FACULTY OF ENGINEERING, COMPUTING AND MATHEMATICS

Final Year and Research Project Descriptions

To find a project description, search (Ctrl + F) using the Supervisors surname. The project title and description are listed below each Academic’s name. Please ensure that the project is applicable to your discipline.
An, Hongwei, Assistant Prof  
Co-Supervisor: Cheng, Liang, W/Prof

Experimental investigation about sedimentation process in a rock berm built on erodible seabed
Disciplines: Civil, Environmental, Ocean Systems, Oil & Gas.

Rock berm is often used as a protection of foundation for subsea structures, like pipelines, platform and piles etc. When a rock berm is built on an erodible seabed, it will trap sediment into the voids between the rocks. Some research shows the sedimentation can reach 80% of the rock berm height. The build-up of sedimentation in the rock berm will change the permeability, thermal conductivity, pressure distribution in the rock berm. At the same time the stability of the rock berm also changes. Therefore it is important to understand the sedimentation process in the rock berm.

In this project, a set of physical model tests will be conducted through the O-tube facility to understand the sedimentation process. The research outcome will provide guidance for constructing subsea rock berm in offshore engineering.

This project gives students an opportunity to access to multi-awards winning research facility (the O-tube) and to gain experience and knowledge to work in offshore industry.

Baillie, Caroline, W/Prof

Mining and Communities
Disciplines: Chemical & Process, Civil, Mechanical, Mechatronic, Mining, Environmental, Materials, Oil & Gas, Petroleum
Prerequisite skills: Interest in interdisciplinary work, reading social science texts and conducting human-based research, rather than technical

Mining companies are increasingly aware that they need to consult with local communities before embarking on any new as well as existing mining activities. In many countries where this has not been done appropriately, serious conflicts have arisen, leading to many years of unrest, violence and even death. Most enlightened companies and governments also know that it is necessary to support and understand the cultural importance of the land for Indigenous peoples of the area, requiring negotiation with the traditional land owners. Concepts such as Free Prior and Informed Consent (FPIC) however, are difficult to enforce and in some countries, less regulated and often illegal companies are able to inflict human rights abuses on local citizens. Two project groups are offered in this area with students studying concepts such as FPIC, Corporate Social Responsibility,
community engagement, interest based negotiation, social licence to operate and how these are or
could be enacted and upheld. Case studies in Latin America and Australia will be selected.

Beckett, Chris. Dr.
Co-Supervisor: Guzzomi, Andrew. Dr.

*Rolled earth: Earthen construction in the 21st century*

Disciplines: Civil, Mechanical

Prerequisite skills: Good knowledge of geotechnical and mechanical engineering principles.

Earthen construction has been used by man for millennia. Once popular for its cheap and robust
properties, it is now regaining popularity due to its sustainable, environmentally-friendly nature.
However, earthen construction techniques have changed little since ancient times despite the
introduction of mechanised compaction processes, with processes still largely dependent on
manual labour.

Although in their infancy, modular construction and 3-D printing technologies have revolutionised
the construction industry. Full-size houses can be constructed in a matter of days whilst being
completely tailored to the client’s desires. These technologies come at a price, however, making
use of (often) expensive materials with high embodied energies. Therefore, although labour costs
are slashed, the environmental cost of these technologies is still high.

This project will investigate the application of 3-D printing construction principles to earthen
materials. The project aims to identify suitable materials for producing strong, durable structures
without excessive use of stabilisers, and methods by which they might be constructed. The use of
such materials would provide alternatives for current solutions in regions where their use might be
prohibitive. The project will comprise several constituent parts, which can be undertaken by one or
more students:

- Development of suitable construction methodologies and deposition equipment;
- Identification of suitable earthen mixes and their preparation states (e.g. water and stabiliser
  contents, particle size distributions etc.);
- Development of numerical tools (in either new or existing software) to model material deposition.

This project would be suitable for students interested in practical applications of geotechnical,
structural and mechanical engineering, particularly when applied to remote operations and
developing nations.

Beckett, Chris. Dr.
Co-Supervisors: Guzomi, Andrew. Dr; Ken Flower, Dr. & Matthias Leopold, Dr. & Mike Perring, Dr.

**Engineering For optimal grain growth**

Disciplines: Civil, Environmental, Mechanical
Prerequisite skills: Experimental and numerical work, dependent on the chosen topic

Soil compaction is a key constraint facing the Australian Grains’ industry, especially as there is an ever increasing shift towards the use of bigger, more powerful machinery. Recent work has demonstrated the importance of soil microstructure, as controlled through compaction conditions, on plant growth. This project extends that work and comprises several parts:

- vehicle dynamics and compaction depth (e.g. mass distribution, dynamic contact patch loads - traction, braking, vibration, cornering, etc.);
- determination of soil property evolution (e.g. hydraulic conductivity, water retention) with varying compaction levels;
- effect of different soil dry densities on plant root growth.

**Bennamoun, Mohammed, W/Prof**
Co-Supervisors: An, Senjian, Asst/Prof & Boussaid, Farid, Prof

**People courting in a surveillance image**
Disciplines: Computer, Electrical & Electronic, Mechatronic, Software
Prerequisite skills: Preferably prior knowledge and skills in image Processing/Computer Vision

People counting is a topic with various practical applications. Certain public areas such as shopping square, emergency exit, stadium or train station are in danger if the crowd density is above limit. This field has seen significance improvement over the last decade. Two general approaches were proposed to tackle the problem of people counting: human detection methods and regression methods. Human detection methods encounter difficulties with occlusions and are time consuming, whereas regression methods do not perform well in presence of noises, static humans or cluttered background. This is still an active field of research. In this project, the student will use regression methods for people counting. Given a scene we perform the task of people counting based on the number of foreground pixels present. This method is fast while can still deal with moderate lighting condition changes. The second method constructs a confidence map to identify the human regions in the scene. Student will have access to the state-of-the-art video processing tools of image processing/computer vision, pattern recognition and machine learning. The project will pursue, under the support of leading researcher and PhD students, theoretic advance and practical novelty to research the people counting in surveillance images. You will develop your research skills in the area of image processing/computer vision, pattern recognition and machine learning that could link to your future career development.
Borle, Lawrence, Adjunct Professor
Co-Supervisors: Sreeram, Victor, Prof; & Boussaid, Farid, Prof

**Power system emulation hardware platform with interactive student interface**

**Disciplines:** Electrical & Electronic  
**Prerequisite skills:** Electronics hardware experience

This project aims at developing an innovative state-of-the-art power system emulation hardware platform that integrates real-time touchscreen control/monitoring of hardware in the emulation loop. This exciting platform with interactive student interface will improve the learning experience in power systems for students at UWA and Australian universities, thereby stimulating renewed interest in this area. The proposed platform, intended for use in undergraduate and postgraduate labs, will provide students with invaluable hands on experience on the operation and real-time response of real-world power systems. While other educational lab equipment exist (e.g. Lab-Volt), they are very limited in scope (power transmission/series compensation only). The scope of the proposed platform is much broader as it constitutes a contribution towards making power engineering education more attractive, modern, and effective in preparing students for power engineering careers.

Borle, Lawrence, Adjunct Professor  
Co-Supervisors: Sreeram, Victor, Prof; & Boussaid, Farid, Prof

**Investigation into the use of low voltage inverters to provide a UPFC function on SWER lines**

**Disciplines:** Electrical & Electronic  

Single Wire Earth Return (SWER) systems (see figure in appendix) are used as an economical power transmission in rural areas of the world where loads are sparse. Invented by Lloyd Mandeno in New Zealand in 1925 to be used for electrifying New Zealand’s rural areas, today, we have over 200,000 km of SWER systems installed around Australia and New Zealand. These lines are subject to large voltage variances due to the relative length and high impedance of the line, resulting in high voltages under light loading and low voltages under heavy loading. As loads continue to grow in rural distribution networks reaching its capacity some form of upgrade is necessary to provide reliability and power quality expected in the 21st century. Due to low load densities and long distances involved, the conventional upgrades of SWER such as conversion to three-phase power may be expensive and difficult to justify economically. The project funded by ASTP investigates the use of Unified Power Flow Converter (UPFC) to provide cost effective alternatives to the conventional SWER upgrades. The specific final year projects on this topic include:
1. Complete a study into UPFC power flow at 50 Hz and at harmonic frequencies. Simulate the operation of the UPFC on SWER lines. Demonstrate the effectiveness of the UPFC conceptually to produce voltage regulation and act as an active filter.

2. Design and assemble the SWER emulation hardware (Variac and configurable Pi network components) ensuring electrical safety. Assemble configurable linear and nonlinear loads. Connect the UPFC to the SWER emulation and loads, ensuring electrical safety.

3. Implement control algorithms to operate back-to-back inverters as a UPFC with voltage regulation with the SWER emulation and loads. Procure custom-made fully programmable back-to-back inverters which are suitable for this purpose. Implement a user interface which will allow monitoring and control of the UPFC from a computer. Demonstrate the effectiveness and analyse the operation in terms of energy efficiency and SWER line capacity improvements.

4. Simulate the effect of adding energy storage to the UPFC. Demonstrate whether battery charging and management can be achieved without any adverse effect on the voltage regulation and active filtering.

5. Implement control algorithms to operate back-to-back inverters as a revised UPFC which includes additional requirements for transformer-less operation with access to the dc-link. Procure custom-made fully programmable back-to-back inverters which are suitable for this purpose. Demonstrate the effectiveness and analyse the operation in terms of energy efficiency and SWER line capacity improvements.

6. Add the batteries to the UPFC. Demonstrate the effectiveness of the developed voltage regulation, active filtering and battery management. Add monitoring and control of the battery management to the user interface. Analyse the operation in terms of energy efficiency and SWER line capacity improvements.

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**Boukpeti, Nathalie, Asst/Prof**

Co-Supervisors: Lehane, Barry, Prof; & Carraro, Antonio, Prof

**Laboratory Testing of Offshore Sediments**

Disciplines: Civil

Prerequisite skills: Basic Geomechanics

Sediments deposited offshore Western Australia have specific characteristics and their behavior is not well understood. How to reconstitute the material in the laboratory for physical modelling in a way that is representative of the state and structure of the soil in situ? How to measure soil sensitivity reliably, which is a design parameter needed to compute skin friction along skirt footings or piles? The project investigates these questions through a series of laboratory tests (sample reconstitution, density measurement, one-dimensional consolidation test, fall cone sensitivity test, vane shear test, mini T-bar tests and possibly centrifuge test) performed on offshore sediments from the North West Shelf of Australia.
Boussaid, Farid, Prof

**Camera on a Chip**
Disciplines: Electrical & Electronic

The current trend in Digital Imaging Technology is towards building camera-on-a-chip imaging systems, i.e., CMOS imagers. The fully integrated product results in significant manufacturing cost savings, reduced system size, but also in lower power consumption. The unique concept of CMOS imagers offers the opportunity to integrate photo-sensing array and signal processing circuitry on a single silicon chip, enabling the development of a new generation of smart mobile imaging systems. Half the size of a small postage stamp, a CMOS imager chip can even be swallowed (pill-camera) to transmit images from inside the body. Besides biomedical, CMOS imagers have numerous commercial applications in cell phones, PC notebooks or any application for which a “micro-camera” can be requested. Proposed final year projects will involve building such a camera, and optimize its performance in terms of dynamic range, resolution and/or power consumption. During this project, you will further develop your analog/digital electronic design skills. Projects will be tailored around your interests.

Boussaid, Farid, Prof

**Electronic nose**
Disciplines: Computer, Electrical & Electronic, Materials

Sniffing-dogs are able to detect thousands of chemicals with high sensitivity and selectivity using only biological components. These nasal powerhouses have been successfully used to search for pipeline leaks, drugs, or explosives. You will develop a biologically inspired Electronic Nose (or ENose for short), that mimics the organization and neural processing of the olfactory bulb. The Enose will comprise a chemical sensor array and a gas recognition engine, integrated on a single chip. Projects offer an opportunity to discover and apply neuroscience principles into made-made engineering systems. Projects will be tailored around your interests, whether neuroscience and/or integrated circuit design.

Boeing, Adrian, Dr
Co-Supervisors: Braunl, Thomas, Prof

**Autonomous Intelligent Robots**
Disciplines: Computer, Electrical & Electronic, Mechatronic, Software
Prerequisite skills: Must have good programming skills in C/C++ Desired: GENG5508 Robotics
We have a team of autonomous mobile robots (Pioneer AT3), equipped with Laser scanner, camera, GPS, and IMU sensors. The task of this project is to develop a system based on ROS to explore an unknown environment, create a map, and find colour-coded objects of interest. Our goal is to participate in the Autonomous Ground Vehicle Competition (AGVC) in Melbourne.


