Faculty of Engineering

Dean of Engineering
Professor Ian Harrison
ian.harrison@nottingham.edu.my

Heads of Research Division

Electronics, communications and intelligent mathematical techniques
Professor Dino Isa
dino.isa@nottingham.edu.my

Energy, fuel and power technology
Professor Prabaharan Sahaya
prabaharan.sahaya@nottingham.edu.my

Environment
Dr Dominic Foo
dominic.foo@nottingham.edu.my

Manufacturing and industrial processes
Dr Sivakumar Manickam
sivakumar.manickam@nottingham.edu.my

Materials, mechanics and structures
Dr Amir Nassirharand
amir.nassirharand@nottingham.edu.my

Director of Research
Professor Andrew Chan
andy.chan@nottingham.edu.my

Director of Studies of Teaching Departments

Applied Mathematics
Dr Rohaizan Osman
rohaizan.osman@nottingham.edu.my

Chemical and Environmental Engineering
Dr Tony Wilson
tony.wilson@nottingham.edu.my

Civil Engineering
Professor Andrew Chan
andy.chan@nottingham.edu.my

Electrical and electronic engineering
Professor Ian Harrison
ian.harrison@nottingham.edu.my

Foundation studies
Mr Terence Wong
terence.wong@nottingham.edu.my

Mechanical, material and manufacturing engineering
Dr Andrew Spowage
andrew.spowage@nottingham.edu.my

Contact us

Any enquiries about our research programmes, collaboration and activities can be addressed to any of us above or to:

Faculty of Engineering
University of Nottingham Malaysia Campus
Jalan Broga, Semenyih 43500
Selangor Darul Ehsan
Malaysia

www.nottingham.edu.my/engineering/research

engineering.research@nottingham.edu.my
Dean’s Message

“The Malaysia Campus of the University of Nottingham aims to recruit, inspire and deliver highly skilled graduates and post graduates to both the domestic and international labour markets. These graduates will take a leading role in the development of the next generation of technological advances. To further this aim we have a long term vision of investing in our people and research infrastructure to develop our core research themes discussed in this brochure.”
Why Nottingham Malaysia?

We are a world-class university, enough said.
And as a world-class university, we deliver quality.

The University of Nottingham is internationally renowned for its ground-breaking research, and continually attracts world-class academics and the best students. The Malaysia Campus, in spite of our fledgling being, is highly successful in attracting research funding from industry and government alike.

Our research students, who are at the heart of our research culture, play an important role in contributing and maintain momentum in all our research projects across the faculty.

Our quality in research is reflected in our research assessment, which is conducted in conjunction with the United Kingdom (UK) campus. The Research Assessment Exercise (RAE) of 2008 places the University of Nottingham amongst Britain’s leading universities, and the Malaysia Campus plays a key role in enhancing this name. The University of Nottingham is a research-led university and we are committed to retain this status as a leading research university, both in the UK and in Malaysia.

As in the UK Campus, the Faculty itself is a vibrant, challenging and supportive environment conducive to world-class research achievements. We provide all the necessary support, facilities, equipment and infrastructures and policy for research matters. Most importantly, we regard research as our flagship priority that we shall carry.

Delivering the next generation of world-changing research – The Nottingham Malaysia Experience

The University of Nottingham is internationally recognised for its world-changing and award-winning research. Our academics won two Nobel Prizes in 2003 and the Shaw Prize in 2008.

Our ground-breaking research has consistently place Nottingham amongst the top elites in the international arena of academics. Research excellence is the core mission of the University of Nottingham, and the Malaysia Campus honours this mission by conducting world-class research activities in the region. Research is simply the flagship undertaking of the Faculty of Engineering, University of Nottingham, Malaysia Campus.

Our research strength is reflected in our tremendous success in attracting considerable local research funding and industry collaboration since our arrival at the Semenyih campus in 2005. We have also won a significant number of international research awards and honours as we took off. Moreover we have invested heavily in our research infrastructure for the past few years to nurture our next generation of researchers, to ensure that our research success sustain and escalate further.

Our modest aim is simply to become the regional leader in our areas of expertise, and with our quality research deliverables we wish to serve and change the world to a better environment. The fact that you are reading this suggests that you are attracted to our proposition. We invite you, as prospective research student or industry collaborator, to join our mission, embark on this exciting and meaningful journey and be part of our success story.

Professor Andrew Chan
Director of Research
Research division

We are now well positioned and better focussed to identify new collaboration and investment opportunities and react efficiently and responsively to emerging global multi-disciplinary challenges.

Following the strategies of the UK Campus, research is organised cross-disciplinarily across the various academic departments. This fundamental change to the traditional departmental structure was made to integrate the faculty better in terms of research. We broke down traditional academic ‘walls’ to enhance multi-disciplinary research and the results are the five main research divisions:

- Electronics, communication and intelligent mathematical techniques
- Energy, fuel and power technology
- Environment
- Manufacturing and industrial processes
- Materials, mechanics and structures

Each division comprises of staff members from different academic departments and this creates an exciting forum of synergy from various expertise, experience, knowledge and perspectives. Most importantly this division moves away from traditional demarcation and reflects the modern day perspective on research areas, industry needs and societal concerns. We are now well positioned and better focussed to identify new collaboration and investment opportunities and react efficiently and responsively to emerging global multi-disciplinary challenges.

