dr John Jamir Benzon R. Aruta**  
Senior Lecturer  
PhD in Counseling Psychology  
MA in Guidance and Counseling  
BSc in Psychology

**Research interests:**

1. Environmental Psychology
2. Climate change
3. Mental health
4. Counselling

**Contact details:**

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## Climate Change and Mental Health in the Philippines: Experiences of the Youth

The Philippines is known as one of the countrys most at risk to the consequences of climate change, despite its minimal contribution to greenhouse gas emissions. Consequently, the young people in the country were found to be the most climate anxious in the world. Therefore, this research program aims to understand the factors that contribute to the vulnerability of Filipino youth to the inimical effects of climate change on their mental health.

This research program actively examines large-scale data and narratives from Filipino youth to understand how their emotional experiences with climate change can be harnessed to motivate climate action as well as find ways to provide psychological assistance to those who experience severe reactions to extreme climate events.



**Dr Lee Ai-Suan**  
Lecturer  
PhD in Psychology

**Research interests:**

1. Cross-cultural face and body perception
2. Body image, food choice and eating behaviour
3. Linguistic relativity

**Contact details:**

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## Investigating Cross-Cultural Perceptual Differences in Face Processing

Faces provide a significant amount of information for social settings such as health, attractiveness, trustworthiness etc. In recent years, research has shown that people from different cultural backgrounds use different strategies for looking at and recognising faces.

Using eye-tracking methods, I explore the factors underlying face recognition, and if people use similar looking strategies to perceive cues to health and attractiveness vs. cues to facial recognition.

Recent projects also include examining the effect of face masks on face and emotion recognition.

My research interests can be summarised into these questions:

- To what extent does cultural background influence visual perception?
- Do people use different looking strategies to recognise faces compared to when rating faces for health and attractiveness?
- How does individuals' body image perception influence their food choice and eating behaviour, and vice versa?



Examining the effect of face masks on face recognition



Examining the effect of face masks on emotion recognition



**Dr Lin Mei-Hua**

Associate Professor  
Associate Dean (Employability and Engagement)  
Programme Leader, PhD in Psychology  
PhD in Human Factors and Industrial/Organizational Psychology

**Research interests:**

1. Employee empowerment and health (i.e. well-being, work design & practices)
2. Trust and Distrust in the workplace
3. Teamwork/Group
4. Cultural differences in work behaviours

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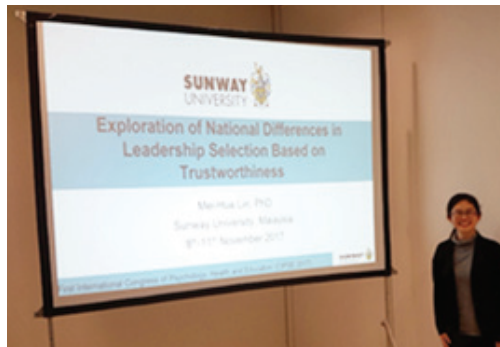
## Understanding Trust and Distrust Across Contexts

Trust is a critical driver of human behaviour in both work and interpersonal interactions. While less is understood about distrust/mistrust, both trust and distrust/mistrust can have positive and negative impact in the workplace, affecting not only the work effectiveness and work relationships but ultimately the well-being of the employees and the overall organisational health. Hence, understanding the antecedents (i.e. trustworthiness, personality, leadership) and the consequences of trust and distrust are essential across various contexts. My research

had examined trust and distrust in teamwork, workplace, and across different cultures. It has been found that

- 1) trust and distrust relationship is complex with different antecedents and outcomes;
- 2) trust and distrust relationship vary across personal, team, and organization contexts;
- 3) trust and distrust impact work outcomes through teamwork processes such as team communication and commitment;

- 4) social and cultural cognition affects trust development and context plays a critical role, and;
- 5) there are national differences in preference for trustworthiness of leaders during leadership selection. Ultimately, this body of knowledge could facilitate trust development during multinational collaborations, facilitating a trust climate in organisations, improving work relationship, and wellness in the workplace.