**Boeing, Adrian, Dr**
Co-Supervisors: Braunl, Thomas, Prof

**Autonomous Electric Car**
Disciplines: Computer, Electrical & Electronic, Mechatronic, Software
Prerequisite skills: Must have good programming skills in C/C++! Desired: GEN5508 Robotics

We have a one-seater electric race car, which has been equipped with a drive-by-wire system in previous years, as well as a laser scanner, camera, GPS, and IMU sensors. The task for this project is to design and implement a high-level driving system based on GPS waypoints as well as on laser scanner data, in order to identify the edges of the track. This involves path planning, collision avoidance, acceleration an steering control.

The ultimate goal is to perform a driverless fast lap on one of Perth’s race tracks.

*Braunl, Thomas, Prof*

**REV-Ski: An Electric Jetski**
Disciplines: Computer, Electrical & Electronic, Mechanical, Mechatronic, Ocean Systems, Software.
Prerequisite skills: Mechanics/Electrical hardware skills, depending on project

REV is currently building its first electric jetski, which will combines the fun of driving without the guilt of pollution or noise. The tasks for this project are:
- motor controller parameter optimisation - cooling system implementation!
- water proofing - battery management system (BMS)
- driver instrumentation and safety system, incl. GPS tracking

The project will include extensive testing and data collection, to determine range / run-time in various conditions, acceleration, speed, and battery balancing behaviour over time.

*Braunl, Thomas, Prof*
Co-Supervisors: Harries, David, Prof
**REView: Online Monitoring of EVs, Charging Stations and Solar PVs**

**Disciplines:** Computer, Electrical & Electronic, Mechatronic, Software  
**Prerequisite skills:** Must have good programming skills in C/C++ Desired: Web programming and database experience

In REView, we want to monitor a number of systems around electric vehicles (EVs):
- Electric Vehicles (where do cars drive, how long before refuelling)  
- Electric Vehicle Charging Stations (when does charging take place and how much energy is used)  
- Solar PVs (when and how much energy is being generated)

All these sub-systems require a robust user interface that gives useful facts and statistics to the various user groups in respective views of the same data, e.g. for drivers, fleet operators, charging station operators. This project encompasses design & implementation of an online portal as well as a smartphone app.

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**Braunl, Thomas, Prof**

**Formula REV - Electric SAE Race Car**  
**Disciplines:** Electrical & Electronic, Mechanical, Mechatronic

The UWA Formula REV Student Project challenges students to develop and race a performance electric racecar against other universities nationally and internationally.

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**Carraro, Antonio, Prof**

**Effect of soil fabric and anisotropy on the engineering behaviour of soils**  
**Disciplines:** Civil  
**Prerequisite skills:** ENSC3009; Excellent organisational skills; Attention to detail; Ability to conduct laboratory experiments carefully; Interest in mechanics and experimentation.

Fabric affects soil behaviour as much as other state variables such as density and stress. Assessing fabric is difficult and its use in geotechnical analyses typically requires advanced modelling techniques. As a result, the lack of a rigorous understanding and appreciation on the effect of fabric on soil behaviour has allowed geotechnical design to be conducted on an exclusive, primarily empirical, ad-hoc basis. In this project, students will research, learn and become proficient in analytical and experimental techniques that allow analyses of soil fabric and anisotropy to be incorporated into modern geotechnical design. Focus is on geotechnical design involving calcareous offshore sediments whose mechanical response is predominantly anisotropic and prone to particle breakage.

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**Chua, Hui Tong, W/Prof**
Co-Supervisor: Kandadai, Srinivasan (Srini) Adj/Professor

Methane cracking, storage, and geothermal energy utilisation
Disciplines: Chemical and Process, Materials, Mechanical, Oil and Gas
Pre-requisite skills: Heat and mass transfer, thermodynamics

(i) The zero emission use of methane to produce industrial hydrogen and high value added graphitic carbon. Students can work on the catalytic process of cracking or the downstream characterisation and functionalisation of the graphitic carbon for catalysis and electrochemical applications.
(ii) The storage of methane and short-chain hydrocarbons via adsorption. The student will be able to fine tune a purpose built calorimeter and perform simultaneous adsorption/desorption and calorimetric measurements.
(iii) The realistic and optimal scheduling of the geothermal submersible pump to shave pumping power consumption and maintain comfort and specified temperature in Olympic size swimming pools.

Chua, Hui Tong, W/Prof
Co-Supervisor: Kandadai, Srinivasan (Srini) Adj/Professor

Geothermal air conditioning, waste heat/biomass desalination
Disciplines: Chemical and Process, Mechanical
Pre-requisite skills: Heat and Mass Transfer, Thermodynamics

(i) Design of a geothermal air conditioning system for the Australian International Gravitational-wave Observatory (AIGO), in collaboration with the Gravitational Wave Observatory.
(ii) Development of an industrial waste heat driven desalination system as a holistic energy/emission reduction and water management tool for alumina refineries. This sub-topic can accommodate two students.
(iii) Pilot plant study of a novel process liquor reconcentration prototype in an alumina refinery.

Chow, Shiao Huey, Research Assistant Professor
Co-supervisors: O'Loughlin, Conleth, Associate Professor

Rapid loading of circular foundation in sand
Disciplines: Civil, Oil & Gas

The installation of offshore circular foundations such as suction caissons and spudcan foundations in sandy seabed will subject the sand to rapid shearing. The behaviour of sand under such rapid shearing has been found to be affected by the shearing rate and sand density, and the mechanism is not well understood. Better understanding on the sand behaviour especially the drainage response is required in order to produce reliable interpretation. Therefore, this project will
investigate the behaviour of a circular foundation subjected to rapid loading in sand at different densities and loading rates using laboratory 1-g model testing. The project is suitable for sharing between two students; one investigating the sand behaviour under loose sand condition; and another investigating dense sand condition.

Ciancio, Daniela, Assoc/Prof
Co-supervisors: Beale, Patrick, Asst/Prof

*Investigation of suitability of Pingelly farm soil for rammed earth*
**Disciplines:** Civil, Environmental, Materials

In the context of the multi-disciplinary UWA Future Farm 2050 (more details here: http://www.ioa.uwa.edu.au/future-farm-2050), this project aims to investigate the suitability of the soil available at the Pingelly farm for rammed earth construction.

Croft, Chris, Mr
Co-Supervisors: Braunl, Thomas, Prof

*Hexacopter*

**Disciplines:** Computer, Electrical & Electronic, Mechatronic, Software
**Prerequisite skills:** Must have good programming skills in C/C++ Desired: GENG5508 Robotics

An autonomously flying Hexacopter system is to be developed, based on a Raspberry Pi or Beagle Bone controller. Sensors are GPS, IMU and camera, actuators are the hexacopter navigation system and a 2-dof camera gimbal.

The goal of this project is to develop a system that will be given the 3D coordinates of a rectangular field, then generates its own flightpath, placing way-points so it covers the area in a lawn-mower pattern, continuously getting image data from the ground and recording any crop anomalies. After the flight, the system has to generate an automated trip report, including flight path, locations and images of any anomalies found.

Croft, Chris, Mr
Co-Supervisors: Braunl, Thomas, Prof

*High-Performance Embedded Systems*

**Disciplines:** Computer, Electrical & Electronic, Mechatronic, Software
**Prerequisite skills:** Must have good programming skills in C, Linux and some hardware experience. Desired: ELEC4403 Dig. and Embedded Sys. or equivalent
Raspberry Pi and Beagle Board have made high-performance embedded systems affordable. We are now using Raspberry Pis for small mobile robots for research as well as lab equipment. Our own RoBIOS operating system sits on top of a Linux system and performs data exchange with sensors and actuators. The tasks for this project are:
- Programming of low-level Atmel controller for sensor/actuator control and USB-link to ARM CPU
- RoBIOS main console program
- Robot applications, including maze navigation and obstacle avoidance
- EyeSim simulation system extension for Raspberry-Pi-based robots

**Doyle, Barry, Asst/Prof**

**Vascular Engineering - Investigations into the biomechanics of aortic disease**

Disciplines: Materials, Mechanical

Prerequisite skills: Finite element method, computational fluid dynamics, solid mechanics, numerical methods, material characterisation, experimental design, biomedical engineering

In its simplest form, the cardiovascular system can be viewed as a series of elastic tubes attached to a pump. Vascular Engineering applies our engineering knowledge to this system. More specifically, we use engineering know-how to further our understanding of cardiovascular diseases, help improve diagnostic methods, design new medical devices and plan surgical repair using computational modelling and computer-assisted surgery. This is an exciting field of research that has experienced tremendous growth over recent times and is set to continue rapidly expanding in the future.

This final year project topic will consist of both computational and experimental projects and will specifically investigate diseases of the aorta – the largest and most important ‘elastic tube’ in the body. Computational projects will use solid or fluid mechanics to model fundamental problems as well as actual patient-specific 3D reconstructions created from medical images. Experimental projects will involve mechanical testing and characterisation of animal and human vascular tissue with a view to establishing how diseased tissue behaves compared to healthy tissue and how medical devices perform in diseased vessels. Much more information on the main research areas of the Vascular Engineering group (VascLab) can be found at our website http://vasclab.mech.uwa.edu.au

**Durham, Richard, Prof**

**Industry topic based on your vacation work over summer**

Disciplines: Mining
During your vacation work over the 2014-2015 summer break, you should ask your employer if they have any topic(s) suitable for your thesis. Ask them at the beginning, and then again towards the end. You need to write up the topic on <1 page, and send it to me. There might be a little negotiation whilst I ensure the topic is suitable (basically not too small, not too big, and involves some research type analysis), but once we've agreed on the scope and objectives it's all fine. Usually up to 50% of mining students get industry based thesis topics like this. They tend to be single student projects, but a multi-student topic can be considered.

**Dyskin, Arcady, W/Prof**
**Co-Supervisors: MacNish, Cara, Prof & Hassan, Ghulam Mubashar, Mr**

**Tracking and Analysis of Deformations in Solids**
**Disciplines: Civil, Computer, Electrical & Electronic, Environmental, Mechanical, Mechatronic, Mining, Software**
**Prerequisite skills: Programming in Matlab (or similar)**

Engineering problems are best solved by combining the skills of people across the disciplines. This research topic brings together challenges in computing and vision with applications in civil, mechanical and electrical engineering, with the aim of achieving a safer environment.

Solid objects and structures are subject to deformation under load. Examples can include rock walls in an underground mine, concrete in a building, geological features, or electrical components under temperature-induced deformation. Since deformation may be a precursor to failure, the ability to detect and track changes in solids may have significant safety applications, for example in forewarning and evacuation of underground mines or buildings, or predicting electromechanical component failure.

The goal of this research topic is to use photogrammetry to robustly track and analyse deformation in solids under load using surface features. This in turn requires search and optimisation algorithms to reconcile features between images.

Because the deformation in solids may be very small, highly accurate techniques are required. In addition there may be many challenges, including adequacy and density of surface features, discontinuities (such as cracks), distinguishing discontinuities from other features (such as lines), and environmental noise (such as dust or occlusion). This research seeks both to characterise the problems (for example, what constitutes a viable surface pattern) and find robust solutions (for example, using evolutionary algorithms or machine learning to track discontinuities). There is also scope to assess viability issues in real-world deployment and collection and analysis of in-situ data for students with suitable background.
Faiello, Cosimo, Assoc/Prof

*Sustainability applied to project management & engineering practice*

Disciplines: Chemical & Process, Civil, Computer, Electrical & Electronic, Environmental, Materials, Mechanical, Mining, Oil & Gas, Petroleum

This topic will introduce students to the field of project management and engineering practice with a focus on achieving sustainable results based on a “triple bottom line” (TBL) approach: That is, achieving project objectives, while taking into account the societal and environmental implications of a project. A sustainable approach to project management and engineering practice is recognised globally by many organizations, as being vital to achieving their strategic objectives. By researching this topic students will learn how to apply theoretical concepts and frameworks to ‘real world projects’ in order to achieve sustainable outcomes using a TBL strategy.

Fernando, Tyrone, Prof

*Stability Analysis of a DFIG Wind Turbine System*

Disciplines: Electrical & Electronic

Prerequisite skills: MatLab programming

Presently there is a global concern about the economic downturn and a green earth which in turn is related to a better and efficient method to generate and transmit electric power. Wind energy systems are becoming popular. Doubly fed induction generator (DFIG) is a popular wind turbine system due to its high energy efficiency, reduced mechanical stress on the wind turbine, and relatively low power rating of the connected power electronics converter. The DFIG is also complex involving aerodynamical, electrical, and mechanical systems. With increasing penetration level of DFIG-type wind turbines into the grid, the stability issue of DFIG is of great importance to be properly investigated. The aim of this project is to study the small signal stability of the DFIG wind turbine system.