How these divisions cut across the Faculty is illustrated below.
Electronics, Communications and Intelligent Mathematical Techniques
- Applied electromagnetic and communication
- Applied mathematics
- Intelligent systems
- Visual information engineering

Energy, Fuel and Power Technology
- Advanced power sources and electrical energy storage systems
- Internal combustion engines
- Power electronics, machines and control
- Renewable energy

Environment
- Fuels and sustainability
- Sustainable process integration
- Urban climate and pollution
- Water and wastewater treatment

Manufacturing and industrial processes
- Engineering management
- Food and pharmaceutical engineering
- Mechatronics
- Nanotechnology

Materials, mechanics and structures
- Advanced materials
- Bioengineering
- Geomechanics
- Polymer composites
- Structural integrity and dynamics

- Division head: Prof Dino Isa
- Intelligent systems group
  - Dr Roselina Arelhi
  - Prof Dino Isa
  - Mr Lim Chie Haw
  - Mr Rajprasad Rajkumar
- Applied electromagnetic and communication group
  - Dr Khalid Al-Murrani
  - Ms Gnanam Gnanagurunathan
  - Prof Ian Harrison
  - Dr Lim Wee Gin
  - Dr Amin Malek Mohammadi
  - Ms Belle Ooi
  - Dr Krishnasamy Selvan
  - Dr Teo Lee Peng
  - Mr Terence Wong
- Visual information engineering research group
  - Dr Kenneth Ang
  - Dr Edward Ho
  - Dr Jasmine Seng
  - Mr Anandan Shanmugam
- Applied mathematics group
  - Mr Belrama Applanaidu
  - Ms Hoo Ling Ping
  - Dr Harikrishnan Kanthen
  - Dr Rohaizan Osman
  - Dr Mohamed Rafi Segi Rahmant
  - Ms Thong Lee Fah
  - Dr Toh Sing Poh
  - Ms Grace Yap
Electronics, Communications and Intelligent Mathematical Techniques Research Division

The Division of Electronics, Communications and Intelligent Mathematical Techniques consists of research groups which deal with topics related to electronic communications, applied electromagnetics, applied mathematics, artificial intelligence for pattern recognition and also image processing.

Funded Research Projects

Title: Sahz nano supercapacitor pilot plant
Project leader: Dino Isa
Sponsor: Ministry of Science, Technology and Innovation; Sahz Holdings Sdn. Bhd.

Title: Artificial Intelligence based battery - supercapacitor renewable energy management system for optimized supply-to-load requirement for rural electrification
Project leader: Dino Isa

Title: Pipeline riser defect prediction using Support Vector Machines
Project leader: Dino Isa, Rajprasad Rajkumar
Sponsor: Ministry of Science, Technology and Innovation
Non-destructive testing Lab with long range ultrasonic testing capability and pipeline simulation rig.

Title: SmartVehicle system to protect drivers and motor cyclists on Malaysian roads
Project leader: Dino Isa
Sponsor: Ministry of Science, Technology and Innovation

Intelligent Systems Research Group (ISRG)

The common thread in the research activities of this group is the use of intelligent systems for pattern recognition and machine learning in order to predict an outcome and/or decide on a suitable course of action in engineering and industrial processes. The inference engine used is the Support Vector Machine, a linear classifier with good generalisation capability.

Title: Detection and prediction of lung cancer using the znose with the Support Vector Machine classifier
Project leader: Roselina Arsehi
Sponsor: Ministry of Science, Technology and Innovation

Project Overview

At least 40,000 Malaysians are diagnosed with cancer each year. Although there have been improvements in cancer diagnosis, these new detection methods may cause an exponential increase in the cost of cancer treatment. Therefore we propose a lung cancer detection system which is a hybrid of breath test and case-based reasoning system that incorporates patient models to assist in multivariate analysis in order to make diagnostic decisions inexpensively, accurately and rapidly. An electronic nose or znose is a portable apparatus that will be used to collect breath test samples and analyse them, based on gas chromatography, to detect the presence of volatile organic compounds within 10 seconds. Support Vector Machine, an artificial intelligent technique, will then be used to automatically accomplish the classification task of identifying potential lung cancer patients.

Student profile: Ahmida Ajina (Lebanon)

My research is on the use of statistical Taguchi methods to improve the quality of the manufactured supercapacitor and to optimize the pilot production process. Taguchi techniques are recently applied to biotechnology, marketing and advertising. Analysis of variance (ANOVA) is a method to statistically determine the significance of factors which affect (in our case) the quality (capacity and ESR) and manufacturing yield of the supercapacitor. Process optimisation techniques are used to stabilise pilot plant manufacturing activities with the view of producing a stable and reproducible product which meet customer and industry specifications. Eventually we wish to predict the behaviour of a high volume process by characterising and classifying critical pilot plant processes.

Title: SVM based battery – Super-capacitor energy management system for electric vehicles
Project leader: Dino Isa
Sponsor: Ministry of Science, Technology and Innovation

Project Overview

The only current viable solution to the problem faced by electric vehicles is to combine a high energy storage device such as an electrochemical battery or fuel cell with a high power device such as an Electric Double Layer Capacitor (EDLC) or ultra-capacitor or more often called a super-capacitor. Usually, a bi-directional buck-boost converter executing an energy management control algorithm is used to interface the battery bank and super-capacitor array to the load bus. It is the aim of this project to design an intelligent buck-boost converter with a Support Vector Machine (SVM) based energy management algorithm which will optimize the power flow from the battery pack to the load.
Applied Electromagnetic and Communication Research Group (AECG)

Investigations on high-performance conical horns

A simple and low cost method to improve the performances of the conventional smooth walled conical horn (SWCH) has been proposed by means of integration of a single metal sphere inside the SWCH. This horn offers very good gain, pattern and return loss (VSWR ≤ 2.0) characteristics. Investigations on cone-sphere and dielectric inserted SWCHs are underway to further improve the horn performance.

Investigations on high-performance pyramidal horns

The employment of the above methods towards improving the performance of pyramidal horns is being investigated. Preliminary results have been encouraging.

Fractal antennas

Research has just been initiated in collaboration with the Indian Institute of Science, Bangalore, India with the two main objectives of (1) practical design and development and (2) research-based investigations. The development work will strive to design and realize a fractal-shaped multi-band antenna for given specifications that may possibly find immediate industry application. The theoretical work will investigate the possibility of (1) increasing the number of operational bands by combining several fractal rings/printed loops, and (2) extending the use of fractal geometries to rectangular and triangular patches.

Antenna performance improvement using metamaterials

Extensive research has been taking place the world over on the use of metamaterials to improve the performance of, among other things, antennas. In line with this, the Applied EM Research Group has recently initiated research in this interesting area.