Dr Lin presenting the findings at the 1st International Congress of Psychology, Health and Education



Dr Lin presenting the findings from her AOARD-funded research project



**Dr Wo Su Woan**

Lecturer  
Programme Leader, MSc in Psychology  
PhD

**Research interests:**

1. Developmental screening test for children
2. Inclusive education in Malaysia
3. Development of questionnaire and its psychometric properties

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## Inclusive Education in Malaysia

Education is the most important factor for persons with disabilities in attaining a better quality of life. Malaysia Education Blueprint 2013-2025 redefined inclusive education program as “an educational program for a pupil with special education need (SEN) which is attended by a pupil with SEN together with other pupils in the same class.” This was further strengthened with the “Zero Reject Policy” implemented in 2019. At present, all mainstream schools are given funding and support to create an inclusive and learning-friendly environment to all children. While some SEN children benefited from inclusiveness at school, most of the parents have negative attitude

towards inclusive education. Using qualitative approach, research showed that the negative attitude was due to parent’s negative experiences (eg. School rejection), lack of resources (eg. Teacher with SEN knowledge), lack of community awareness (eg. discrimination) and lack of social integration (eg peer rejection in school). Parental attitudes towards inclusive education have a significant impact on current education policy, future program planning and funding decisions. Cooperation from parents will help to promote and facilitate a stronger social integration framework for SEN children.

## Risk and Protective Factors of Suicidal Ideation among Adolescents in Malaysia



### Dr Wu Shin Ling

Senior Lecturer  
PhD (Psychology of Child  
Development)

### Research interests:

1. Suicidal phenomena
2. Child and adolescent mental health issues
3. Environment and well-being

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Suicide phenomenon has become the leading cause of death worldwide especially among adolescents. In Malaysia, suicide cases are increasing rapidly yet little research has been done especially among the general population due to the sensitivity of this topic. Therefore, the current study investigated the risk and

protective factors of suicidal ideation among adolescents in Selangor, Malaysia. A total of 682 school-going adolescents aged 14 - 17 were recruited using a multistage cluster sampling technique. The Positive and Negative Suicide Ideation Inventory, Network of Relationships Inventory - Relationship Quality Version, Children's Hope Scale, Perceived Stress Scale, General Self-efficacy Scale, and Satisfaction with Life Scale were

used to measure suicidal ideation, parental and peer relationships, hope, stress, self-efficacy and life satisfaction respectively. Overall, slightly more than half of the respondents reported having some sort of suicidal thoughts. This study found that all the study variables were significantly correlated with suicidal ideation.

Moreover, stress, negative paternal and peer relationships were found to be the risk factors that predict adolescents' suicidal ideation.

Meanwhile, life satisfaction was the only protective factor that predicts adolescents' suicidal ideation. Thus, to curb suicidal issues, implications should include providing adolescents with stress management and social skill, as well as improving their satisfaction in life.



Credit: asy/surv/Shutterstock.com

## **AGEING, HEALTH AND WELL-BEING RESEARCH CENTRE**

## AGEWELL: Understanding The Effects of Ageing and Socioeconomic Condition on Mental Health.



### Prof Alexandre Schaefer

Professor  
Head, Ageing, Health and Well-being Research Centre  
PhD in Psychology  
MSc in Psychology  
BA in Psychology

### Research interests:

1. Human Emotions and Its Disorders
2. Decision-making & Neuroeconomics
3. Socioeconomic Determinants of Mental Health
4. Healthy Ageing
5. Research Methods in Social and Behavioral Sciences

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My main expertise is in the field of human emotions and their relationships with cognitive processes using methods from both psychology and neuroscience. The promise of this field of research is to contribute towards a better understanding of mental health disorders linked to a dysfunction of emotions (e.g. depression and anxiety disorders). In recent years, I have also developed an interest in understanding how socioeconomic factors affect mental health and the process of ageing, with a particular focus on populations from developing countries. Within this context, I lead the Ageing, Health and Well-being center at Sunway University. This work has a particular focus on senior citizens from low-income communities in the greater Kuala Lumpur area, and it happens within the framework of the AGEWELL cohort, a diverse sample of senior citizens linked to Sunway University.



Dementia Screening in the local community



EEG testing

## AGEWELL: Evidence-based interventions to delay ageing-related decline.

Sunway University's AGEWELL is a longitudinal project aiming to find out the optimal combination of life conditions that predicts positive multidimensional (i.e. neural, psychological, biological and economic) ageing outcomes in a sample of senior citizens from the larger Kuala Lumpur metropolitan area in Malaysia.