Fernando, Tyrone, Prof

*Control Strategy of DFIG Wind Turbines for Power System Fault Ride Through*

Disciplines: Electrical & Electronic

Prerequisite skills: MatLab programming

Doubly fed induction generator (DFIG) is a popular wind turbine (WT) system due to its high energy efficiency, reduced mechanical stress on the WT, and relatively low power rating of the connected power electronics converter of low costs. With increasing penetration level of WTs into the grid, the wind power grid connection codes in most countries require that WTs should remain connected to
the grid to maintain the reliability during and after a short-term fault. The ability of WT to stay connected to the grid during voltage dips is termed as the low-voltage ride-through (LVRT) capability. The aim of this project is to develop a control strategy for both the rotor and grid side converters to enhance the LVRT capacity of the DFIG WT.

Fourie, Andy, W/Prof

Reducing the environmental impact of small-scale mining
Disciplines: Chemical & Process, Civil, Environmental, Mining.
Prerequisite skills: Fundamental engineering Units, such as those covered in the 3 year Engineering Science degree at UWA

Many countries around the world face increasing incidence of small-scale, often illegal mining. Known as ASM (artisanal and small-scale mining), these activities are often unregulated, infiltrated by criminal gangs, deprive countries of tax collection and cause significant environmental damage. This project will require the preparation of four separate case studies, each one from a different part of the world. These investigations will focus on issues such as the scale of mining in the selected country, regulations of these activities (if any) and quantification of environmental damage. These case studies will be conducted individually, but the group will be required to address the additional question of identifying and, time permitting, investigating techniques for inexpensive clean-up of contaminants such as mercury, which are used in these ASM activities. This topic would be very suitable for EWB students, although it would also suit any student from the list above.

Fourie, Andy, W/Prof

Optimising the performance of thickeners used in mining applications
Disciplines: Chemical & Process, Civil, Environmental, Mining.
Prerequisite skills: Fundamental engineering skills, such as those covered in the Engineering Science Units; some knowledge of geotechnical engineering preferred, but not essential.

Thickeners are used in the mining industry to separate water from the waste material (tailings) that remain after the mineral in question has been extracted. These thickeners are multi-million dollar structures, yet their operational systems are inefficient. A recent student project at UWA highlighted the importance of better understanding how the nature of the ore body affects the performance of these thickeners, and the role of variability of the thickener feed in affecting performance of these structures. This project will require investigation of various topics that influence thickener performance, such as ore mineralogy, composition of synthetic additives, residence time, etc. There will be four separate topics, with a distinct link between these topics being necessary to optimise performance.
Anatomy of the mammalian kidney and its influence on kidney
Disciplines: Chemical & Process, Computer, Electrical & Electronic, Oil & Gas

The anatomy of the kidney vasculature is very interesting in that veins are seen to wrap around arteries in a counter-current arrangement. We believe this close spatial association facilitates diffusive transport of small molecules, such as oxygen, and may explain why the kidney is at risk of developing hypoxia (not enough tissue oxygen). Hypoxia is a critical common pathway to renal disease. This project has aspects that may be suitable for a chemical engineering student i.e. modelling advective diffusive transport or a student interested in image processing of data from the Victorian Synchrotron.

Mechanics and repair of cartilage, bone and tendon
Disciplines: Chemical & Process, Civil, Computer, Electrical & Electronic, Environmental, Materials, Mechanical

We have a number of projects in the general area of modelling musculoskeletal tissues. The projects can be catered to suit a number of backgrounds, but generally we are interested in how cells sense and then respond to their mechanical and biochemical environment. Often this response is to synthesis new tissue components, so as to repair mechanical induced damage incurred during daily activity. Projects can be entirely mechanical, entirely transport related (e.g. diffusion) or entirely about control systems. Ideally each project will contain a little of each. Methods could be anything from FEM of PDEs to discrete or agent-based models.

Sludge accumulation in wastewater ponds (municipal, mining, agroindustrial)
Disciplines: Environmental, Mining

This topic will investigate different aspects around sludge accumulation in wastewater treatment plants; it might include investigating factors contributing to the amount and distribution of sludge accumulation in a variety of sectors.
Ghadouani, Anas, Prof  
Co-Supervisors: Reichwaldt, Elke, Asst/Prof

**Engineering solution to wastewater treatment**  
Disciplines: Environmental, Mining

This topic might include work into investigating the bio-physical coupling in waste stabilisation ponds; the assessment of hydrodynamics in ponds of different design; the effect of attached growth baffles on water quality improvement; the prevention of struvite precipitation in wastewater treatment plants.

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Ghadouani, Anas, Prof  
Co-Supervisors: Reichwaldt, Elke, Asst/Prof

**Water resource recovery from wastewater**  
Disciplines: Environmental, Mining

This work might include resource recovery (N, P) from waste water using bacteria or mixed algae communities.

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Ghadouani, Anas, Prof  
Co-Supervisors: Reichwaldt, Elke, Asst/Prof

**Sediment accumulation in pools in the Swan Coastal Plain and effect on biodiversity**  
Disciplines: Environmental, Mining

This project is in collaboration with the Swan River Trust. It is aimed to focus on investigating factors that contribute to sediment accumulation in small pools adjacent to the Canning/Swan River (e.g. age of pool). The topic could also include identifying biodiversity in these pools.

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Ghisalberti, Marco, Assoc/Prof

**Water resource recovery from wastewater**  
Disciplines: Civil, Environmental, Mechanical, Ocean Systems

Many environmental flows (in both freshwater and marine systems) are characterised by large-scale roughness elements on the bed, such as seagrass canopies, coral reefs and sediment bedforms. This roughness causes the flow to deviate significantly from archetypal boundary layer
flow. This project involves the creation of physical models in the laboratory to investigate flow, turbulence and mixing in the bottom boundary layer of environmental systems.

Graham, Brendan, Dr
Co-Supervisors: Johns, Mike, W/Prof & May, Eric, W/Prof

Hydrocarbon Fluid Characterisation
Disciplines: Chemical & Process, Mechanical, Oil & Gas

In the production and transport of oil and gas, three solids may form as a consequence of cooling process fluids: gas hydrates, asphaltenes, and wax. The cost of preventing formation of these solids is a limiting factor in the design of subsea systems, and represents a limitation of the industry’s reach into deep water. As these solids form, they will change the crude oil composition and will share interfaces with gas, water and the pipeline wall. This project will focus on experimental measurement of simple properties (such as interfacial tension, or water wetting angle) to help guide the development of chemical inhibitors to prevent these solids from blocking the flowline, ultimately enabling the next generation of oil and gas production.

Graham, Brendan, Dr
Co-Supervisors: Johns, Mike, W/Prof & May, Eric, W/Prof

Development and Implementation of Chemical Engineering Laboratories
Disciplines: Chemical & Process, Mechanical, Oil & Gas

Over the last couple of years the School has acquired a number of leading edge experimental rigs designed from enhanced practical chemical engineering teaching. These rigs cover processes such as absorption, refrigeration, distillation/rectification, and mass balance. This project will focus on the development of (a) practical experiments to enhance the learning experience of chemical engineering undergraduates; (b) student practical assignments based on the developed experiments in (a) to reinforce concepts taught in class and maximise the potential of the teaching apparatus; (c) training manuals for laboratory demonstrators.

Guzzomi, Andrew, Research Asst/Prof
Co-Supervisor: Liu, Yinong, W/Prof

Engineered structural wood products
Disciplines: Civil, Mechanical

Designing and developing structural materials using small section timber for novel uses such as
glulam and laminated veneer lumber (LVL) has the potential to revitalise the south west timber industry. This particular project focusses on the research and development (R&D) of engineered beams comprising small section and short length timber. The project will involve: state-of-the-art literature review (of technical papers and standards); mechanical characterisation of individual off-cut/small section pieces and composite beams (moisture, hardness, stiffness etc.); experimental and theoretical investigation into the performance of different composite layouts (glue-joint performance, effect of joint geometry and orientation etc).

Guzzomi, Andrew, Research Asst/Prof
Co-Supervisors: Silva, Dilusha, Prof & Walsh, Michael, Research Assoc/Prof

Drones, ground engaged robots and site-specific weed management
Disciplines: Computer, Electrical & Electronic, Environmental, Mechanical, Mechatronics

Sustainability of Australian grain production is challenged by the widespread evolution of herbicide resistance in weed populations and the subsequent rising costs of weed control. Current crop-weed control is practiced on a broad acre basis with blanket applications of herbicides applied across vast areas regardless of the distribution of infesting weeds. This is neither efficient, nor sustainable. This project aims to engineer solutions that optimise weed control in cropping systems by removing the inefficiencies of off target herbicide applications. Research and development will focus on ground engaged (robotic tractors etc.) and/or aerial (UAV, novel personnel flying devices) weed identification and mapping systems and on targeted herbicide/tillage devices for broadacre application.

Guzzomi, Andrew, Research Asst/Prof
Co-supervisors: Merritt, David, Adjunct Senior Lecturer & Dixon, Kingsley, W/Prof

Agricultural engineering for rehabilitation of remote mining operations
Disciplines: Computer, Electrical & Electronic, Mechanical, Mechatronic

Agricultural engineering is important for Australia’s sustainable future, especially in WA as the state moves beyond a mining based economy. This project focusses on mine rehabilitation using a multidisciplinary approach. The research and development (R&D) project will be undertaken in collaboration with Kings Park and Botanic Gardens (KPBG), who operate a leading mining restoration research group, and build on the state-of-the-art produced over the past year. Specific R&D opportunities related to Australian native grass species are: developing seed coating technologies, seed pelleting, broadacre precision sowing, automation as well as other challenges present in remote mining operations. The outcomes should also be applicable to the agricultural sector (i.e. farming) and areas suffering from desertification. To facilitate field trials next winter, KPBG will offer one student a $7000 tax-free stipend for a period of 12 weeks and operating costs,
to commence in early December 2014. Applications are to be submitted to Dr Andrew Guzzomi via email.

Hodkiewicz, Melinda, Prof
Co-Supervisor: Keating, Adrian, Prof

The run-to-failure project
Disciplines: Computer, Electrical & Electronic, Mechanical, Mechatronic
Prerequisite skills: Good knowledge/understanding of MECH4424 Noise and Measurement or equivalent EE units or experience in Arduino programming. There is also the option of some Labview, Matlab or Python programming for the diagnostics.

We are setting up a new laboratory (the System Health Lab) which will build and fail assets. The assets are custom designed (small) cars running on parallel tracks.

We are looking for students from interested in developing the sensing systems (temperature, vibration, image etc), testing the units and developing diagnostic tools.

This year we will instrument the assets to monitor the progress of specified failure modes. Following this we will perform diagnostics and identify and test suitable prognostic and reliability models.

Hodkiewicz, Melinda, Prof

Reliability Block Modeling of Heavy Mobile Mining equipment
Disciplines: Mechanical, Mining
Prerequisite skills: Good knowledge/understanding of GENG5507

The aim is to build reliability block models for heavy mobile equipment (trucks, graders, loaders, excavators) to explore effects of alternative maintenance schedules. We have data for several sub-systems but need to work out how the sub-systems are connected and develop reliability distributions for missing sub-systems and find (from industry) what maintenance is currently done and when.

The modelling will be done using the commercial software Avsim which is widely used in industry. You will need to be comfortable with stats as we have to run some tests on the data but you also need to be interested in relating the stats results to what is actually going on from an engineering perspective. A knowledge or interest in how machines work is a must.

Hu, Xiao Zhi, W/Prof
Design and manufacturing of thin ceramic plates for mobile phones
Disciplines: Materials, Mechanical

(no additional information)

Huynh, Du, Assoc/Prof (CSSE)
Co-Supervisors: Rosenberg, Michael, Assoc/Prof (SSEH)

Assessment of Fundamental movements using the Kinect Sensor
Disciplines: Computer, Mechatronic, Software

The aim of this project is to obtain objective estimates of 7 to 11 year old children’s movement proficiency using the Microsoft Kinect Sensor. We propose to develop a software driven tool that can interpret movements from videos captured by the Kinect Sensor while children perform four fundamental movements. The innovation behind the Kinect hinges on advances in skeletal tracking. In computer generated skeletal tracking, a human body is denoted by a number of joints representing body parts, each of which is further characterised by its 3D coordinates. The Kinect Sensor captures the positions of 20 body joints every 30 seconds in three-dimensional space, providing an accurate representation of the major body segments. The Kinect Sensor’s skeletal tracking ability is designed to work for every person on the planet, in every household, without any calibration. We have already developed software capable of capturing Kinect Sensor data to count the range and frequency of different movements (for example, jumping, throwing and sidesteps) while children play movement-based video games. However, the current software is unable to process the more complex task of determining the quality of children’s movements. Taking on this project, the student is expected to apply machine learning and computer vision techniques with the software development phase of the research. The results of this project will contribute towards a validated objective measurement tool for determining children’s movement proficiency using off-the-shelf hardware and tailored software.