Optical communications (WDM systems)

Various dispersion management methods, particularly the Fiber Bragg Grating (FBG) and Dispersion Compensating Fiber (DCF), are being investigated for WDM system's performance as the modulation scheme and channel spacing are made to vary. Positioning of these dispersion compensating units (DCU) are also being looked into. Focus is also on the non-linear effects encountered in the WDM system. The choice of modulation formats and its consequence on the non-linear effects are being looked into.

Research carried out in modeling and analysis of a method to improve receiver sensitivity of the Absolute Polar Duty Cycle Division Multiplexing (AP-DCDM) transmission system by using Dual-Drive Mach–Zehnder–Modulator (DD–MZM). It is found that by optimizing the bias voltage in DD–MZM, the sensitivity of the AP-DCDM can be improved. The optimizations lead towards the larger eye opening.

AP-DCDM over WDM for High Speed Optical Fiber Communication Systems

Visual Information Engineering Research Group (VIER)

Visual Information Engineering Research (VIER) explores the various aspects of visual information systems. The research has multidisciplinary foundations, including visual, image and video processing, information theory, coding and compression and engineering of real-time systems. Some of our current projects are in the areas of biometrics and audio-visual systems, automotive vision systems, medical image processing, medical image instrumentation, embedded systems design, wireless and vision sensor networks, and practical applications of visual and information systems for society.

Research on biometrics and audio-visual systems aims to develop intelligent biometric, multi-biometric and audio-visual systems. One project is audio-visual authentication or recognition system over IP. Another project aims to develop real-time multi-biometric systems e.g. face-finger, face-speech, face-fingerprint. Other projects are audio-visual speech recognition, automatic 3D model-based face recognition, etc.

Research on automotive vision systems aims to develop advanced vision systems for driver assistance and safety applications and focuses on real-time visual processing technologies. Research on image processing is focused on medical applications such as processing of the medical data from B mode elastography images and various feature extraction methods applied to dense breast mammography images for classification purposes. Work is on going in enhancing filtering algorithms to reduce speckle noise in ultrasound images. Research on FPGA embedded systems design is focused on efficient ways of developing complete embedded hardware platform by embedding the software and hardware part of the design to the FPGA. The hardware part is designed using one or more soft microprocessors such as microblaze, different IPs and memory blocks. Whereas the software part is designed using the C or C++ language.

Research on wireless VSN is focused on integrating camera sensors with hardware cores to perform vision processing at the sensor level which are compressed and transmitted via a wireless VSN to a central processing station for analysis.

The projects of VIER group are fully or partly supported and funded by the UK Nottingham New Researcher Grants and the Malaysian Government eScienceFund Research Grants. The recent funded project:

Title: Energy efficient reconfigurable wireless vision sensor network for research and applications
Project Leader: Kenneth Ang
Sponsor: Ministry of Science, Technology and Innovation

Sensor nodes are presently powered by batteries. This situation presents a substantial obstacle to the widespread deployment of wireless sensor systems because the replacement of batteries is cost-prohibitive in real-world environments. It is therefore essential that alternative power sources be considered and developed. The SPSR group aims to perform research and development activities for a new generation of Self-Power Sensor System (SPSS) and Self-Power Visual System (SPVS) with collaborative data and visual wireless sensing, long battery life or battery-less sensors, and new applications for science and society. The group will apply a wide range of methodologies to carry out this research. The objective is to perform research and development activities into energy-efficient SPS using low-power electronics, storage, processing, renewable and harvesting techniques. The SPSR projects are fully or partly supported and funded by the UK Nottingham New Researcher Grants and the Malaysian Government eScienceFund Research Grants. One of the recent funded projects:

Title: highly scalable real-time intelligent audio visual system aimed at face recognition over IP
Project Leader: Jasmine Seng
Funding Institution: Ministry of Science, Technology and Innovation
Applied Mathematics (AM) Research Group

Fractional calculus on time scales

The theory of time scales, which recently received a lot of attention, was introduced by Stefan Hilger in his PhD thesis (1988) in order to unify continuous and discrete analysis. Many results concerning differential equations carry over quite easily to corresponding results for difference equations, while other results seem to be completely different in nature from their counterparts. The general idea is to prove a result for a dynamic equation where the domain of the unknown function is a so-called time scale, which is an arbitrary nonempty closed subset of the reals. Fractional calculus is an emerging field recently drawing attention from both theoretical and applied disciplines. During the last two decades it has been successfully applied to problems in computational biology, medical sciences, economics, physics and several fields in engineering. On the other hand, discrete fractional calculus is a very new area for scientists. Recently, many papers have been published and more work on progress.

The aim of this research is to unify the fractional calculus and fractional discrete calculus, and their generalisation. By constructing the required basic structures on fractional calculus, we may apply them to solve fractional dynamic equations on time-scales.

Analysis of incomplete categorical data

During the process of collecting data, sometimes we may not get the fully observed data. This results in partially incomplete data. An inappropriate conclusion may occur when the researchers ignore, truncate, censor or collapse those data as it might contain important information.

The analysis of categorical data rapidly emerged as an important field of research after mid-twentieth century. This is due to the influence of increasing availability of multivariate data sets with categorical responses in the social, behavioural, biomedical sciences, public health, ecology, education, food science, marketing and industrial quality control. Categorical data analysis has provided important insights in resolving problems with categorical response. Since the 1970s, incomplete data analyses have emerged as an important issue of concern.

The EM algorithm, MLE, generalized linear model (GLM) with composite links and logistic regression approaches have been improved to solve the incomplete categorical data which we have been faced so far.

For future research, another approach called General Estimating Equation (GEE) which is the another approach that have been consider for incomplete data will be studied and improved in order to solve the incomplete categorical data problems. This approach will be then be compared with the above approaches that have been improved.