I lead the neuroscientific aspects of the project, namely the collection and analysis of electroencephalographic (EEG) and structural magnetic

resonance imaging (sMRI) data from senior citizens. The combination of these neuroimaging methods enables strong insight into how certain structures and functions of the brain alter as we age. Simultaneously, I am personally invested in uncovering mechanisms underlying cognition in older age, and utilises an analytical method known as 'computational modelling' to disentangle latent features underlying complex functions.



### Dr Aleya Aziz Marzuki

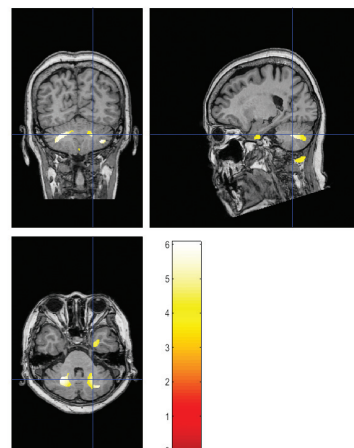
Postdoctoral Research Fellow  
PhD in Psychology (Specialising in Computational Psychiatry)  
BSc in Psychology

### Research interests:

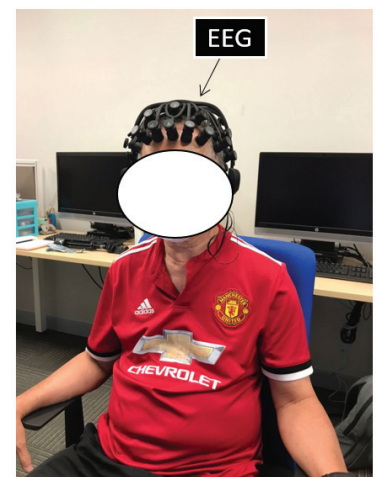
1. Cognition
2. Psychiatry and Mental Health
3. Learning and Decision-making
4. Computational Modelling and Machine Learning

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Data from AGEWELL project showing brain regions found to have less grey matter



Participant wearing an EEG cap

## AGEWELL: Investigating how lifestyle choices affect successful ageing – The role of SES and cognitive functioning on mental health



### Dr Chan Jee Kei

Postdoctoral Research Fellow  
DBA, PhD (in progress)

### Research interests:

1. Socioeconomic Status/  
Condition
2. Ageing
3. Memory
4. Cognition

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One of the objectives of AGEWELL - a longitudinal multi-dimensional project, is to find out the underlying mechanisms behind the linkage between ageing and mental wellbeing (i.e., depression and anxiety), using a well-balanced stratified sample, in term of gender, ethnicity, recruited from metropolitan areas in Klang Valley.

As part of the larger project, my interest lies in the potential mediating

roles played by SES (i.e., education, income, lifestyles etc.) and cognitive functioning (i.e., working memory, planning, abstraction, cognitive flexibility etc.) in the relationship between ageing and mental health.

Various cognitive assessment tools have been used in this project, including Tower of London, 2-Back, EEG etc. With this multi-approach, we hope to provide deeper insights to the ageing literature.



Recruitment session



EEG session







Credit: Numstocker/Shutterstock.com

Centre for  
**VIRUS & VACCINE  
RESEARCH**

## Development of Novel Vaccines and Antiviral Agents against RNA Viruses



### Prof. Dr Poh Chit Laa

Distinguished Professor  
Head, Centre for Virus & Vaccine Research  
PhD, BSc (Hons)

#### Research interests:

1. Development of antivirals and vaccines against RNA viruses
2. Molecular mechanisms of natural compounds and peptides with antiviral properties.
3. Insights into evolution of viral RNA genomes
4. Development of novel vaccine platforms (peptide-, recombinant-peptide-, DNA- and VLP-based) against EV-A71, dengue and SARSCo-V-2.

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Development of novel vaccines and antiviral agents against Enterovirus 71 (EV-A71), dengue virus, influenza virus and SARSCo-V-2.

I also want to gain insights into evolution of RNA viral genomes and understanding viral pathogenesis as well as the host immune responses. This encompasses in vitro and in vivo studies.

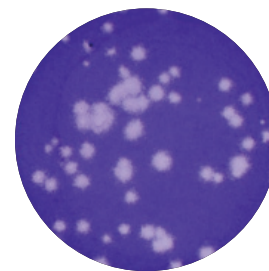
I have determined the molecular mechanisms of natural compounds such as flavonoids and synthetic peptides on the infectivity of EV-A71 and dengue viruses.