Huynh, Du, Assoc/Prof

Visual tracking using sparse appearance models
Disciplines: Computer, Software

The aim of this project is to track an object in videos. The focus is on how to represent the object to be tracked so as to better handle partial occlusion and changes in appearance of the object. One of the techniques is to have a number of canonical representations of the object (in the form of templates) and adaptively update the representations along the way. Other issues to research on
include how to minimize the number of templates and the update criteria and frequency. This project suits those students having some background in optimization techniques.

**Johns, Mike, W/Prof**
Co-Supervisors: Graham, Brendan, Dr

**Oilfield Water Management**
Disciplines: Chemical & Process, Mechanical, Oil & Gas

Natural gas (and oil) extraction results in the production of substantial quantities of (formation) water. This water is required to be discharged back to sea following separation from the hydrocarbon fluid. Increasingly this separation is being pursued sub-sea, such that water treatment on the surface is avoided. Such sub-sea technology is particularly relevant to floating LNG production facilities. We are currently developing technology to both monitor the ppm oil contamination of this discharge water such that it is compliant with environmental legislation, as well as the use of novel NMR-based flow metering methods for oil/gas/water production flow quantification. Projects are available in which further validation of these technologies will be conducted as well as their adaptation for sub-sea deployment. We also consider optimum desalination of sea water for the provision of required process water and the effective separation of frequently encountered and troublesome water-in-crude oil emulsions into their constituent parts.

**Johns, Mike, W/Prof**
Co-Supervisors: May, Eric, W/Prof

**Carbon Sequestration**
Disciplines: Chemical & Process, Mechanical, Oil & Gas

Western Australia will soon be the world-leader in the geo-sequestration of carbon dioxide. Both the Gorgon project and the recently announced South West CCS Hub will store millions of tonnes per annum of CO$_2$ in saline aquifers. Two of the most important but least understood mechanisms by which CO$_2$ remains trapped in these aquifers are residual trapping and solution trapping. Research projects will be conducted to enable better prediction of the extent of these two trapping mechanisms.

Western Australia has several major offshore gas assets containing significant quantities of carbon dioxide. Scenarios for dealing with this CO$_2$ must be developed before these gas fields can be developed. One scenario involves the re-injection of carbon dioxide produced from one reservoir into the extremities of a different natural reservoir for the purpose of both CO$_2$ disposal and
enhanced gas recovery. However, such a strategy is only viable if the probability of breakthrough by the re-injected CO₂ to the producing wells is small. Simulating reliably this novel reservoir production scenario requires an improvement in our fundamental understanding of the hydrodynamic behaviour of supercritical CO₂ in heterogeneous gas and water-saturated rock. Research projects are available measuring this behaviour as well as its inclusion into relevant field simulations.

Joldes, Grand, Assoc/Prof  
Co-Supervisors: Doyle, Barry, Asst/Prof

**Stress modeling in vascular aneurisms**  
Disciplines: Mechanical  
Prerequisite skills: Finite Element Modeling (Abaqus, Ansys)

Abdominal aortic aneurysm (AAA) is a symptomless disease and has earned itself the reputation ‘the silent killer’. AAA rupture kills nearly 4 Australians every day and surgical repairs cost the national health system ~$230m/year. Importantly, the majority of these operations may be unnecessary as only 10% of cases ever rupture. If we could reliably predict which cases are at risk of rupture and which are not, we could save many lives and reduce the huge associated medical costs. Patient-specific modeling (PSM) is fast becoming a useful risk assessment tool. This project involves the modeling of AAA using the finite element method and the computation of stresses in the vascular wall under the effect of blood pressure.

Jones, Nicole, Assoc/Prof

**Internal tides on the Australia Northwest Shelf**  
Disciplines: Chemical & Process, Civil, Environmental, Mechanical, Ocean Systems, Oil & Gas.  
Prerequisite skills: Matlab skills are desirable for this project.

Tidal motions and internal waves generated by these tides (internal tides) are of special importance to the physical oceanography of the Australian North West Shelf (NWS). The internal tide is generated at the shelf break and as it propagates inshore it can evolve into highly non-linear solitary wave trains that induce intense near-bottom motions that drive significant turbulent mixing; affecting the vertical fluxes of heat, nutrients and biological material over the water column. In addition to such ecological effects, these energetic flows impact on offshore structures and influence sediment mobilization and scour; this affects the stability of offshore structures and pipelines. Failure to accurately estimate these effects can have potentially serious implications for oil and gas operations, as well as the environmental damage associated with pipeline failure and spillage. This project will involve the analysis of field observations to better understand the internal tide on the NWS.
Jones, Nicole, Assoc/Prof

Oceanography of the coastal Kimberley
Disciplines: Chemical & Process, Civil, Environmental, Mechanical, Ocean Systems, Oil & Gas.
Prerequisite skills: Matlab skills are desirable for this project.

The tropical central coast of the Kimberley in northwestern Australia contains an extensive system of islands and reefs that interact with its extreme tides. This region has a broad continental shelf (~200 km in width) with a morphologically complex coastal region, where drowned river valleys have formed deep and narrow inlets, and isolated ridges have evolved into extensive island archipelagos. The tides are semidiurnal, with tidal ranges among the highest in the world; spring tides reach up to 11 m and result in current speeds in excess of 2 m/s (Anon, 1972). Combined with this region’s tropical monsoonal climate, these unique conditions have produced a very ecologically diverse marine ecosystem, with marine communities including coral reefs, seagrass meadows, mangrove forests and sponge gardens. This project will use existing data sets to examine the biological and physical oceanography of an example mid-Kimberley coastal region.

Keating, Adrian, Prof

Thermal mapping of structures at the microscale
Disciplines: Computer, Electrical and Electronic Materials, Mechanical and Mechatronic Software
Prerequisite skills: This is an interdisciplinary project. An understanding of measurement systems (such as obtained through MECH4424) would be valuable. MatLab/Mathematica required.

This project investigates the thermal properties of porous films at the microscale. The nano sized pores in the films can be used to tailor the thermal properties, which is useful for applications such as next generation thermal sensors and night vision systems. Techniques will be reviewed and compared, and depending on the skills of the applicants, experimental test beds will be designed and developed to undertake measurements of these films. The performance of night vision systems strongly depends on the thermal conductivity and heat capacity of films. Night vision systems are longer term expected to appear first in vehicles and later in mobile devices (once technology and cost barriers can be overcome), and will be pervasive in medical and industrial monitoring systems.

Keating, Adrian, Prof

Understanding noise in films at the microscale
Disciplines: Computer, Electrical and Electronic, Materials, Mechanical and Mechatronic Software
Prerequisite skills: This is an interdisciplinary project. An understanding of measurement systems (such as obtained through MECH4424) would be valuable. MatLab/Mathematica

This project investigates the noise that porous thin films produce, particularly Johnson (thermal) noise and 1/f noise. The mechanism for 1/f noise is not well understood and less so in porous films. This work will be review, compare and contrast the noise in these films, and depending on the skills of the applicants, experimental test beds will be designed and developed to undertake measurements of these films. An understanding of noise in these films is particularly important for next generation thermal sensors and night vision systems as longer term these technologies are expected to appear first in vehicles and later in mobile devices (once technology and cost barriers can be overcome).

Kim, Youngho, Research Associate
Co-Supervisors: Hossain, Muhammad Shazzad, Assoc/Prof

Investigation of Dynamically Installed Anchors (DIAs)
Disciplines: Civil, Oil & Gas
Prerequisite skills: Basic knowledge of geotechnical engineering principles

Dynamically Installed Anchors (DIAs) are a recent type of mooring technology that have been shown to provide a cost-effective alternative to other forms of anchoring system in deep water clayey sediments. These anchors are released from a designated height above the seafloor, causing the anchor to penetrate into the seabed by the kinetic energy obtained through ‘free-fall’ and through the self-weight of the anchor.

The project will investigate the behaviour of DIAs in clay at different impact velocities and soil conditions using Finite Element Method (FEM) and theoretical solutions.

Kurup, Raj, Dr

Assessment of nutrient removal capability of constructed wetlands using industrial waste products as bed media
Disciplines: Chemical & Process, Civil, Environmental, Mechanical, Mining
Prerequisite skills: Chemistry, physics, hydraulics / fluid mechanics

Constructed wetlands offer a low carbon solution for wastewater treatment systems. The capital costs of such systems have been found to be higher than conventional treatment system due to the cost of bed media. This project aims to investigate the potential benefits of using industrial by-products as bed media for constructed wetlands. In the previous study, it has been found that the certain industrial by-products are capable of high level of nutrient removal, at the same time
reducing the overall cost of the wastewater treatment system. Along with understanding the dynamics of the media, isotherm studies will be undertaken to determine the maximum removal capacity of nutrients from wastewater. Also, the project will result in design of different types of constructed wetlands systems using industrial waste products.

For this project students start their research in December, the hours spent on the project during summer break can be included as work experience.

It is expected to commence the project in December 2014. The project work undertaken during the summer break will count towards the industry training period of 12 weeks.

Kurup, Raj, Dr
Co-Supervisors: Kurup, Biji, Dr (EEI)

**Moringa Oleifera Seed Extract as a Natural Coagulant for Water Treatment**

Disciplines: Chemical & Process, Civil, Environmental, Mechanical
Prerequisite skills: Physics, Chemistry

This study focuses on the application of Moringa oleifera (M. oleifera) seeds as a natural coagulant and disinfectant for drinking water treatment for remote and regional locations and during extreme weather events when the natural water supply is contaminated. Previous studies have shown that M. oleifera possess treatment capability similar to conventional chemicals. The project will have two components:

a) Optimisation of water treatment using M. oleifera seed extracts
b) Sustainability assessment of water treatment using M. oleifera seed extracts

For this project students start their research in December, the hours spent on the project during summer break can be included as work experience.

Leggoe, Jeremy, Assoc/Prof

**Discrete Element Modelling of Transfer Chutes for Difficult Iron Ores**

Disciplines: Chemical & Process, Mechanical, Mining

The Discrete element method is commonly used by consultants to evaluate transfer chutes used in the transport of materials in mines. While the technique works well for some ores, there are questions as to whether the technique is capable of accurately modeling the behaviour of iron ores.
Iron Ores often comprise a mixture of lump and fine materials, meaning that a particle size distribution must be accounted for in models. The moisture content of the ores is highly variable, depending on the site, weather conditions and particle size, and this too affects transport behavior in a way that has not yet been satisfactorily modeled. The objective of this project is to establish a DEM modeling capability in the school, and to explore techniques that might be used to accurately model the behaviour of iron ores commonly encountered in the states mines.

Leggoe, Jeremy, Assoc/Prof  
Co-Supervisors: Liu, Wei, Asst/Prof

**Development of a Fluid Mechanics Teaching App**  
Disciplines: Chemical & Process, Mechanical  
Prerequisite skills: Successful completion of ENSC3003 or CHPR2433 (Fluid Mechanics); Interest in App development, Interest in Computational Fluid Dynamics.

The objective of the project is to develop an app for the unit ENSC3003 (Fluid Mechanics) that will ultimately bring together course lecture notes, both text and video, example problems for use in self-directed learning, distribution and marking of assignment problems for assessment, and weekly online quizzes. The app would represent the next generation in the development of online courses, and greatly enhance the teaching of the unit (and could potentially be used in future MOOC offerings). To accomplish this, we are looking for a team of students to accomplish the following tasks:

- Development of the software and server platform
- Development of animations, including some based on CFD models, for use in the online lectures
- Identification of key learning difficulties in fluid mechanics, based on past assignment and exam archives, and the development of teaching materials to address this difficulties (including sourcing materials from related courses, such as mathematics)
- The development of example and assignment problems to support both self-directed learning and assessment

Lehane, Barry, W/Prof  
Co-Supervisors: Lim, Jit Kheng, Mr

**Improving pile design methods**  
Disciplines: Civil, Oil & Gas, Software  
Prerequisite skills: Geotechnical Engineering

Recent projects have highlighted deficiencies in number of different areas of pile design. These will be addressed as part of this project and will include (i) examination of the capacity of CFA piles in Perth’s alluvial soils, (ii) the axial capacity of driven pipe piles and (iii) pile behaviour in residual...
soils. Students will be required to assist with field and laboratory experiments, conduct statistical analyses and perform PLAXIS computations. One of the focus points of the project will be the modelling of the uncertainty of pile capacity predictions and some statistical and programming experience is desirable. A number of PhD students will assist project supervision.