Casimir effect

Casimir force is a force between any two objects due to quantum fluctuations of fields. This force is very weak for separations larger than one micrometer. However, when the separation between objects is reduced to 10nm, this force becomes non-negligible. The advent of nanotechnology has demanded a serious consideration of the effect of Casimir force in the design of nanodevices. Many researches have been carried out to investigate this force for different geometric configurations. A major difficulty in this area is that besides the simple parallel plane configuration, this force is not easy to calculate. Many mathematical methods have been designed to calculate this force approximately. However, the reliability of the approximation results is always a question. Our research focuses on rigorous exact methods for computing the Casimir force.

Funded projects:

Title: Casimir effect of magneto-dielectric objects and its applications
Project leader: Teo Lee Ping
Sponsor: Ministry of Higher Education

Renewable energy group

- Prof Sahaya Prabaharan
- Dr Yousif Abakr
- Dr Svenja Hanson
- Dr Feroz Kazi Kabir
- Dr Lee Chan Wai
- Dr Lee Lai Yee
- Dr Nawaf Saied
- Dr Yap Eng Hwa

Advanced power sources and electrical energy storage systems group

- Prof Sahaya Prabaharan
- Mr Anandan Shanmugam
- Dr Gan Su Xin
- Dr Ng Hoon Kiat

Internal combustion engines group

- Dr Haider Abbas Mohamed
- Dr Mohamed Dahidah
- Dr Gobbi Ramasamy
- Mr Nandhakumar Thulasiraman

Power electronics, machines and control group

- Dr Haider Abbas Mohamed
- Dr Mohamed Dahidah
- Dr Gobbi Ramasamy
- Mr Nandhakumar Thulasiraman
Energy, Fuel and Power Technology
Research Division

The research focus of this division is to elucidate the fundamental and applied aspects of Energy by employing various power technologies. Research undertaken within EPFT research division addresses the importance in the area of sustainable, affordable fuel and power technologies with clear emphasis on clean energy. Much of the division’s work is cross-disciplinary and multi-agency. It has outstanding facilities for applied work as well as computational studies, and has internationally recognized expertise under various sub-groups which are classified as:

- Advanced power sources and electrical energy storage systems
- Internal combustion engines
- Renewable energy
- Power electronics, machines and control

Funded projects:

- Sponsor: Ministry of Science, Technology and Innovation
- Project leader: Sahaya Prabaharan, Ananda Shanmugam
- Title: Sustainable biofuel production technologies
- Description: The experimental research at the Malaysia Campus is mainly focussed on sustainable biofuel production technologies. Current projects include solid acid catalysed biodiesel production from waste oils, bio-oil production through pyrolysis as well as combustion and emissions characteristics of biofuels. The theme of all these projects is the utilisation of wastes to produce fuels to help meet increasing worldwide energy demand. In the current debate over the use of edible plant feedstock for biofuel production, conversion of waste oils and agricultural wastes into biofuels is among the best solutions for the short to medium term. To date, experimental parametric and optimisation studies supported by on-campus laboratory and analytical facilities have been conducted.
- Awards/Honours: First Prize, CESA Smart Award for European Maritime Visions, Brussels (October 2007).
- Funded projects:
  - Project leader: Ng Hoon Kiat, Gan Suyin
  - Sponsor: Ministry of Science, Technology and Innovation
  - Title: Performance optimization of a pico-hydro generator
  - Description: Similar to its larger variation, a Pico-Hydro Generator (PHG) converts water potential energy into clean electrical energy in a similar method. The advantage of a PHG is that it has smaller footprint and it is most suitable for household and domestic usage. The PHG leans upon the technical maturity of larger hydro generation schemes. This project is therefore concerned with these technical challenges: a.) to maximize efficiency by optimizing the design of existing PHG model; b.) to maximize power output of the PHG. It is anticipated that this project is experimental in nature but CFD and CAD are also expected to be used extensively in the design and analysis phase.

Internal Combustion Engines Group

The research group works on an array of combustion-related topics, especially in sustainable energy technologies for ground transportation. Activities in experimental research here are mainly focussed on biofuel production and its application in automotive diesel engines. In terms of computational research, the opportunities to improve in-cylinder modelling for diesel-biodiesel combustion have been the main research theme. The group benefits from strong cross-campus collaborative research efforts, particularly with the Engines Research Group in the UK. Both the experimental and computational projects have attracted industrial and academic collaborators, as well as sponsorships from governmental agencies.

Funded projects:

- Project leader: Ng Hoon Kiat
- Sponsor: University of Nottingham UK
- Title: Experimental and computational study of combustion and emission characteristics of palm oil biodiesels in a direct-injection diesel engine

- Project leader: Gan Suyin
- Sponsor: Ministry of Science, Technology and Innovation
- Title: Reduced chemical kinetics and CFD modelling for the combustion of palm oil biodiesel in a light-duty diesel engine

- Project leader: University of Nottingham UK
- Title: Experimental and computational studies of ignition delay timing from biodiesel combustion in a diesel engine

Sustainable biofuel production technologies

The experimental research at the Malaysia Campus is mainly focussed on sustainable biofuel production technologies. Current projects include solid acid catalysed biodiesel production from waste oils, bio-oil production through pyrolysis as well as combustion and emissions characteristics of biofuels. The theme of all these projects is the utilisation of wastes to produce fuels to help meet increasing worldwide energy demand. In the current debate over the use of edible plant feedstock for biofuel production, conversion of waste oils and agricultural wastes into biofuels is among the best solutions for the short to medium term. To date, experimental parametric and optimisation studies supported by on-campus laboratory and analytical facilities have been conducted.

- Project leader: Sahaya Prabaharan
- Sponsor: Ministry of Science, Technology and Innovation
- Title: Sustainable biofuel production technologies

Renewable Energy Group

Energy storage and buffering for PV applications

For the renewable energy areas, the focus is on the stand-alone power system for remote areas where the improvement of the storage capability through hybrid technologies (battery-fuel cell; battery-supercapacitor) is the main concern. Other concerns include the application of advanced intelligent control techniques to protect and get the optimum output from the system (e.g. maximum power point tracking, battery protection and battery life span expansion). Research work also includes development of a learning aid tools for the fundamental concepts of the main three types (solar, wind and hydro) of energy.