I also developed a new vaccine platforms for the design of epitope-based synthetic peptide and VLP-based vaccines against Dengue virus, Influenza virus and SARSCo-V-2 as well as nanoparticle vaccines will be developed. Nanotechnology for the delivery of DNA and peptide-based vaccines as well as antiviral peptides for the prevention and treatment of viral infections is another promising area of research.

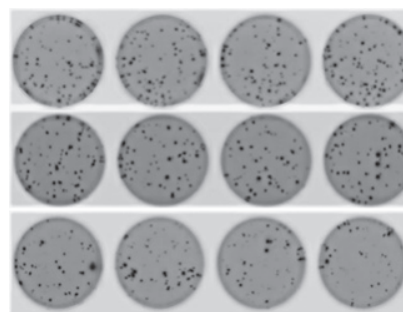
The high costs associated with the manufacturing of monoclonal antibodies against dengue necessitates construction of multivalent DNA plasmids to express

optimal B-cell epitopes that will elicit cross-protecting antibodies.

As such, the CVWR group is interested in developing multi-epitope vaccines, which are a promising strategy against viral infections and tumours. Bioinformatic predictions and selections of optimal B- and T-cell epitopes which are validated in small animals are essential to construct effective multi-epitope vaccines.



Different plaque sizes of wild type EV-A71 indicating quasispecies.



EliSpot analysis of Interferon gamma secreted by splenocytes in response to peptide-based vaccine against SARSCo-V-2.

## Development of Vaccines against Dengue and SARS-CoV-2 Viruses



### Dr Lim Hui Xuan

Research Fellow  
PhD

#### Research interests:

1. Vaccinology
2. Innate immunity
3. Adaptive immunity

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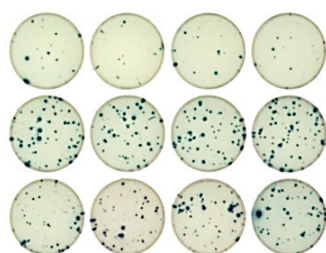
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My studies aim to gain insights into the adaptive immune responses against dengue and SARS-CoV-2 viruses.

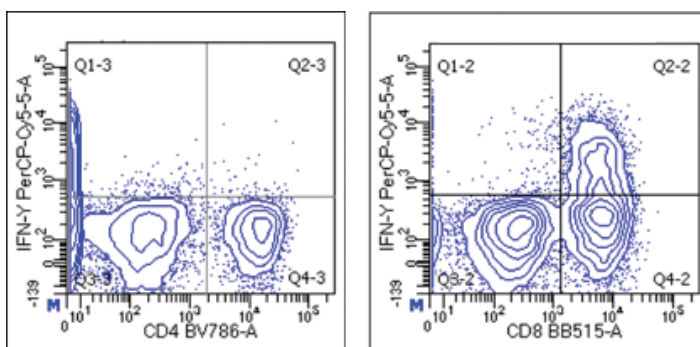
Dengue is currently rated as the most important arbovirus disease worldwide. Studies are conducted to find the CD4<sup>+</sup>, CD8<sup>+</sup> and B cell epitopes to elicit optimal humoral and cellular responses, which could be beneficial for designing a multi-epitope vaccine construct. Additionally, the potential adjuvants in maximizing the T cell responses will be investigated in mice.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has caused a global public health crisis.

COVID-19 vaccines developed by Pfizer-BioNTech, Moderna and Astra Zeneca have been authorized by the US FDA or EMA for emergency use. In view of the emergence of new SARS-CoV-2 variants, vaccines developed against the Wuhan strain were less effective against variants. My study focuses on the identification of highly conserved B- and T-cell epitopes to develop a multi-epitope peptide-based vaccine which can confer effective protection against SARS-CoV-2 variants.



ELISpot analysis of IFN- $\gamma$  secretion in murine splenocytes.



IFN- $\gamma$  expression by CD4<sup>+</sup> and CD8<sup>+</sup> T cells in murine splenocytes.

