Research Projects at UQ Engineering available to CSC candidates

Project Title	Project Decription	Supervisor Name, Discipline and Contact Details
Understanding the role of catalyst in the growth of semiconductor nanowires	Epitaxial semiconductor nanowires are considered as building blocks for future nanoelectronic and optoelectronic devices. In general, these nanowires are induced by metallic catalysts. Due to the complicated interactions between catalysts and nanowire materials, the morphological, structural and chemical characteristics of manufactured nanowires often differ from desired characteristics, which in turn affect their properties. In this project, the PhD candidate will use various electron microscopy techniques to determine these characteristics, and, by correlating determined characteristics with manufacturing conditions, to determine the impact of the catalysts during the nanowire manufacturing. The ultimate goal is to provide insights for better design the nanowire manufacture.	Professor Jin Zou **Materials Engineering and Nanotechnology** j.zou@uq.edu.au
The development of fibre optic gas sensors for mining Application	Deploying an optical fibre sensor network provides a passive sensing element which can be remotely located and monitored, promising an intrinsically safe technique in harsh underground coal mine environments. This capability can be expanded via disturbed sensing methods, where a single control unit can monitor a target parameter- gas concentration in this case- through an optical fibre network. This offers a cost effective sensing solution relative to the number of sensor heads. Remote methane detection by laser absorption spectroscopy and the development of diode lasers in near-infrared (NIR) opened the way for remote methane measurements using optical fibres in the late 20th century. The aim of the proposed project is to develop and investigate a distributed fibre-optic based methane sensing system. This will be achieved by developing new distributed fibre-optic based gas spectroscopy method that uses micro-fabricated HCFs as sensor heads. In order to develop or build on current distributed sensing technologies, a numerical and experimental investigation on the performance of micro-fabricated HCF and their splice will be conducted.	Dr Saiied Aminossadati **Mining Engineering** uqsamino@uq.edu.au
Wet expansion	A wet expander is an expander where condensation takes place while the working fluid is expanding through the turbine. With today's expanders, the efficiency drops significantly if this occurs. Expanders that maintain an acceptable efficiency even under wet expansion conditions would be very useful for low-enthalpy resources. Even with high-enthalpy resources, they would help reducing the heat exchanger irreversibilities by extracting heat from the hot stream while keeping the cycle working fluid in compressed liquid conditions. Developing/expanding meanline design and analysis models for several types of expanders for wet expansion and integrate into existing code base. Select best type of expander based on meanline analysis. Design, build and test a wet expander. Validate a general loss model for a wet expander. Implement validated loss model into cycle analysis code	Dr Kamel Hooman **Mechanical Engineering** k.hooman@uq.edu.au

Supercritical fluid flow	Fluids at supercritical state are more efficient energy carriers than those at lower pressure and temperature. This has made them a popular option for a number of applications including power generation form solar and geothermal power plants. Prior to this, such fluid flows were used in power and nuclear industry for power generation and cooling purpose, respectively. The aim of this project is to shed some light on the, rather strange, behavior of such fluid flows through more complex structures like compressors and nozzles. This work can be done, theoretically, numerically, or experimentally.	Dr Kamel Hooman **Mechanical Engineering** k.hooman@uq.edu.au
Waste heat recovery	Thermo-Electric-Generators are solid state designs that can generate electricity from a temperature difference without the need to a moving part. As such, their application to an existing engineering system that requires large amount of heat dissipation, like automotive or power industry, is a straight-forward way of saving energy. The efficiency of such systems is, however, low. A smart design, relying on advanced material and heat exchanger technology can make such systems, and thereby, economic waste heat recovery possible. This is, in fact, the aim of the project.	Dr Kamel Hooman **Mechanical Engineering** k.hooman@uq.edu.au
Development of a 'Floating Trench' algorithm for surface mining operations using In-Pit-Crusher-Conveyor (IPCC) systems	Exisiting open pit optimisation algorithms including the 'Floating Cone Algorithm' and the 'Lerches Grossmann Algorithm' are geared toward traditional truck and shovel mining. They therefore fail to account for the geometrical requirments (long straight conveyor lines) associated with In-Pit-Crusher-Conveyor systems. In this project, the PhD candidate will use various mathematical programming techniques to altering existing algorithms and develop new algorithms to aid the process of determining the ultimate pit limit for surface mining operations employing IPCC technology.	Professor Peter Knights, A/Professor Mehmet Kizil, Dr Micah Nehring **Mining Engineering** p.knights@uq.edu.au m.kizil@uq.edu.au
Novel block modelling methods for continuous mining and In-Pit-Crusher-Conveyor (IPCC) systems	For the purpose of being able to allocate various attrributes and properties to specifc parts of an orebody (including grade, hardness, desity, etc.) for mine planning purposes, the orebody is generally split into a number of smaller more manageable segments or blocks known as a 'block model'. These blocks may all be uniform in size or they may vary in size depending on the characteristics of the orebody and the equipment employed to extract the material. Current block modelling on metalliferous deposits is performed with a focus on traditional truck and shovel mining resulting in cubic blocks and rectangular shaped blocks which may not be optimal when planning an operation for an In-Pit-Crusher-Conveyor (IPCC) system. In this project, the PhD candidate will trial various block shapes and dimensions to ultimately determine the most appropriate.	Professor Peter Knights, A/Professor Mehmet Kizil, Dr Micah Nehring **Mining Engineering** p.knights@uq.edu.au m.kizil@uq.edu.au m.nehring@uq.edu.au
Optimal selective mining unit (SMU) sizing for maximising the value of operations employing In-Pit-Crusher-Conveyor (IPCC) systems	The size and shape of the selective mining unit (SMU) has a major impact on the selectivity of an operation. A greater control of selectivity will generally enhance recovery and minimise dilution. The SMU sizing therefore has a major impact on the value that can be generated from and orebody. Current SMU sizing on metalliferous deposits is performed with a focus on traditional truck and shovel mining resulting in SMU sizes that may not be optimal when planning an operation for an In-Pit-Crusher-Conveyor (IPCC) system. In this project, the PhD candidate will determine the optimal SMU sizing with a focus on minimising dilution and thus maximising the value of an orebody.	Professor Peter Knights, A/Professor Mehmet Kizil, Dr Micah Nehring **Mining Engineering** p.knights@uq.edu.au m.kizil@uq.edu.au m.nehring@uq.edu.au