Awards/Honours:
- First Prize, CESA Smart Award for European Maritime Visions, Brussels (October 2007).

Funded projects:

- Project leader: Yousif Abakr
- Sponsor: SCORE Project, UK
- Title: Optimization study on the SCORE engine

- Project leader: Le Lai Fye
- Sponsor: Ministry of Science, Technology and Innovation
- Title: Preparation of low-cost activated carbon from Malaysia agricultural by-products for adsorption of heavy metal ions from industrial wastewaters

- Project leader: Lee Lai Fye
- Sponsor: Ministry of Science, Technology and Innovation
- Title: Preparation of low-cost activated carbon from Malaysia agricultural by-products for adsorption of heavy metal ions from industrial wastewaters

- Project leader: Yousif Abakr
- Sponsor: SCORE Project, UK
- Title: Theoretical and experimental investigation of an energy focused solar operated thermo-acoustic heat engine

- Project leader: Yousif Abakr
- Sponsor: University of Nottingham UK
- Title: Preparation of low-cost activated carbon from Malaysia agricultural by-products for adsorption of heavy metal ions from industrial wastewaters

- Project leader: Lee Lai Fye
- Sponsor: Ministry of Science, Technology and Innovation
- Title: Preparation of low-cost activated carbon from Malaysia agricultural by-products for adsorption of heavy metal ions from industrial wastewaters

- Project leader: Yousif Abakr
- Sponsor: SCORE Project, UK
- Title: Theoretical and experimental investigation of an energy focused solar operated thermo-acoustic heat engine

- Project leader: Yousif Abakr
- Sponsor: University of Nottingham UK
- Title: Preparation of low-cost activated carbon from Malaysia agricultural by-products for adsorption of heavy metal ions from industrial wastewaters
**Power Electronics, Machines and Control Group**

Power Electronics, Machine and Control Research Group (PEMCRG) conduct a wide range of research activities which are supported by internal and external funding.

Multi-level boost inverter with single DC source for standalone photovoltaic systems

One of the merits offered by solar energy sources is their potential to supply abundant electricity in areas not provided by the general power and inverters converting DC power sources produced by PV cells to AC grid systems are increasingly becoming popular as the energy crisis and environmental concern become the driving force for alternative energy. This project investigates a novel multi-level inverter controlled by SHE-PWM approach, which uses a single transformer with two windings of different turn numbers at the primary side to synthesize the multilevel waveform. The devices account is considerably reduced compared to conventional multilevel inverters for the same waveform.

Design of a bio-controller to diagnosis faults in electric machines to achieve high system reliability

The usage of electric motors has been expended largely to critical loads. Some of the recent critical applications are aerospace and hybrid electric vehicles (HEVs). Reliability of the electric motor is crucial to maintain continuous operation of the system until necessary help is available. There are many studies mainly for the prediction of faults on the electric motors. In this research work, identifying the part of human body that can be related closely to the electric machine will be done, then medical techniques used to find symptoms to failure will be investigated, finally manipulation and rectification of the potential failures will be the highlight of this project. In general, the project will be designing a bio-controller to achieve high reliability for machine operations.

**SHE-PWM multilevel converter based STATCOM system**

Reactive power is a key element in maintaining voltage and synchronous stability and ensuring proper power system performance. This project supports the steps towards prevention of voltage collapse and power instability through research of a novel, more effective STATCOM system, based on a topology, which is still in its infancy and improved switching control through the application of the latest multilevel SHE-PWM method. The switching power losses will be considerably reduced which directly simplifies the required cooling equipment.

**Funded projects:**

<table>
<thead>
<tr>
<th>Title</th>
<th>Improved power electronic reactive power compensator for the future transmission lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project leader</td>
<td>Mohamed Dahidah</td>
</tr>
<tr>
<td>Sponsor</td>
<td>Ministry of Science, Technology and Innovation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>Motor starters laboratory (Schneider Electric Industries Sdn Bhd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project leader</td>
<td>Gobbi Ramasamy</td>
</tr>
<tr>
<td>Sponsor</td>
<td>Schneider Electric Industries (M) Sdn. Bhd.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>Transparent motor control and drives laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project leader</td>
<td>Gobbi Ramasamy</td>
</tr>
<tr>
<td>Sponsor</td>
<td>University of Nottingham, UK</td>
</tr>
</tbody>
</table>

**Awards/Honours:**

1. Bronze Medal for the project “ROBOTTINARM 001” in 21st International Invention, Innovation and Technology Exhibition 2010.

**Funded projects:**

<table>
<thead>
<tr>
<th>Title</th>
<th>Innovative development of a robotic arm: modeling, intelligent non-linear control and motion planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project leader</td>
<td>Haider Abbas</td>
</tr>
<tr>
<td>Sponsor</td>
<td>Ministry of Science, Technology and Innovation</td>
</tr>
</tbody>
</table>

**Environment**

- **Division head:** Dr Dominic Foo
- **Energy and sustainability group**
  - Dr Svenja Hansen
  - Dr Feroz Kabi Kazir
  - Dr Lee Chan Wai
  - Dr Lee Lai Yee
  - Dr Yap Eng Hwa
- **Sustainable process integration group**
  - Mr Chiang Choon Lai
  - Dr Dominic Foo
  - Dr Denny Ng
- **Urban climate and pollution group**
  - Dr Yousif Abakr
  - Prof Andrew Chan
  - Dr Cheah Siew Cheong
  - Dr Gan Suyin
  - Dr Ng Hoon Kiat
  - Dr Sergey Spotar
Sustainable development is the eventual goal for all human activities, which is also the main aim for the research division. This research division and its research groups are hence dedicated to the development of various process and product technologies in achieving the sustainable development goal, ranging from upstream waste minimisation to downstream end-of-pipe waste treatment. Specifically, these technologies address various air, wastewater and solid waste management problems.

There are four research groups in the division, i.e. Urban Climate and Pollution (UCP), Sustainable Process Integration (SPI), Wastewater-Treatment (WWT), Fuels and Sustainability (F&S).