## Development of Novel Peptides and Natural Compounds against Dengue and Enterovirus-A71



**Dr Noraini Abd Aziz**  
Research Fellow  
PhD, MSc, BSc (Hons)

### Research interests:

1. Antiviral agents against viral diseases caused by RNA viruses
2. Mechanisms of action of antivirals

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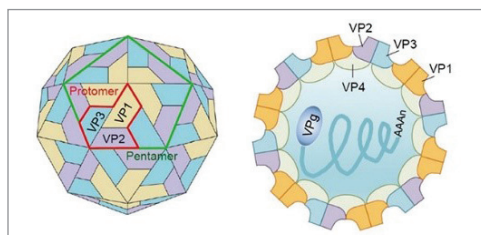
Dengue has put almost half of the world's population at risk as the disease is endemic over 100 countries. Over the last few decades, dengue has become one of the major public health challenges especially in tropical and subtropical countries. Approximately 390 million people are infected yearly, with 500,000 hospitalizations and 25,000 deaths.

Besides Dengue virus, RNA viruses of significant medical importance in Asia are Enteroviruses. Enterovirus 71 (EV-A71) is one of the major etiological agents involved in Hand,

Foot and Mouth Disease (HFMD). HFMD caused by some strains of EV-A71 have been demonstrated to associate with fatal complications including neurological manifestations and pulmonary edema. Millions of infants and children have been reported to suffer from this disease every year.

To date, synthetic peptides and natural compounds have been reported to exhibit antiviral effects and these have emerged as promising therapeutic agents to inhibit virus infections. However, none has been

approved by the FDA due to limited *in vivo* efficacy of antivirals and this highlights the urgency to develop effective therapeutics strategy to treat Dengue and EV-A71 in humans. Thus, the main focus of my research is to develop novel antiviral agents against Dengue and EV-A71. The work will contribute to the understanding of the mechanisms of action of potential antiviral peptides and natural compounds which could be developed as therapeutics against Dengue and EV-A71



Structure of EV-A71 virion



Clinical symptom of HFMD

## Identification of Molecular Targets and Associated Molecular Mechanisms as Anticancer and Antiviral Agents and Application of Aptamer-based



**Dr Wu Yuan Seng**  
Lecturer  
PhD (Pharmacology)

### Research interests:

1. Molecular pharmacology
2. Molecular biochemistry
3. Cancer pharmacology and therapeutics
4. Drug discovery for cancer, viruses and metabolic diseases
5. Pharmacognosy

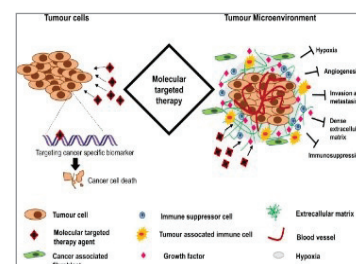
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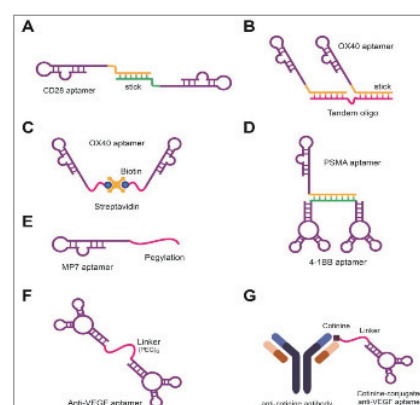
Molecular targeted therapies are revolutionary therapeutics that identify specific molecules and understand their associated molecular mechanism(s) in the pathogenesis of different diseases, followed by interfering with specific molecules to inhibit their biological and regulatory roles. However, their clinical therapeutic outcome is mostly unpromising due to low bioavailability. Aptamers are single-stranded oligonucleotides that specifically bind and interact with their corresponding targets, including proteins and cells, through unique three-dimensional structures. Numerous aptamers have been developed to target their specific molecules with high specificity and affinity, and some are employed as versatile guiding ligands for cancer and virus-specific drug delivery, as well as anticancer and antiviral therapeutics.

My research interests lie in searching for molecular targets as potential anticancer and antiviral agents and understanding their associated molecular mechanism(s), as well as developing efficient drug delivery or targeting system to

cancer cells or virus-infected cells. I am also interested in searching and evaluating phytochemicals and peptide-based therapeutics or combination treatment as potential anticancer and antiviral agents and understanding associated molecular mechanisms, followed by applying aptamer-based treatment.