Lehane, Barry, W/Prof
Co-Supervisors: Truong, Pauline, Ms; & O’Loughlin, Conleth, Assoc/Prof

**Modelling soil behaviour**

Disciplines: Civil
Prerequisite skills: Geotechnical Engineering

This project will involve the testing of various numerical models to predict the response of (i) soft clay under and after the surcharging imposed at the site of the new Perth stadium, (ii) residual soil adjacent to a footing and laterally load pile and (iii) sand beneath a spread footing. Each component of the project will involve both experimental and numerical research.

Li, Xiaopeng, Asst/Prof
Co-Supervisors: Sercombe, Tim, Prof

**Fabrication of Metallic Glass Coatings via Selective Laser Melting**

Disciplines: Chemical & Process, Materials, Mechanical

Metallic glass (MG) is a class of advanced material with a range of unique mechanical and chemical properties due to its amorphous microstructure. For example, Al-based MG has an extremely high corrosion resistance while Fe-based MG has a combined property of super high strength and wear resistance, compared to their crystalline counterparts respectively. Both of them are promising in application as coating materials, the global market value of which exceeds $A120 billion in 2012. However, fabrication of MG coatings through conventional methods (e.g. sputtering) can result in weak interface bond, devitrification and undesired pore formation. In contrast, selective laser melting (SLM) provides an alternative to the fabrication of MG coatings free from abovementioned drawbacks due to its advantageous “point-by-point” processing manner. Therefore in this project, the influence of SLM processing parameters on the fabricated MG coatings will be investigated, which will provide necessary insights into fabrication of MG coatings with desired properties.
Liu, Jishan, Prof

**Shale Gas Reservoirs: Evolution and In-Situ Control of Permeability**

Disciplines: Oil & Gas, Petroleum  
Prerequisite skills: PETR3511 (Reservoir Engineering) and PETR4511 (Reservoir Simulation)

Unlike conventional gas reservoirs, shale permeability changes during gas production. The goal of this project is to quantify the evolution of shale permeability and to develop a set of strategies how to control the change in-situ.

Liu, Jishan, Prof

**CO2 Sequestration in Coal Seams: Injectivity and In-Situ Control**

Disciplines: Oil & Gas, Petroleum  
Prerequisite skills: PETR3511 (Reservoir Engineering) and PETR4511 (Reservoir Simulation)

CO2 can be stored in coal seams and its injectivity is largely controlled by the evolution of coal permeability. The goal of this project is to quantify the evolution of coal permeability during the CO2 injection and to develop a set of strategies to optimize the injection.

Liu, Yinong, W/Prof  
Co-Supervisors: Yang, Hong, Prof

**Subsea Pipeline Corrosion**

Disciplines: Oil & Gas, Petroleum

This project involves experimental investigation of corrosion of experimental subsea pipeline samples using corrosion probes and seawater sample analysis of corrosion inhibitor residuals, bacterial level and dissolved oxygen. The project is with a local industry, and it has very strong emphasis on continued commitment and timely progress.

Lu, Hervert Ho-ching, Prof

**Study of Multi-Structure Multi-Operating-Mode Hybrid Power Conversion Systems with Renewable Energy Sources**

Disciplines: Electrical & Electronic  
Prerequisite skills: Good mathematical skills and simulation/ hardware skills
Due to the growth of usage of renewable energy, multi-input single-output converters become popular. The aim of this project is to design multi-structure multi-operating-mode power electronics systems using the fundamental power flow and circuit theory. Stability analysis and transient analysis will be performed. Good mathematical skills and simulation/hardware skills are essential in this project.

Lu, Hervert Ho-ching, Prof

**Development of memristor based relaxation oscillators**

**Disciplines:** Electrical & Electronic  
**Prerequisite skills:** Good mathematical skills and simulation/hardware skills

In this project, a memristor based relaxation oscillator will be developed. A flux-controlled memristor emulator with floating terminals by making use of four current conveyors has been proposed. By replacing the three resistors in the positive and negative feedback loops of a typical relaxation oscillator respectively, three cases of memristor emulator based oscillating circuits can be theoretically constructed and mathematically analysed. This new memristor emulator based oscillator will provide novel and steady oscillating behaviours.

Marti, Clelia Luisa, Research Assoc/Prof  
Co-supervisors: Imberger, Jorg, Prof

**Quantifying nutrient cycling in the Peel-Harvey Estuarine System**

**Disciplines:** Civil, Environmental, Ocean Systems  
**Prerequisite skills:** Prior knowledge of Matlab is preferable.

The Dawesville Cut, joining the Peel Inlet and Harvey Estuary to the adjacent ocean, was originally designed with the Centre for Water Research (CWR) participation, to improve the flushing of the estuary. The Cut was a great success, but the construction was coupled with a recommendation to lower the phosphorous loading coming into the estuary from neighbouring agriculture. Recently, the algal concentrations, in the estuary, have once again been increasing. The objective of this project is to do a nutrient loading inventory and use this to simulate the algal growth in the Peel-Harvey Estuarine System using the CWR modelling suite and develop strategies for water quality improvements.

Marti, Clelia Luisa, Research Assoc/Prof  
Co-Supervisors: Imberger, Jorg; Prof

**Understanding of Lake Monger's functioning**
Disciplines: Civil, Environmental
Prerequisite skills: Prior knowledge of Matlab is preferable.

This project will involve the acquisition of new field data and hydrodynamic and ecological modeling to gain a full understanding of the functioning of Lake Monger (Perth) in terms of nutrient dynamics and pathogens, with all sources identified, amelioration strategies defined and a functional model.

May, Eric, W/Prof
Co-Supervisors: Graham, Brendan, Dr

Natural Gas Processing
Disciplines: Chemical & Process, Mechanical, Oil & Gas

FSD 1(a): Natural Gas and LNG property prediction
Unplanned shutdowns of LNG plants caused by hydrocarbon solids blocking cryogenic heat exchangers are a major, ongoing problem for the industry. Current methods of avoiding them are costly and energy intensive. In addition, LNG production systems are over-engineered because the predictions of process simulators are unreliable. Furthermore, the natural gas industry needs new thermo-physical property data at high-pressures and low temperatures to develop more efficient processes capable of handling more problematic gas reserves. These projects aim to develop new predictive models to avoid shutdowns and improve plant efficiency, and/or improve the reliability of process simulator predictions by anchoring their underlying thermodynamic models to data characteristic of realistic LNG fluids and conditions. Students working on these projects will help develop or improve models that predict crucial properties such as vapour-liquid and solid-liquid equilibrium, density, heat capacity, viscosity, surface tension or thermal conductivity for binary and multi-component hydrocarbon mixtures. This will be done by combining state-of-the-art measurements of these properties with new property package models in process or multi-phase flow simulation software.

FSD-1(b): Advanced Natural Gas Separation Technology
Carbon dioxide capture, whether from natural gas streams or from flue gases, is an important and increasing area of research with significant implications for our economy and environment. N₂ capture from natural gas is increasingly important in the development of LNG projects where this component is energetically parasitic. These projects will look at the use of novel materials for improved capture efficiency that are either solid adsorbents, including carbons, zeolites and calixarenes, or liquid solvents, such as transition metal complexes. Students working on these projects will help develop and characterise the separation performance of new materials synthesized in our laboratory over a wide range of temperature, pressure and mixture
compositions, and/or use the results of such experiments to develop numerical models of advanced industrial separation processes.

May, Eric, W/Prof  
Co-Supervisors: Johns, Mike, W/Prof  

Flow Assurance and Natural Gas Hydrates  
Disciplines: Chemical & Process, Oil & Gas

Natural gas hydrates are ice-like solids that form and can often suddenly stop the flow during oil and gas production. The cost of their prevention during design and production is high and the removal of hydrate plugs is expensive and dangerous. Today hydrates are still a major flow assurance concern especially as production moves to deeper water, and many of Australia’s major new gas field developments are considering innovative approaches to this long-standing problem. These projects aim to provide the knowledge needed for a risk-based approach to hydrate management by establishing quantitative model to assess plugging potential, optimize inhibitor doses, and develop methods to detect hydrate formation and location using novel technologies. The outcomes will help reduce chemical use by the industry, provide better methods to locate plugs and provide safer methods for their remediation, ultimately allowing for the reliable and economic development of marginal oil and gas fields. Students working on these projects will measure and/or model hydrate formation, agglomeration and dissociation processes. Naturally-occurring gas hydrates also represent a tremendous energy reserve: in early 2013, first production was reported from a naturally occurring hydrate reserve located offshore the coast of Japan. Projects will also be available in which various properties of these natural hydrates are quantified, such that more informed decisions regards the exploitation of natural hydrates can be made.

McCormick, Paul, Emeritus Prof  

Modelling and optimisation of domestic solar power system II  
Disciplines: Computer, Electrical & Electronic, Mechanical, Software  
Prerequisite skills: high level analytical and computing skills

The aim of the project is to design and model the performance and economics of solar electric systems. This project follows on from a 2014 project of the same name which focused on solar radiation modelling, system components, design, system analysis and optimisation. The project this year will extend to refinements in system design, economic modelling and evaluation of short and long term strategic opportunities.
Each member of the project team will be responsible for a particular aspect of the project, which has the overall objective of arriving at optimally designed solar systems.

**McLaughlin, Robert, Assoc/Prof**  
**Co-Supervisors: A/Prof Rodney Kirk**

*Image processing and Visualisation of Optical Imaging Data*  
**Disciplines:** Computer, Electrical & Electronic, Software  
**Prerequisite skills:** C, C++ or Java

This project will develop image processing and visualisation algorithms for high resolution imaging data in biomedical applications. The Optical + Biomedical Engineering Lab develops new medical imaging techniques for a range of diseases, including cancer detection and intra-operative guidance. Depending on the student’s aptitude, this topic contains a range of potential software development subprojects, including implementing algorithms for visualisation of very large data sets; automated techniques to quantify medical images; and algorithms for tissue detection. Students are required to be experienced in one of the following languages: C, C++, Java. It is expected that some algorithm development will be done in Matlab.

**Morkel, Gerhard, Asst/Professor**  
**Co-Supervisors: Wesseloo, Johan, Dr**

*Geomechanics Projects*  
**Disciplines:** Civil & Mining  
**Prerequisite skills:** Mathematics: Credit Pass. Programming: Matlab or other general programming skills.  
*Students placed in Geomechanic’s Projects will be offered topics from the following list, at the discretion of the Centre for Geomechanics*

1. Discrepancies between local networks and regional networks:  
It is common for mine networks with limited frequency ranges to under-record seismic source parameters. These source parameters are used to determine the local magnitude of seismic events, which plays a critical role in determining Seismic hazard at sites. The ground support design will not be sufficient if the seismic hazard is under estimated. It is proposed that the Geoscience Australia database (regional network) is used in conjunction with local seismic networks to determine the extent of under recording. Furthermore, to follow Mendecki (2013) to determine if the frequency range deficiencies in local networks can quantify the under recording of seismic parameters.  
Mendecki, A. J. (2013). Frequency Range, log E, log P and Magnitude. Proceedings 8th...
International Symposium on Rockbursts and Seismicity in Mines, St Petersburg-Moscow, Russia, edited by A. Malovichko, R. Dyagilev, and DA Malovichko.

2. Developing a generic strong ground motion equation for peak particle:
PPV (Peak particle velocity) is used to determine the dynamic component of a ground support design. Kaiser, MacCreath et al. (1996) suggests a PPV scaling law which is useful for determining ground movement outside of the event source radius. However, this law overestimates the PPV-values inside the event source radius. (Potvin and Wesseloo 2013) suggest a modified PPV scaling law, which saturates as it nears the event source radius. Although useful, this work still requires validation and or calibration. This project will determine a suitable PPV equation based on site specific data, which conforms to the above mentioned papers.Kaiser, P. K., et al. (1996). Canadian rockburst support handbook, Geomechanics Research Centre.Potvin, Y. and J. Wesseloo (2013). "Towards an understanding of dynamic demand on ground support." Journal of the Southern African Institute of Mining and Metallurgy 113(12): 913-922.

3. Seismic hazard analysis for different Australian mines:
Lasocki (1993) showed how the seismic hazard can be quantified per time unit per volume unit. Furthermore, he illustrated that in some case studies there is a good relationship between the seismic hazard and the occurrence of large events. However, the majority of these case studies were done on Polish coal mines. There is a need to use his methodology and investigate the properties and characteristics of the Australian mining environment. Specifically, the differences between drill and fill, open stope and cave mining. Lasocki, S. (1993). "Statistical short-term prediction in mining induced seismicity." Rockbursts and Seismicity in Mines 93: 211.

4. Dynamic wave propagation analysis:
Daehnke (1997) performed laboratory tests to study the wave-excavation interaction. The tests consisted of detonating a small charge at the surface of a metal block. Photo-elastic material was stuck to the section view of the block and the wave propagation was captured with the use of a high speed camera. This study will aim to reproduce the laboratory results from Daehnke (1997) with 2D open source and or commercially available software.