**Urban Climate And Pollution (UCP) Group**

This research group focuses on the urban climate and pollution problems, especially related to air pollution in the urban environment. The group develops various technologies in understanding and mitigating these problems.

**Funded Research Projects**

**Title:** Urban heat island effects in Malaysia  
**Project leader:** Andrew Chan  
**Sponsor:** National Center for Atmospheric Research, USA Putrajaya Development Company Limited

**Water And Wastewater Treatment (WWT) Group**

This research group has conducted various researches on water and wastewater treatment ranging from quality monitoring, biological treatment system (anaerobic and aerobic), coagulation and flocculation, adsorption, membrane technology and cavitation technology.

**Awards**

**Award:** 9th Malaysia Technology Expo 2010 (SILVER)  
**Title:** UNIQ2008: New software for better water quality index using neuro-fuzzy logic  
**Project leader:** Ramani Bai Varadharajan

**Award:** WaterInno Awards 2009 (GOLD)  
**Title:** POMB Bottom Ash - A natural adsorbent for boron removal via novel adsorption-flocculation mechanism  
**Project leader:** Mei Fong Chong

**Funded Projects**

**Title:** Biogas generation as renewable energy from palm oil mill effluent (POME) using mixed culture microbes via hybrid anaerobic-aerobic bioreactor (MOSTI)  
**Project leader:** Mei Fong Chong  
**Sponsor:** Ministry of Science, Technology and Innovation

**Title:** Boron removal for wastewater by using impregnated palm oil mill boiler (POMB) bottom ash  
**Project leader:** Mei Fong Chong  
**Sponsor:** Yayasan Felda

**Title:** Asian coastal ecosystems: an integrated database and information management system (DIMS) for assessing impact of climate change and its appraisal  
**Project leader:** Ramani Bai Varadharajan  
**Sponsor:** Asia Pacific Network, Japan

**Title:** Data mining on hidden parameters of water quality index for safe drinking water using artificial neural networks and fuzzy logic systems  
**Project leader:** Ramani Bai Varadharajan  
**Sponsor:** Ministry of Science, Technology and Innovation
Fuels and Sustainability (F&S) Group
This research group looks at medium and long-term sustainable energy futures and mainly focuses on low carbon fuels and carbon reduction and mitigation technologies, as well as policies and strategies to achieve the transition effectively and sustainably. The group wishes to contribute to the effort in breaking dependency of humankind on fossil fuel and other non-renewable, depleting resources and to protect the environment from green house gases and other emissions.

Funded Projects
Title: Gasification behaviour and hydrogen generation potential of agricultural wastes in Malaysia
Project leader: Svenja Hanson
Sponsor: Ministry of Science, Technology and Innovation

Title: Biodiesel production from crude palm oil (cpo) and high acid oil by using novel multiphase membrane reactor
Project leader: Mei Fong Chong
Sponsor: Malaysia Palm Oil Board

Student profile: Chan Yi-jjing (Malaysia)
I am currently involved in biological wastewater treatment, and the research aim is to design a novel anaerobic-aerobic bioreactor for Palm Oil Mill Effluent (POME) treatment. I am grateful to have chosen University of Nottingham for my postgraduate studies. Here, I enjoy a serene personal working space, state-of-the-art research facilities and access to all kinds of information. University of Nottingham has opened up a world of opportunities to me, providing me a chance to attend workshops, conferences, research seminars as I pursue my postgraduate studies. The best part is the opportunity to interact and work with all walks of life regardless of lecturers or research students.
Manufacturing and Industrial Processes Research Division

Efficient product and process development and manufacturing are paramount for all the industrial activities and are the core theme for this research division. Various novel technologies have been emerged from the dedicated and coordinated activities of our division members. Establishment of research collaborations as well as projects have been obtained from Shell, Petronas, Malaysian Palm Oil Board (MPOB), The Institute of Materials, The Project Management Institute and Ministry of Science, Technology and Innovation (MOSTI).

Following are the four research groups in this division, i.e. Food and Pharmaceutical Engineering (FPI), Nanotechnology (NT), Mechatronics (MT) and Engineering Management (EM).

Food And Pharmaceutical Engineering (FPI) Group

Core areas of research: Process modelling and its applications in process and plant development, design, operation and control; Process applications of AI and self-learning control, Soft sensors and measurement data fusion, Resource conservation via process integration techniques, Process simulation & optimisation for batch & biochemical processes, Life cycle analysis (LCA), Product dehydraation and drying, Advanced drying technology, Fluidised bed technology, Dimensionless analysis and scale-up, Powder mixing, Powder characterisation, Diffusion, Vortex flows and Microfluidics.

Awards/Honours

Funded projects
Title: Development of an optimal dehydration technique in minimizing the degradation of antioxidant polyphenols in cocoa during postharvesting process
Project leader: Chung Lim Law
Sponsor: Ministry of Science, Technology and Innovation

Nanotechnology (NT) Group

Core areas of research: Nano-chemical engineering of advanced materials, Development of nano-suspensions and nano-emulsions for pharmaceutical industries, Process research, Engineering and development of drugs and drug intermediates, Utilisation of highly energy-efficient ultrasonic and hydrodynamic cavitation technique for the development of nano-materials, Synthesis of low dimensional materials, Study of photodegradation of organic matters and surfactant chemistry and colloidal system

Awards/Honours
Award: Exhibition of Invention, Research and Innovation (GOLD) 2009
Title: Dynamic emulsion system for cream formulation and drug delivery

Award: Water Malaysia (SILVER) 2009
Title: Novel nanostructured ZnO based photocatalyst material for organic degradation in waste water treatment system

Award: Malaysia Nuclear Agency (BRONZE) 2009
Title: Ultraviolet light (UV) photoinduced magnetic nanocatalyst for detoxification of organic pollutant in waster water treatment system

Patents Filed
Synthesis of magnetic nanophotocatalyst (ZnO/Fe3O4) for textile industry wastewater treatment (Status pending)