An example of molecular targeted therapy in cancer



Aptamers used as agonists and antagonists against cancer biomarkers





Image by istux from Pixabay

Research Centre for  
**CRYSTALLINE MATERIALS**



**Dr Edward R.T. Tiekink**  
Distinguished Professor  
Head, Research Centre for  
Crystalline Materials  
D.Sc.(Melb), PhD, BSc (Hons)

**Research interests:**

1. Supramolecular chemistry
2. Non-covalent interactions
3. Co-crystal technology
4. Functional coordination polymers
5. Metal-based drugs

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## Designing Crystals for Practical Applications Developing Metal-based Pharmaceuticals

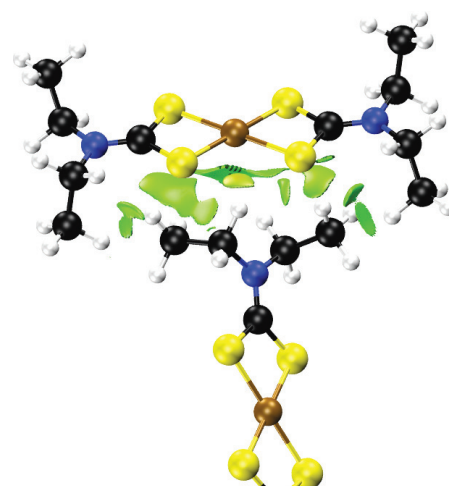
The understanding of the forces that hold molecules together in crystals is a fundamental endeavour of contemporary science. The identification of non-covalent interactions (e.g. hydrogen-bonding, halogen-bonding, interactions with  $\pi$ -systems, etc.) is based on single crystal X-ray crystallography supported by spectroscopic techniques, thermal characterisation methods as well as computational chemistry, all of which are available

in Sunway University's Research Centre for Crystalline Materials (RCCM). The goal of this research is to identify, quantify, rank and then, control such interactions to construct tailored crystals. The latter is crucial, as the control of the way molecules assemble in crystals leads to an exceptional range of practical applications. Co-crystal technology enables the design of new pharmaceuticals and even the repurposing of old drugs. The design

of hybrid inorganic/organic materials generates framework materials with practical applications in areas as diverse as CO<sub>2</sub> capture and storage, catalysis, bio-remediation, etc. The second focus of research in the RCCM is conducted with colleagues in the Department of Biological Sciences and elsewhere. There is a practical emphasis of this research as well: the design of novel metal based pharmaceuticals.



Single-crystal X-ray diffractometer in the RCCM



Understanding weak intermolecular interactions.



**Dr Annie Lee See Mun**  
Associate Professor  
PhD, MSc, BSc (Hons)

**Research interests:**

1. Metal-based drugs
2. Co-crystallization
3. Metallomesogens
4. Drug delivery
5. Analytical chemistry

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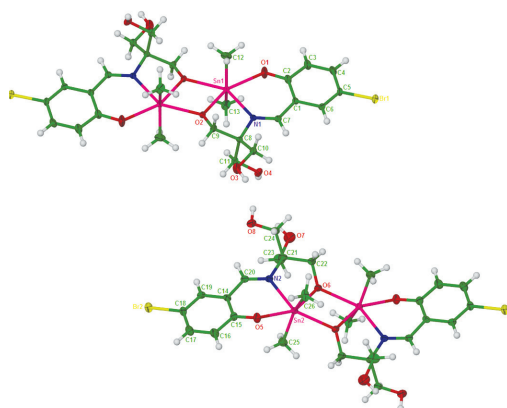
## Structural Studies, Biological Activities and Encapsulation Studies of Metal-based Drugs

In recent years, interest in main-group metals, transition metals and organometallic complexes with multidentate ligands has increased due to its versatility in a wide range of applications. The choice of coordinated ligand is crucial for the biological effects of the complexes in terms of solubility and bioavailability. The presence of selected functional groups and bonds is capable to obstruct enzyme activities. Moreover,

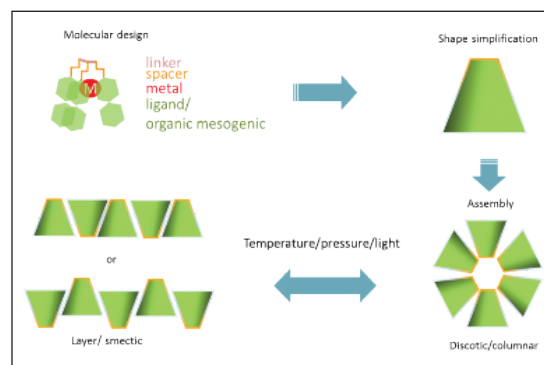
this could enhance the biological activities by the influence of structural factors, such as solubility, dipole moment and cell permeability.