5. Investigating the performance of different methods of estimating the next largest seismic event: In the Australian mining environment there are numerous methods for determining the maximum expected magnitude of future seismic events. The most widely used methods include, statistical determination techniques, energy balance methods, theoretical calculations based on mining spans, and calculations based on rockmass properties. In this project the aim is to determine the maximum expected magnitude for different Australian mining sites, based on the different techniques, and then discuss the results in terms of which techniques are most relevant.

Oldham, Carolyn, W/Prof
Co-supervisors: Ocampo, Carlos, Asst/Prof.

Water sensitive urban design (WSUD) in areas with significant groundwater – surface water interactions - Mandurah and Byford
Disciplines: Chemical & Process, Civil, Environmental

High groundwater tables across the Swan Coastal Plain rise under urbanization, constraining development options as well as impacting on ecosystem health. These inter-disciplinary projects will explore a) the interaction between geomorphology, sediment transport and WSUD elements, b) changing landscape connectivity under urbanization, c) seasonal variation of water budget for sub-surface drainage and filtration basins used for management of high groundwater tables and d) how we link engineering technical understanding of urban development to planning and regulatory frameworks. The projects will involve data analysis, field work and modelling.

Oldham, Carolyn, W/Prof
Co-Supervisors: Ocampo, Carlos, Asst/Prof.

Water and nutrient budgets in areas with significant groundwater – surface water interactions - Jenkins Weir, Waroona
Disciplines: Chemical & Process, Civil, Environmental

Land development may alter wetland water and nutrient budgets and nutrient export to receiving waters, in this case the Peel Harvey Estuary. These inter-disciplinary projects will explore a) the interaction between geomorphology, sediment dynamics and the wetland, b) changing landscape connectivity, c) seasonal variation of water and nutrient budgets and d) the impact of engineering works on restoration of hydrology and nutrient status. The projects will involve data analysis, field work and modelling.

Could take 1 electrical engineer. Rest need to be Env/Civil/Chem.
Oldham, Carolyn, W/Prof  
Co-supervisors: Baillie, Caroline W/Prof; Mercer, Ken W/Prof; Chua, Hui Tong W/Prof; Fourie, Andy W/Prof

Engineering for Communities  
Disciplines: Chemical & Process, Civil, Environmental, Mechanical, Mining, Ocean Systems

Engineers working in remote locations need to work collaboratively with local communities to explore innovative solutions to minimize potential negative impacts and to ensure long-term benefits flow to these communities. This topic aims to benefit remote communities via a range of projects including the restoration of a degraded river, the management of mine water, the cleanup of environmental damage caused by mining, and community engagement in mine sites.

Pan, Jie, W/Prof  
Co-Supervisors: Ju, Li, Assoc/Prof

Advanced Vibration Isolation  
Disciplines: Computer, Electrical & Electronic, Mechanical

Mechanical Engineering and Physics have been collaborating on the development of ultrahigh performance vibration isolation systems for many years. A team consisting of Jie Pan (Mech Eng) Li Ju, David Blair and Chunnong Zhao (Physics) and 4 PhD students (now completed) developed extremely high performance vibration isolators for gravitational wave detection.

Our multistage isolators use various types of novel anti-springs and linkages to synthesise very low frequency isolation structures. These structures have been used to suspend mirrors for experiments related to gravitational wave detection. The systems are able to reduce seismic vibrations that are normally in the micron range, down to nanometers. We are currently using these isolators to create optical standing waves between supermirrors with more than 30kW of optical power.

This project will aim for a 10-fold improvement in these state of the art isolators, with a particular aim of reducing vibrations at frequencies below 1Hz. This will be achieved using 4 techniques together:

a) through use of new advanced digital control technology,
b) electrostatic force actuation on suspended mirrors,
c) careful measurement of signal correlations and cross coupling effects for control system optimisation and
d) through optimising the balance of feed forward and feedback.
Each team member will focus on one of the topics above, while working as a team to achieve a major outcome. Results will be published in an international journal.

Much of the summer work will take place at the Gingin Gravity Precinct where the vibration isolators are installed. Students will stay as a team in our pleasant accommodation facility for a few nights per week.

During the final year project most of the work will take place on the UWA campus. Remote control, and monitoring allows remote testing. During semester students will not need to visit the site except for brief trips for hardware installation. Contact Jie Pan (jie.pan@uwa.edu.au) and Li Ju (li.ju@uwa.edu.au) if you are interested.

Parish, Giacinta, Prof
Co-Supervisors: Nener, Brett, Prof

**Transistor-based chemical sensors for contaminant monitoring**

Disciplines: Chemical & Process, Electrical & Electronic, Environmental, Materials, Mechanical, Mechatronic

Reliable, economically accessible technology for in situ monitoring of contaminants in water has the power to transform health, industry, and society the world around. Applications of such monitoring range from process control monitoring and optimisation for industry, to water supply quality and wastewater monitoring, to environmental monitoring for resource extraction, and beyond. The microelectronics-based technology under investigation in this project will enable in situ, real-time contaminant monitoring that is accurate, reliable and low-cost. Semiconductor-based technology offers high performance and can also be mass produced at low-cost with flexible functionalisation allowing for a variety of analytes. Furthermore, it offers the ability to integrate multiple sensors into one chip, along with wireless communication technology for maximum benefit of the in situ monitoring capability.

Students will work together on the one or more of following integrated project components (and will also work alongside students working in the adjacent projects on “transistor-based biosensors”).

1. Physical, chemical, materials characterisation of functionalisation methods, particularly surface studies
2. Electrical, chemical and physical characterisation and optimisation of functionalised ion sensors
3. Mechanical, electrical and chemical characterisation and optimisation of packaging techniques
4. Design and integration of complementary sensors (pH, temperature, drift compensation) to maximise reliability.
5. Adapt device design, packaging, measurement protocols for reliable, reference electrode free, operation.
Parish, Giacinta, Prof  
Co-Supervisors: Nener, Brett, Prof

**Transistor-based biosensors**  
Disciplines: Electrical & Electronic, Materials, Mechanical, Mechatronic

The ability to monitor biological and chemical signals with an electronic device is a tremendously innovative approach for cell research and process control in pharmaceutical and microbiological production, and chemical sensing applications. A bio-friendly, chemically inert and stable III-Nitride-transistor-based bio/chem-sensor will be developed to detect responses to various specific compounds/chemicals, particularly through cell receptors. The successful development of this electronic biosensor technology has the potential to improve health and disease treatment through major improvements in throughput, precision, quality, speed and simplicity of, for example, drug and disease testing methods.

Students will work together on the one or more of following integrated project components (and will also work alongside students working in the adjacent projects on “transistor-based chemical sensors for contaminant monitoring”).

1. Physical, chemical, materials and biological characterisation of functionalisation methods, particularly surface and cell studies
2. Electrical, chemical, biochemical and physical characterisation and optimisation of functionalised ion sensors
3. Mechanical, electrical and chemical characterisation and optimisation of packaging techniques
4. Design and integration of complementary sensors (pH, temperature, drift compensation) to maximise reliability.
5. Adapt device design, packaging, measurement protocols for reliable, reference electrode free, operation.

Pasternak, Elena, Prof

**Catastrophes in the resource industry**  
Disciplines: Chemical & Process, Civil, Environmental, Materials, Mechanical, Mining, Oil & Gas, Petroleum  
Prerequisite skills: XL, matlab, excellent writing skills

The topic aims to investigate various aspects associated with the catastrophes in the resource industry. The possible avenues of investigation can encompass modelling, technical aspects of the discipline, environmental, societal and economical impacts of the industry.
Pasternak, Elena, Prof

**Modelling of fragmented structures and systems with tunable negative stiffness**
Disciplines: Civil, Materials, Mechanical
Prerequisite skills: finite element analysis, matlab

Fragmented solids and structures are discontinuous or heavily fractured materials, whose fragments are not bound together. That is why prediction of structural response of fragmented bodies and evaluation of their mechanical properties is a challenging and exciting task. The project involves modelling of fragmented solids using the finite element method. Modeling the oscillator with negative stiffness elements consists of (1) designing and manufacturing an apparatus with tuneable eigen frequency; (2) conducting experiments and frequency measurements under different compressive loads; (3) direct structural modelling of the apparatus motion; (4) modelling the motion using the concept of negative stiffness.

Pattiaratchi, Chari, Prof
Co-supervisors: Wijeratne, Sarath, Dr

**Estuarine dynamics in south-west Australia**
Disciplines: Civil, Environmental, Ocean Systems
Prerequisite skills: Fluid Mechanics, computer literate.

There are many estuaries along the south-west Australia: Swan-Canning, Peel-Harvey, Leshenault, Blackwood, Wilson etc. Students will apply a model which includes the ocean areas to an estuary in south-west Australia to examine - extreme water levels, storm surge, salt wedge intrusion and examine the effects of climate change through changes in mean water level and reduction in river run-off.

Pattiaratchi, Chari, Prof
Co-supervisors: Wijeratne, Sarath, Dr

**Design and performance of Canal Estates**
Disciplines: Civil, Environmental, Ocean Systems
Prerequisite skills: Fluid Mechanics, computer literate.

Residential canal estates have been developed over the past couple of decades particularly along Mandurah and Busselton areas. After several years of construction, the canal estates have low water quality as a result of poor flushing or water renewal. This project will examine the different
processes responsible for flushing of canal estates through the application of a numerical model with particular reference to constructed and planned canal estates in south-west Australia.

**Pattiaratchi, Chari, Prof**
**Co-supervisors: Wijeratne, Sarath, Dr**

*Connectivity around Australia through particle tracking*

**Disciplines:** Civil, Environmental, Ocean Systems  
**Prerequisite skills:** Fluid Mechanics, computer literate.

We have developed a hydrodynamic model called ozROMS which covers the whole of Australia providing current patterns over a 3 year period. This project will use the output of this model together with a particle tracking model to examine the connectivity around Australia. The particles could be used as a proxy for oil spills, tracks of turtles, migration of eggs and larvae, marine debris etc. Students will be able to choose any number of locations and these proxies to examine and analyse particle tracks for a particular application.

**Paurobally, Roshun, Prof**

*Development of prototype wireless active noise and vibration control*

**Disciplines:** Chemical & Process, Electrical & Electronic, Mechanical, Mechatronic, Software  
**Prerequisite skills:** an interest in noise and vibration and mechatronic systems is valuable.

Recent studies have shown that it is possible to use wireless technology to implement an active noise control system. These have several advantages including reduced wiring and improved mobility and portability. In this project students will work towards selecting the best transceivers to develop stand-alone prototype active noise and vibration systems. The effectiveness of these systems can then be studied and practical issues considered. This project will suit students wanting to learn about active control and a willingness to learn about and use wireless technology.

**Paurobally, Roshun, Prof**

*Review of vibration and noise-based condition monitoring of asset*

**Disciplines:** Chemical & Process, Computer, Electrical & Electronic, Mechanical, Mechatronic, Software  
**Prerequisite skills:** a good knowledge of noise and vibration and signal processing valuable.

Previous studies have shown the capability of the impedance-based condition monitoring method. In this project students will do a thorough literature review of existing vibration and noise-based
monitoring techniques and their limitations. A prototype sensor for application in industry will also be developed using the impedance-based technique and tested.

Sercombe, Tim, Prof

Selective Laser Melting of Novel Materials
Disciplines: Materials & Mechanical

In this project, you will undertake research on Selective Laser Melting of a novel material that has not yet been investigated. Possibilities include magnetic materials, shape memory alloys, ceramics, etc. As a group you will need to come up with a list of possibilities, after which you will determine if high density parts can be produce.

Sercombe, Tim, Prof

Improving the Selective Laser Melting of Aluminium
Disciplines: Materials & Mechanical

The Selective Laser Melting of Al is significantly more difficult than Ti. In this project, you will undertake research to improve Selective Laser Melting of aluminium alloys. There have been a number of different approaches reported both in the literature and by prior research at UWA. You will evaluate these for their effectiveness (including their effect on density, surface finish and mechanical properties).

Sercombe, Tim, Prof
Co-Supervisor: Doyle, Barry, Assoc/Prof

Development of a 3D BioPrinter

The aim of this project is to set up, test and develop a new 3D Printer which is capable of 3D printing tissue engineering scaffolds from a wide range of “soft materials”. Ultimately, we wish to use this technology not only to incorporate slow release drug delivery into the structure (eg. antibiotics, chemotherapy), but also the seeding of the scaffolds with cells. With such technology, we may eventually be able to print new organs, vessels and cartilage thereby overcoming the current shortages of donors. Further, the use of the patient’s own cells will overcome prevent organ rejection, one of the major, ongoing risks of organ transplant.