Funded projects
Title: Novel Strategy of Ultrasonic Cavitation for the Generation of Nanoemulsions and Nanosuspensions in Pharmaceutical Preparations
Project leader: Sivakumar Manickam
Sponsor: Ministry of Science, Technology and Innovation

Mechatronics (MT) Group

Core areas of research: Robotics and automation system, Developing advance metrology instruments, Product design and applications associated with non-contact brake and damping, Design of control systems with heavy emphasis on nonlinear systems, Modelling and simulation of liquid propellant engines, Development of high integrity systems for aerospace and industrial applications, Application of sliding mode control to industrial and aerospace systems helical actuation systems

Awards/Honours

Funded projects
Title: Development of a force-current integrated control to control spot weld strength
Project leader: Aravinthan Arumugam
Sponsor: Ministry of Science, Technology and Innovation
Engineering Management (EM) Group

Core areas of research: Project financing, Project planning and scheduling, Project management, Life cycle costing, Construction ethics, Construction corporate social responsibility, Construction law, Research methodology in construction management, Sustainable construction, Culture in international construction, Quality management, Railway engineering and materials characterisation and failure analysis are some of the areas in which this group is focused.

Student profile: Nachimani Charde (Malaysia)

Nottingham University Malaysia Campus has widely experienced lecturers and professors from various countries. All the staffs are very cooperative and helpful especially my supervisors and the lab technicians are very approachable and also helpful on my research field which enables me to think beyond borders. It provides easy online access to updated international journals, latest books on technologies and 24 hours access to the state-of-the-art facilities for its post graduate candidates to conduct research at their own time. The university environment refreshes young mind for academic excellence all the time.

Materials, Mechanics, and Structures

- Division head: Dr Amir Nassirharand
- Advanced materials
  - Dr Khiew Poi Sim
  - Dr Lau Pei Li
  - Dr Janet Lim
  - Dr Andrew Spowage
  - Dr Michelle Tan
  - Mr Tan Thian Koon
- Bioengineering group
  - Dr Edward Ho
  - Dr Enamul Hoque
  - Ms Lim Siew Shee
- Geomechanics group
  - Dr Abdullahi Ali Mohamed
  - Dr Mostapha Boulbibane
  - Dr Chan Swee Huat
  - Ir Yeong Tuck Wai
- Polymer composite group
  - Mr Abdul Aziz Baharuddin
  - Dr Chin Jit Kai
  - Dr David Hassell
  - Dr Albert Tshai
- System dynamics and integrity group
  - Dr Haider Abbas
  - Dr Mohamed Anwar
  - Dr Mostapha Boulbibane
  - Dr Chin Jit Kai
  - Mr Hazem Demdrash
  - Dr Wael Elleithy
  - Mr Edwin Goh
  - Dr Lau Teck Leong
  - Dr Amir Nassirharand
  - Dr Cosmas Pagwiwoko
  - Dr Nawaf Saied
  - Dr Wong Kok Cheong
  - Dr Woo Ko Choong
Materials, Mechanics, and Structures Research Division

The mission of the Division is to conduct original, fundamental and/or applied multidisciplinary research in areas such as aerospace, biomaterials and biomechanics, computational mechanics, dynamic systems and control, geomechanics, nanomaterials, and polymer composites.

Research comprises theoretical, computational, and experimental works which are supported by fast computing and modern laboratory facilities.

Research sponsors include the Malaysian Ministry of Science, Technology, and Innovation (MOSTI), University of Nottingham (UK Campus), and various industries.

Geomechanics Group

The current research focuses on development and improvement in the design and construction aspects of some common engineering works in the construction industry. The research outputs are intended for practical civil engineers to improve their knowledge and competency in carrying out design and construction works.

Advanced Materials Group

The advanced Materials Group is actively engaged in broad-ranging and cutting-edge research in the fundamental and application of advanced functional materials disciplines. Research within the group is at the forefront of interdisciplinary developments of unique functional materials, from micron size to nanoscale regime, which can be exploited in various high performance scientific and technological applications.

The research group has been extremely successful in attracting external funding and involves extensively in establishing major collaborations with researchers nationally and internationally. In the effort to strive for research excellence and to support high quality research programs, the group has a wide range of state-of-the-art equipments that are essential for the synthesis and characterization of the advanced materials. Some of the notable, highly recognized and award-winning research fields within the group are in the areas of nanophotocatalyst, highly efficient charge storage device, novel bio-scaffolding materials, high capability drug delivery system and effective metal recovery water treatment process.

Title: Magnetic nano-composites templated from surfactant system: synthesis, characterisation and potential application as photocatalyst
Project leader: Khiew Poi Sim
Sponsor: Ministry of Science, Technology and Innovation

Title: Fundamental studies on charge storage property of manganese oxide/carbon nanotube (MnO2/CNT) nano-composites for high performance supercapacitor system
Project leader: Tan Thian Koon
Sponsor: Ministry of Higher Education

Structural Integrity and Dynamics Group

The (SID) Research Group activities have a connection with the structure, its dynamics and the thermo-fluid – structure interactions. Our research areas broadly including: Aerospace applications, Computational Mechanics, Solid, Fluid, and component analysis and testing and Advance Dynamics and Vibration. Funding is received by the group members from the industrial and government organizations.

Aerospace

The Aerospace group is active in the areas of dynamic systems and control, aero-elasticity, and fluid-structure interaction. Modeling, simulation, and control of liquid propellant engines, unmanned aerial vehicles and quad-rotor helicopters, spacecraft attitude control, microfluidic-based propulsion system, and application of aerospace techniques to automotive problems are considered.

Component Design and Integrity

The component design and integrity group is actively engaged in developing computational techniques for life assessment of material components subjected to static, cyclic, high temperature and/or mechanical loadings. These techniques use the Finite Difference, Finite Volume, Finite Element, and Boundary Element methods or any combination of these, which proves advantageous, as a platform for carrying out the assessment. In addition to the developed codes, commercial software, e.g., FLUENT, CFX, ANSYS and ABAQUS are used to research suitable solutions. The proposed techniques would contribute significantly in improving design of material components. Furthermore, the group is actively adopting numerous experimental approaches and testing for analysis and design of solid and/or fluid based devices/components.