Although metal complexes have the potential to be chemotherapeutic drugs, they might be non-selective towards targeted delivery sites, which leads to the severe side effects similar to common anticancer and antibacterial drugs. A widespread strategy to reduce

these unwanted side effects is the encapsulation of the drug using selective carriers. I hope to make a significant contribution in the drug delivery systems. Besides this, co-crystallization is a process by which the molecular interactions can be altered to optimize drug properties. I hope my studies can lead to the development of new drug products with improved physicochemical properties.



Molecular structure of organometallic complexes



Applications in molecular materials

## Dengue Therapeutics: In search of the magic bullet



**Dr Alan Tan Sang Loon**  
Senior Research Fellow  
PhD

### Research interests:

1. Antidengue therapeutics
2. Co-crystallization
3. Computational chemistry
4. Structure-activity relationship

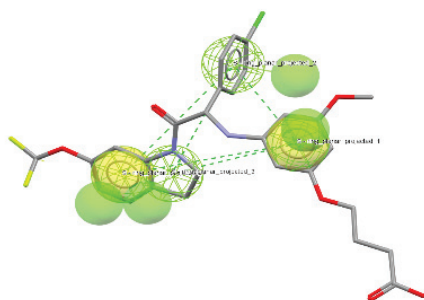
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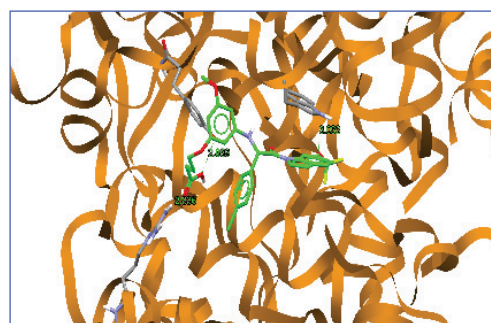
Dengue fever is one of the most dangerous viral borne diseases with more than 40% of the world's population is at risk of the infection. Despite the number of cases continue on the rise, there is no known effective vaccine or therapeutic drugs available to cure the disease. Therefore, the search of a magic bullet for dengue treatment continues to be one of the main agendas in drug discovery worldwide.

My primary research focus is to develop effective anti-dengue therapeutic agents through computer

aided drug design (CADD) by pharmacophore modelling, in silico molecular docking, virtual screening and molecular dynamics. The CADD approach is based on knowledge finding and rational design of drug ligand that serve to improve the efficiency and likelihood of success over the conventional serendipitous method. I also have broad interest in improving bioavailability of drugs through formation of co-crystals. The research is aimed to contribute to the good health and well-being for mankind under the sustainable development goals.



3D pharmacophore model generated for a potential antidengue agent.



In silico molecular docking of a potentially active compound in the RNA-dependent RNA-polymerase of dengue virus

## Coinage Metal(I) Thiolates: Interaction Studies and Biological Evaluation



**Dr Ally Yeo Chien Ing**  
Senior Research Fellow  
PhD in Inorganic Chemistry  
BSc (Hons) in Chemistry

### Research interests:

1. Luminescent study of coinage metal(I) complexes
2. Biological evaluation of coinage metal(I) thiolates
3. Delineation of weak interactions via NMR approach