Sreeram, Victor, Professor
Co-Supervisors: Jazlan, Ahmed, PhD Student
Control Engineering Projects
Disciplines: Electrical & Electronic, Mechanical, Mechatronic
Prerequisite skills: Matlab

Model Reduction Techniques (4 projects)

Mathematical description of the dynamic characteristics of a system is called a mathematical model. The dynamic system may be a chemical process, multimachine electrical power system altitude control of a space craft, synchronous orbit satellite, etc. Deriving a reasonable mathematics model is the most important part of analysis and design of dynamic systems. In many practical situations, one can obtain a fairly complex and a very high order model for the system. This complexity often makes it difficult to obtain a good understanding of the behaviour of the system. The analysis and design of such systems can be accomplished with greater ease if a low-order model is derived which provides a good approximation. This problem is known as "model reduction problem". The objective of model reduction problem is to find a low-order model for a given high-order system such that the low-order model retains or closely approximates the input-output behaviour of the system.

In this project, we analyse and compare different model reduction techniques for the following applications:

- Circuit simulation.
- Seismic signal processing
- Low order controller design
- Solar collector modelling

In this project, work involved consists of some mathematical analysis and computer simulation using matlab.

Sreeram, Victor, Professor
Co-Supervisors: Azadfar, Elham, PhD Student

Integration of PV, PEV, and Storage Battery on power distribution system
Disciplines: Electrical & Electronic

This project investigates plug-in electric vehicle (PEV) and photovoltaic (PV) integration, which propose a PEV charging that considers distribution integration issues. It examines the potential and the technical benefits of using PV systems as energy supplier for charging EVs. For this purpose, a residential electric grid will be considered for the modelling
behavioral characteristics and requirements of the distributed technologies including solar photovoltaic (PV), plug-in electric vehicles (PEV), and energy storage devices.

To investigate the interaction between the PV system and charging for EVs, different scenarios were defined to analyse the overloading of the LV distribution grid and energy losses after the integration of EVs incorporating with distributed generation (PV) and storage technology.

Scenario 1: EVs integrated with PVs
This scenario investigates the effect of integration of EVs and PVs into the electricity grid. It is assumed that EVs are allocated to customers that also have installed PV solar system. Under this scenario, different penetration of residential EVs and various power level of PVs (0-5kW) is implemented.

Scenario 2: EVs integrated with PVs utilised battery storage
In this scenario, integration of EVs with PVs into the grid is explored but PVs are connected to storage batteries. It is assumed that EVs are allocated to customers that also have installed PV system.
EVs energy charging is derived from the grid. Solar PVs and storage batteries (60kWh) are utilised for accumulating excess energy from PVs that is generated during the day. During the early evening, when the peak residential EV charging demand occurs, PV output is typically small, so storage units will supply EV charging demand.

Tavner, Angus, Prof

*Jet-fire testing of composite repairs*
**Disciplines:** Civil, Materials, Mechanical, Mechatronic, Oil & Gas, Petroleum
**Prerequisite skills:** Finite Element Analysis, Matlab
IAS use composite technologies to repair infrastructure in the mining/oil-and-gas sector. In many instances, repairs need to meet fire protection requirements. This project will test various passive fire-protection materials used to protect composite infrastructure repairs. A previous project has developed a small-scale jet-fire test rig, and preliminary trials with intumescent coatings have been encouraging.

Tavner, Angus, Prof

*UWA Motorsports projects*
**Disciplines:** Electrical & Electronic, Materials, Mechanical, Mechatronic, Oil & Gas
**Prerequisite skills:** Finite Element Analysis, Matlab
Each year the UWA Motorsport team builds a single-seat open-wheel racing car to compete in the Formula SAE competition. These projects will allow students to design, build, test and analyse parts or systems for the 2015 car. Project topics for 2015 are as follows -

- Exhaust turbine driven electrical generators.
- Feasibility of a Hybrid powered UWAM FSAE Vehicle. (Looking to develop a Hybrid for 2016)
- Ricardo analysis of the Honda CBR 500 with and without supercharger.
- Design steps towards electric supercharger system.
- Open differential with electric torque split.
- Transaxle / reverse gear / reversed headers engine.
- Steering system design of a Mechanically Mode Separated Suspension vehicle.
- Control strategy of a rear wheel steer FSAE car.
- Laser sintered inserts for composite panels.
- Technical Management of a student engineering team.
- Post event Race engineer program, sorting saving and producing summary sheets.
- Further Development of a Ayres composite panel exhaust pipe.

**Tavner, Angus, Prof**

Co-Supervisor: W/Prof David Blair (School of Physics)

**Engineering Design, Test and Manufacture of Mars One Lander Payload**

Disciplines: Mechanical, Electrical & Electronic, Mechatronic, Software, Chemical and Process

- Design, Test and Documentation of Electrolysis system for use of extracting Oxygen from Water extracted by the Mars One lander on the surface of Mars.
- Developing an integrated package that can house and operate the above systems, and sustain operation through interplanetary travel, landing and operation.
- Design, Test and Documentation of Electrical system that can sustain operation of the above systems, and sustain operation through interplanetary travel, landing and operation.
- Feasibility and scope study of Solar Radiation detection system to be implemented on the payload.

**Trevelyan, James, W/Prof**

**Low-power air-conditioning**

Disciplines: Mechanical, Mechatronic

Electricity is scarce and expensive in developing countries. This project is based on a simple idea that could make airconditioning much more affordable in developing countries and much more energy efficient everywhere. If this project is successful, 2-4 billion people will no longer need to suffer from sleepless nights in the hottest season of the year, without unsustainable increases in
electricity demand. The operating principle is based on controlling air flow to focus the air conditioning effect where it is needed, reducing energy consumption for personal comfort by between 80 and 90%. In conventional air conditioning, much of the energy is wasted in cooling the structure of the surrounding building. New developments in 3D printing technology make it possible to develop physical prototypes for experimental testing. Students will be encouraged to do this. You will be expected to become familiar with airconditioning technologies and market evaluation studies, as well as electricity supply issues in developing countries. Addition of inverter speed control technology to existing prototype equipment is also a possibility. This project is run in collaboration with a start-up company, Close Comfort Pty Ltd.

Vukcevic, Slobodanka Assoc/Prof

New Approaches in Concentration of Minerals from their Ores by Gravity and Magnetic Separation
Disciplines: Chemical & Process, Environmental, Materials, Mechanical, Mining, Oil & Gas, Petroleum

Prior to metal production, ore is usually submitted to concentration where the amount of useful minerals is increased and they are selectively separated from the ore residue. Concentration can be done by many different methods which are applied usually in combination that allows the achievement of the high metal recovery (usually 80 % or more), and high grade of metal in concentrate (varies from ore to ore and can be for example 80 parts per million for gold up to 68 % for iron). Both Gravity and Magnetic concentration are old methods but because of advanced overall technology in recent times they are significantly improved and tend to be more applied particularly due to stricter environmental requirements (they do not involve chemicals) .Concentration processes is somewhat revolutionized by return of these two process units with much higher overall efficiency then in the past. It is the objective of this research that students understand in depth which theoretical principles are involved in these processes and what technological advances allowed this progress. The second objective is to discuss and confirm or otherwise performance advantages of particular modern equipment in these process units. Recommendation on directions and further development of these two methods and their application is to be given based on decided criteria of process performance.

Vukcevic, Slobodanka Assoc/Prof

Development of New Technologies in Production of Base Metals
Disciplines: Chemical & Process, Environmental, Materials, Mechanical, Mining, Oil & Gas, Petroleum
Base Metals are common name for the important group of widely used metals such as copper, nickel, zinc etc. They can be produced from oxide and sulphide ores by using pyro-metallurgical, hydro-metallurgical and electrometallurgical methods. Due to depletion of the ores with high metal content and equally due to stricter requirements related to environment, a number of new technologies are applied in recent times to treat these ores efficiently. The objective of this research is to identify the new technologies, to understand in depth theoretical principles behind them as well as to select process parameters that contribute in increasing the efficiency making the process viable and advanced. Thorough analysis and comparison of different process flowsheets and equipment in relation to ore mineralogy and environmental regulations is expected. On this basis, directions in further development and likelihood of industrial applications of new approaches in separated process units as well as overall processes are to be given.

Vulpe, Cristina, Research Assoc
Co-Supervisors: Gourvenec, Susan, Prof

Effect of loading cycles on the bearing capacity of shallow footings
Disciplines: Civil, Mining, Ocean Systems

The bearing capacity of a shallow foundation will be enhanced by consolidation of the soil in the vicinity of the foundation. Any increase in bearing capacity is merely a consequence of the increase in shear strength of the deposit. Consolidation generally leads to a reduction in void ratio of the soil matrix resulting in an increase in the shear strength of the soil in the vicinity of the foundation. Determination of the consolidated undrained bearing capacity of a shallow foundation is relevant to offshore engineering scenarios including preloading of jack-up rigs to set up the in-service general load capacity of spudcan foundations, soil improvement to enhance bearing capacity of soft clays, and predicting the increased factor of safety of a foundation over the lifetime of the structure (which in turn diminishes the annual probability of failure under the governing design loading event).

Significant research has been carried out on the undrained capacity of shallow foundations under combined loading. Insight has been offered into the consolidated undrained response of shallow foundation systems following sustained monotonic preloading.

In the offshore environment, the load applied to a foundation during the working life may include a significant cyclic component. Examples include structures that are exposed to hydrodynamic loading from wind and waves and subsea equipment that experience changing loads depending on the operating conditions.

This study will explore the influence of cycles of preloading via finite element modelling and show how repeated preloading leads to a higher gain in bearing capacity compared to monotonic preloading.

Wittek, Adam, Prof
Co-Supervisors: Singh, Surya, Dr – University of Queensland

**Biomechanical Simulation for Remote Surgery**

**Disciplines:** Mechanical Engineering, Mechatronics

**Prerequisite Skills:** Basic skills/prior knowledge in numerical methods for engineers, computer language programming, electrical/electronic systems and solid mechanics

Integration of computing and robotics has been recognised as one of the key elements of “the wave of third industrial revolution” (a term used in the article in “The Economist” from October 4th, 2014) that affects not only traditional engineering applications but also health care delivery (e.g. surgery). So far application of surgical robots has been limited. Surgical tool placement/insertion in the body organs (such as e.g. needle insertion when conducting biopsy) is a challenging task that requires one to account for changes in the target position caused by organ deformation due to interactions between a surgical tool and the tissue. One may attempt to track a surgical target (e.g. tumour) and tool using medical imaging. However, intraoperative 3D imaging (magnetic resonance imaging MRI, computed tomography, ultrasound US) for surgical tracking is limited using the equipment in standard operating theatres. Predicting the intraoperative organ/tissue deformations using biomechanical can augment the currently used imaging techniques for surgical tracking.

This project focuses on:

- Fast ("real-time") biomechanical algorithms and models for predicting intraoperative organ/tissue deformations due to interactions with a surgical tool;
- Integration of biomechanical models with medical image processing software;
- Integration of biomechanical models with robotic systems;
- Evaluation of the proposed modelling and hardware solutions using experiments on mechanical phantoms of body tissues/organs.

The project will be conducted as a part of collaboration between the Intelligent Systems for Medicine Laboratory at the University of Western Australia and Robotics Design Laboratory at the University of Queensland.

**Wittek, Adam, Prof**

**Large Vehicle Tyre Modelling**

**Disciplines:** Mechanical Engineering, Civil Engineering

**Prerequisite Skills:** Basic skills/prior knowledge in numerical methods for engineers and solid mechanics

Vehicle mobility, stability and manoeuvrability are to large extent determined by tyre behaviour/performance. For large and very large (e.g. mining trucks), tyre failure poses significant
safety hazard. Through application in tyre design and maintenance, tyre modelling using the algorithms of non-linear computational mechanics may lead to improvements in tyre performance and mitigation of failure risk.

Final year project conducted in 2014 by three Mechanical Engineering students (Matthew Hoang, Michael Robba, and Thomas Horton) focused on basic investigation of the tyre (SUV) responses, determining the structural/material properties of a tyre and baseline tyre modelling using a commercial finite element solver. Based on the results and findings obtained in 2014, this project will focus of tyre interactions with terrain models and algorithms for simulation of truck tyre (including failure) and its interactions with terrain.

The project will include following lines of investigation:
1) Modelling of interactions between a tyre and terrain using a selected commercial finite element code (or codes);
2) Modelling of mining large tyre for vibration and transient analysis using a selected commercial finite element code (or codes);
3) Modelling of mining truck tyre failure using a selected commercial finite element code (or codes);
4) New efficient algorithms of computational mechanics for tyre modelling.