Bioengineering Group

Bioengineering Research Group (BRG) aims at the excellence of research in the areas of Tissue Engineering (TE) and Biomaterials. TE provides an advanced alternative therapy to the patients with deceased or damaged organs through regeneration of tissue. The overall goal is to contribute to the better and healthier human lives.

Currently, the BRG is ambitiously focused on the development of scaffold library by means of rapid prototyping (RP) technology in combination with novel biopolymers to cater for tailored TE applications.

Dynamics

One of the main focuses of this group is on the nonlinear phenomena associated with physical systems, especially in relation to engineering problems. Solutions to both fundamental and applied problems are sought by engaging in analytical work, numerical computation as well as adopting an experimental approach. Interests are in Micro-systems and Micro-Electro-Mechanical-Systems (MEMS) technology, Ground Vehicle Dynamics, Rotor Dynamics, Electromechanical systems and Fluid-Structure Interactions.

Funded projects:

Title: Development of an integrated miniature viscometer cell utilising microfluidics and MEMS technology
Project leader: Chin Jit Kai
Sponsor: Ministry of Science, Technology and Innovation

Title: Nonlinear controller synthesis for highly nonlinear-unstable systems
Project leader: Amir Nassirirand
Sponsor: Ministry of Science, Technology and Innovation

Title: Modelling of flow boiling in microchannels
Project leader: Wong Kok Cheong
Sponsor: Ministry of Higher Education

Title: Investigation on convection heat transfer from electronic heat sink using nanofluid
Project leader: Nawaf Saeid
Sponsor: Xyratex Sdn Bhd

The overall research includes computational modeling and simulation of the scaffold design, fabrication and characterization of physical scaffold, in vitro and in vivo tissue generation and finally clinical trial for TE application.

The research group has successfully established collaborations with world reputed researchers nationally and internationally. The group is equipped with the essential facilities required for high quality evolutionary research. The group is also always open to exchange research ideas and extend further research collaborations.

Funded projects:

Title: Fabrication of nano-scaffolds for bone tissue engineering
Project leader: Lim Siew Shee
Sponsor: Ministry of Science, Technology and Innovation

Title: Electro-vibroimpact system
**Polymer Composites Group**

The Polymer Composites Research Group is formed by a dedicated team with expertise knowledge in design, manufacture and performance optimisation of both polymer and advanced fibre reinforced composites.

Fundamental principles are applied, and ‘state-of-the-art’ techniques are utilized to ensure that the properties and performance of the end products are perfectly adapted to design specifications.

The research themes combine curiosity-driven research with application-driven objective, leading the development of advanced synthetic/natural fibre reinforced composites.

The key activities include:
- Development of novel manufacturing processes
- Materials characterisation
- Optimization of performance/cost ratio in processing of thermoplastics and thermosets
- FEA and CFD modelling relate to mechanical performance and process simulation
- Crashworthiness studies of automotive vehicle
- Textile composites

**Title:** Recycled carbon fibres for heating and cooling  
**Project leader:** Andrew Chan  
**Sponsor:** Nottingham Innovative Manufacturing Research Centre, UK; EXA Technology Development

**Student profile: Britto Satheesh (India)**

I am currently working as a PhD student in Nottingham University of Malaysia. I took up Mechanical Engineering (Aerospace) in Nottingham UK, and then decided to do a PhD in composite materials after my MEng degree. Nottingham University is known for diversity, culture and is certainly a home far away from home. As an international student from India, it was certainly a home for me, as I had spent five years in Nottingham University UK, before being transferred to the Malaysia campus. Living in a vibrant campus like Nottingham, certainly helped me enhance my leadership and other qualities that a Nottingham student should have. I completed one year of PhD after MEng, in UK before moving to Malaysia. My PhD research programme in Malaysia would involve working with carbon fibres which are a widely used material in aerospace, automobile and in many other applications. The future of this research would involve creating a model that visualises the curing process of an epoxy material and hence predict those parameters which are considered during the manufacturing process of a part with carbon fibres. The research area is very interesting and certainly had the pleasure to work with some of the most expensive equipment and softwares. Since moving from UK to Malaysia, this mobility in fact is a new experience with new life styles and cultures. Moreover it is an opportunity for me to represent the university back in UK. I really enjoy this exchange because I know I am a part of a reputed university which is expanding internationally.

---

**Application and open days**

Our aim is to make the application process as hassle-free and efficient as possible. We thus encourage applicants to apply online.

Please go to [http://www.nottingham.edu.my/Students/Admissions/Pages/HowToApply.aspx](http://www.nottingham.edu.my/Students/Admissions/Pages/HowToApply.aspx)

Applicants for MPhil or MRes would normally be expected to hold an honours degree at 2:2 or above (or international equivalent) in a pertinent subject.

Applicants for PhD programmes are generally required to hold an honours degree at 2:1 level or above (or international equivalent) in a pertinent subject.

The University of Nottingham Malaysia Campus uses English as a medium of instruction. All applicants must achieve an appropriate level in an approved test in English before they are formally registered.

There is no closing date for research programmes.

We organise open days and application days on a regular basis and everyone is welcome. The University is also happy to receive visitors any time, by prior arrangement. Please contact the university directly to arrange a visit.

The University is represented at various local or international fairs. The fairs are a good opportunity to meet with members of the University staff to discuss your plans. Again please contact us directly regarding our attendance of these events.

**Funding, scholarship and stipends**

The Faculty does offer studentships, research assistantships to our research students, while most projects are under a research contract meaning there would be funds to support research students. The Faculty also provides opportunities for research students to supplement their income while gaining experience in teaching or laboratory demonstration. However, these offers cannot be guaranteed, please contact the Faculty to enquire about funding or studentship opportunities.

**Research collaboration or industrial works**

The University welcomes with open arms industrial collaboration or consultancy of any kind which we are capable of. Please contact the Faculty directly should any interest arise.