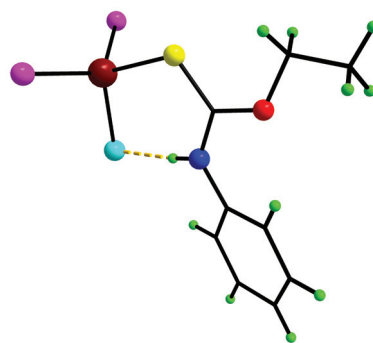
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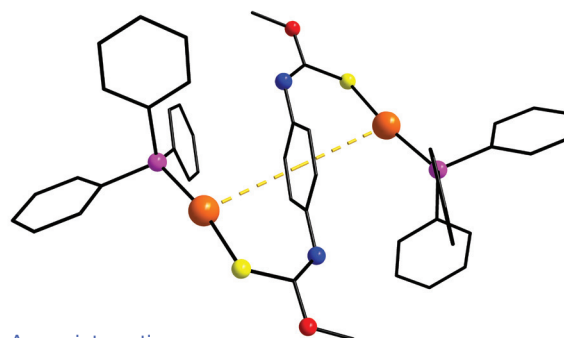
Current research focuses on, but not limited to, coinage metal(I) thiolates. Main interest to delve into the interactions involved in the crystal formation, via multi-nuclear solution and solid-state NMR studies. The changes in chemical and/or physical properties arise owing to the presence of interactions such as gold(I)-gold(I) interaction being one of the main reasons for current research interest.

Thiolate molecules, e.g. thiocarbamate and dithiocarbamates, are found to be biologically active; they have presented great potential to be developed to replace drugs that have currently shown resistance to diseases.

The compounds prepared will be screened for antimicrobial and anticancer activities, as part of the effort in discovering highly potent metal-based drugs, in support with Sustainable Development Goal 3: Good health and well-being.



Quasi chelate ring, {CuCl...HNCS}



Au...π interactions





**Dr Tan Yee Seng**

Senior Research Fellow  
PhD,  
BSc (Hons)

**Research interests:**

1. Crystal Engineering
2. Flexible Porous Coordination Polymer (PCP)/ Metal-Organic Frameworks (MOFs)
3. Crystal Transformation

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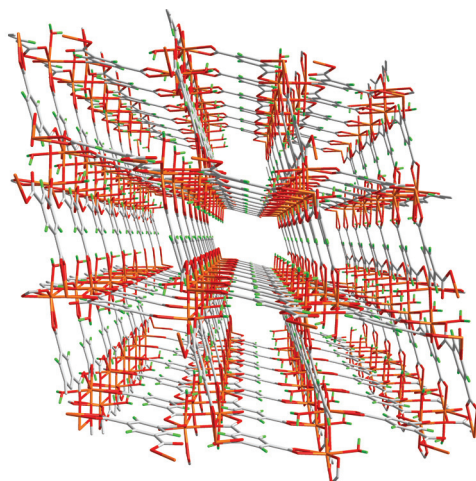
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## Flexible Porous Coordination Polymer {PCP} Metal-Organic Frameworks {MOFs}

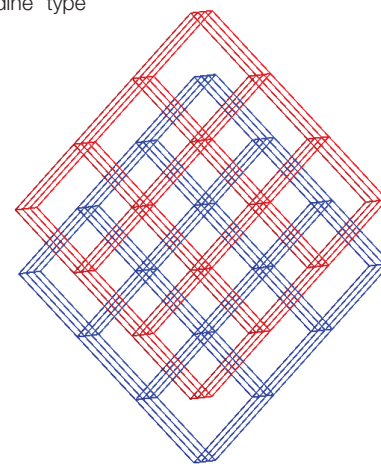
Flexible Porous Coordination Polymer (PCP)/Metal-Organic Frameworks (MOFs) is a class of unique porous material as compared to the traditional first- and second-generation PCP/MOFs. The uniqueness is due to the flexibility which allows changes in porosity properties such as shrinking or expanding, pores shape etc. The external stimulating factors which cause the changes include temperature, pressure,

guest molecule saturation and photo irradiation, to name a few. The flexibility further boosts the application value of this materials in various fields such as sustainability (CO<sub>2</sub> capture, energy (H<sub>2</sub>) storage, catalysis, separation/purification, etc.), industrial (detection probe, conductivity etc.). My current research focus on the synthesis of novel flexible PCP/MOFs by using various d<sup>10</sup> metal ion, multitopic carboxylic acid, and pyridine type

linker. The synthesized compound will be subjected for various spectroscopic and materials analysis including SCXRD, PXRD, NMR, TGA, DSC, FTIR, UV-Vis, and others. Ultimately, the application of this material especially in gas sorption, temperature dependent transformation, photo-reactivity, and fluorescence property will be explored.



Porous Coordination Polymer/Metal-Organic Framework



Double Interpenetrated Framework with Potential Flexibility

Owned and governed by the Jeffrey Cheah Foundation   
*Nurturing the Seeds of Wisdom*

All information is correct at the time of printing (September 2022)