Xu, Lu, Dr.
Co-Supervisors: Huang, Defeng, Prof

Nonlinear channel modeling and equalization using neural networks
Disciplines: Electrical & Electronic

Channel modeling and equalization are two important components in wireless communication systems. The wireless physical channel introduces both linear distortion (e.g. inter-symbol interference (ISI)) and nonlinear distortion, therefore nonlinear structures should be employed in modeling to imitate those impairments and in equalization to achieve the compensation. With their inherent nonlinear nature, neural networks can be used to achieve such tasks. In this project, we will investigate nonlinear channel modeling and equalization techniques using several typical neural networks, such as multilayer perceptron (MLP), radial basis function (RBF) network, recurrent neural network (RNN), and function link artificial neural network (FLANN).

Yang, Hong, Prof

Combating microbiological influence corrosion (MIC) in offshore pipelines - understanding bacteria control in natural seawater
Disciplines: Environmental, Chemical & Process, Materials
Microbiological influenced corrosion (MIC) represents a significant treat in combating corrosion of offshore pipelines during their pre-commissioning and suspension. MIC is commonly mitigated using a selected proprietary chemical package. The aim of this project is to study and evaluate the effectiveness and long term stability of a specific proprietary chemical package in controlling microbe activities in natural seawater.

Yang, Hong, Prof

*Understanding pitting corrosion of steel alloys in natural seawater*
Disciplines: Materials, Mechanical

Following a successful FYP in 2014, this project is designed to study the pitting behaviour of a range of steel alloys commonly used in subsea pipelines including carbon steels, stainless steels and other corrosion resistant alloys in fresh and treated natural seawaters. The main aim of the project is to investigate the effectiveness of a proprietary chemical package in corrosion control of subsea pipeline materials.

Yang, Hong, Prof
Co-Supervisors: Guzzomi, Andrew, Prof

*Design and manufacturing a prototype dispenser for solid free-flowing powder*
Disciplines: Materials, Mechanical

There is a need for a dispenser of solid powder for paediatric and geriatric patients. The challenge is to be able to design and manufacture a dispenser which upon actuation will deliver an predetermined amount of free-flowing powder accurately, while satisfying other constrains such as easy operation, safety and cost. A device measuring dosages by weight had been designed by a successful previous FYP, and the dispenser made use of a compression spring to weigh the doses and a torsion spring as means of actuation method. However, there remain a number of technical challenges which need to be addressed before a prototype device can be made and tested. So the aim of this project is to improve the current design, create a prototype dispenser and test the dispenser.

Yang, Hong, Prof

*Experimental investigation on the potential of using biochars to remove heavy metal species from mine tailings*
Disciplines: Environmental, Chemical & Process, Materials
Following several successful FYPs in 2014, this project aims to take a system’s view on the results obtained so far to develop a mechanistic understanding of adsorption behaviour of biochars on heavy metal species. Further experimental work is to be carried out to complete the investigation on the relationship between the pyrolysis temperature for biochar production, key biochar properties and adsorption capacities of heavy metal species.

Zhang, Dongke, W/Prof
Co-Supervisors: Zhu, Mingming, Dr; Yani, Wati, Ms; Zhang, Zeno; Setyawan, Hendrix; & Liu, Pengjie

**Rheological and combustion characteristics of biochar based slurry fuels**

Disciplines: Chemical & Process, Environmental, Mechanical, Materials, Petroleum

Sub-topic 1: preparation and rheological characteristics of biochar-glycerol slurry fuel
This project will study the preparation and rheological characteristic of pine sawdust biochar-glycerol slurry fuel. The pine sawdust biochar will be crushed and sieved into particles with different size fractions. The biochar particles prepared will be mixed with glycerol with the addition of an additive to form biochar-glycerol slurry fuel. The rheological properties of the slurry fuel, including viscosity, yield stress and stability will be studied. The effect of particle size, glycerol concentration and additives on the rheological properties will be investigated.

Sub-topic 2: preparation and rheological characteristics of biochar-biooil slurry fuel
This project will study the preparation and rheological characteristic of pine sawdust biochar-biooil slurry fuel. The pine sawdust biochar will be crushed and sieved into particles with different size fractions. The biochar particles prepared will be mixed with biooil that from the pyrolysis of pine sawdust with the addition of an additive to form biochar-biooil slurry fuel. The rheological properties of the slurry fuel, including viscosity, yield stress and stability will be studied. The effect of particle size, biooil concentration and additives on the rheological properties will be investigated.

Sub-topic 3: Ignition and combustion characteristics of biochar-glycerol slurry fuel
This project will study ignition and combustion characteristic of droplets of pine sawdust biochar-glycerol slurry fuel in a hot tube furnace. The ignition and combustion characteristics include ignition delay period, burning time and burning rate of droplets. The effect of furnace temperature, glycerol content in the slurry fuel and droplet size on the ignition and combustion characteristics of biochar-glycerol slurry fuels will be investigated.

Sub-topic 4: Ignition and combustion characteristics of biochar-biooil slurry fuel
This project will study ignition and combustion characteristic of droplets of pine sawdust biochar biooil slurry fuel in a hot tube furnace. The ignition and combustion characteristics include ignition delay period, burning time and burning rate of droplets. The effect of furnace temperature, biooil
content in the slurry fuel and droplet size on the ignition and combustion characteristics will be investigated.

Zhang, Dongke, W/Prof
Co-Supervisors: Yani, Wati, Ms; Zhou, Wenxu; Zhu, Mingming, Dr; Dang, Guangyao; Liu, Siying; & Sunyoto, Nimas.

Two-Phase Anaerobic Digestion (T-PAD) of Organic Wastes for Biogas Production
Disciplines: Chemical & Process, Environmental

Sub-topic 1: Effect of loading rate of organic wastes on hydrogen production in T-PAD
This project will study the performance of a pilot-scale T-PAD process demonstration unit in terms of hydrogen production. The effect of loading rate of organic wastes on the yield and composition of total gas, yield and concentration of hydrogen in the first phase of T-PAD will be investigated.

Sub-topic 2: Effect of loading rate of organic wastes on the first phase effluent properties in T-PAD
This project will study the performance of a pilot-scale T-PAD process demonstration unit in terms of effluent quality from the first phase. The effluent from the first phase will be fed into the second phase and the chemical composition of the effluent will determine the quality of methane production in the second phase. The effect of loading rate of organic wastes on the effluent properties, such as volatile solids, total solids, chemical oxygen demand, pH value, from the first phase of T-PAD will be studied.

Sub-topic 3: Effect of loading rate of organic wastes on methane production in T-PAD
This project will study the performance of a pilot-scale T-PAD process demonstration unit in terms of methane production. The effect of loading rate of organic wastes on the yield and composition of total gas, yield and concentration of methane in the second phase of T-PAD will be investigated.

Sub-topic 4: Effect of loading rate of organic wastes on the second phase effluent properties in T-PAD
This project will study the performance of a pilot-scale T-PAD process demonstration unit in terms of effluent quality from the second phase. The effluent will be utilised as organic fertilizer. The effect of loading rate of organic wastes on the effluent properties, such as pH value, nitrogen, potassium, phosphorus concentration, from the second phase of T-PAD will be studied.

Zhang, Dongke, W/Prof
Co-Supervisors: Zhu, Mingming, Dr; Zhang, Zeno; Yani, Wati, Ms; Liu, Pengfie; & Wan, Wenchao

Pyrolysis of biomass

Updated: 30 Oct 2014
Disciplines: Chemical & Process, Environmental, Mechanical, Materials

Sub-topic 1: Pyrolysis of cellulose, hemicellulose and lignin
This project will study the pyrolysis behaviour of three major components of biomass, namely cellulose, hemicellulose ad lignin in a fixed bed reactor. The effect of pyrolysis temperature on the yield and composition of pyrolysis gas, biooil and biochar products will be studied. The compositions of pyrolysis gas and biooil will be analysed using GC-MS. The physical and chemical properties of biochar produced, including proximate and ultimate analysis, specific surface area and morphology will be studied.

Sub-topic 2: Pyrolysis of cellulose/hemicellulose mixtures
This project will study the interaction between cellulose and hemicellulose during pyrolysis process in a fixed bed reactor. The effect of pyrolysis temperature and the blending ratio of cellulose/hemicellulose on the yield and composition of pyrolysis gas, biooil and biochar products will be studied. The compositions of pyrolysis gas and biooil will be analysed using GC-MS. The physical and chemical properties of biochar produced, including proximate and ultimate analysis, specific surface area and morphology will be studied.

Sub-topic 3: Pyrolysis of lignin/hemicellulose
This project will study the interaction between lignin and hemicellulose during pyrolysis process in a fixed bed reactor. The effect of pyrolysis temperature and the blending ratio of lignin/hemicellulose on the yield and composition of pyrolysis gas, biooil and biochar products will be studied. The compositions of pyrolysis gas and biooil will be analysed using GC-MS. The physical and chemical properties of biochar produced, including proximate and ultimate analysis, specific surface area and morphology will be studied.

Sub-topic 4: Pyrolysis of cellulose/lignin mixtures
This project will study the interaction between cellulose and lignin during pyrolysis process in a fixed bed reactor. The effect of pyrolysis temperature and the blending ratio of cellulose/lignin on the yield and composition of pyrolysis gas, biooil and biochar products will be studied. The compositions of pyrolysis gas and biooil will be analysed using GC-MS. The physical and chemical properties of biochar produced, including proximate and ultimate analysis, specific surface area and morphology will be studied.

Zhang, Dongke, W/Prof
Co-Supervisors: Zhu, Mingming, Dr; Ma, Yu, Ms

Effect of biodiesel on fuel efficiency and emissions in compression ignition engines
Disciplines: Chemical & Process, Environmental, Mechanical
Sub-topic 1: combustion characteristics of diesel/methyl oleate in a diesel engine
This project will study the combustion characteristics of a diesel engine fuelled with diesel/methyl oleate. Methyl oleate is a common component of commercial biodiesel fuels. The effect of diesel/methyl oleate blending ratio and the combustion catalyst on the fuel efficiency, ignition delay and heating release rates will be investigated under different engine loads and conditions.

Sub-topic 2: combustion emissions of diesel/ methyl oleate in a diesel engine
This project will study the emission characteristics of a diesel engine fuelled with diesel/methyl oleate. Methyl oleate is a common component of commercial biodiesel fuels. The effect of diesel/methyl oleate blending ratio and the combustion catalyst on the emissions of smoke, NOx, CO and unburned hydrocarbons, soot oxidation properties will be investigated under different engine loads and conditions.

Sub-topic 3: combustion characteristics of diesel/palmitate in a diesel engine
This project will study the combustion characteristics of a diesel engine fuelled with diesel/palmitate. Palmitate is a common component of commercial biodiesel fuels. The effect of palmitate ratio in the diesel/palmitate mixture on the fuel efficiency, ignition delay and heating release rates will be systematically investigated under different engine loads and conditions.

Sub-topic 4: combustion emissions of diesel/ palmitate in a diesel engine
This project will study the emission characteristics of a diesel engine fuelled with diesel/palmitate. Palmitate is a common component of commercial biodiesel fuels. The effect of palmitate ratio in the diesel/palmitate mixture on the emissions of smoke, NOx, CO and unburned hydrocarbons, soot oxidation properties will be systematically investigated under different engine loads and conditions.

Zhou, Tongming, Prof

Vortex shedding frequency and vortex structures from various kinds of bluff structures
Disciplines: Civil, Mechanical

Vortex shedding is a phenomenon that occurs when a flow passes a bluff body (e.g. a single or a group of tall chimneys, which are attached outside the cylinder with various gaps). The objective of the project is to examine the vortex shedding characteristics from various kinds of bluff bodies by measuring the flow velocity using PIV and ADV. Vortex shedding frequency will also be quantified.

Zhou, Tongming, Prof

Experimental studies of passive control of vortex shedding from a circular cylinder for the purpose of suppressing pipeline vortex-induced vibration
Disciplines: Civil, Mechanical

Vortex shedding is a phenomenon that occurs when a flow passes a bluff body (e.g. a single or a group of tall chimneys, tall buildings, marine risers for oil production, mooring lines, deepwater structures such as the pipelines). It is well known in the offshore community that the cylindrical bluff structures suffer from vortex-induced vibration (VIV) in strong current conditions. The marine risers, for example, also induce the flow around them to separate and initiate vortex shedding. These vortices cause extra dynamic forces and vibration to the risers. VIV should be avoided in engineering applications. This is because: (1) VIV will increase the fluid dynamic loading to the structures, (2) it will also influence the stability of the structures, (3) the vibration of the structures will accelerate the fatigue failure etc. The above factors will influence both the capital investment of the structures and the expenses for maintenance. Therefore, great effort has been devoted to the control of vortex shedding from a bluff body, both using active methods and passive methods. In the present project, vortex shedding will be controlled using screen meshes, which are attached outside the cylinder with various gaps. The objective of the project is to examine the effectiveness and mechanism of the control methods on VIV reduction.