Direct numerical simulation of fines generation and transport in CSG reservoirs	The production of fine, granular material during the operation of a coal seam gas (CSG) well results in damage to downstream mechanical pumping equipment. An increased understanding of the fines generation process, particularly from seam interburden, is required in order to reduce its occurence. The aim of this project is to develop a computational modelling tool which can be used to directly model the the physical processes of fines liberation, transport and sedimentation in a fractured/cleated coal seam. The modelling approach will combine fluid mechanics and particle mechanics, as well as other required physics such as electromagnetics and chemistry, to adequately capture the dominant, relevant phenomena.	Dr Christopher Leonardi **Mechanical and Mining Engineering** c.leonardi@uq.edu.au
Co-Adsorption of Wet Contaminants in Ordered and Disordered Solids and Computer Modelling of Adsorption with Interconnected Pore Networks	The goal of this project is to establish the molecular mechanism, and develop a working model, for adsorption and desorption of gaseous mixtures involving water, in both traditional disordered, and modern ordered solids. The significance of this work will be its potential use in numerous applications including: (i) the better characterisation of materials; not only the pore size distribution and pore connectivity, but also the identification and determination of functional groups by a novel adsorption technique; (ii) the tailoring of porous structures for the optimal design of purification and separation processes involving water.	Professor D. D. Do **Chemical Engineering** d.d.do@uq.edu.au
Molecular model of adsorption of associating fluids in hydrophobic and hydrophilic nano-confined space	The aim of this project is to develop an universal molecular model for adsorption and desorption of associating fluids in hydrophobic and hydrphilic adsorbents by Monte Carlo simulation, and to investigate how scanning curves can help in the better characterization of a porous solid.	Professor D. D. Do **Chemical Engineering** d.d.do@uq.edu.au
Advanced model-based battery management for applications in renewable integration	Despite growth in the demand of battery-based renewable energy storage systems, batteries continue to be expensive and the management of important performance measures such as cell degradation and failure remains a major technological challenge. Consequently, there is an urgent need for cutting-edge technologies for superior battery management in automotive and grid applications. The aim of this project will be to deliver reduced-order battery models and advanced battery management algorithms to improve battery performance, safety and longevity which are essential to enhance battery affordability and reliability. The performance of new algorithms will be experimentally evaluated.	Dr Rahul Sharma **Power and Energy Engineering** rahul.sharma@uq.edu.au
Compressed Sensing Magnetic Resonance Imaging	In clinical practice, magnetic resonance imaging (MRI) play a vital role in the diagnosis and treatment of human diseases. However, existing MRI technology is limited by slow scan speeds, which usually leads to motion artefacts and therefore compromise image accuracy. Compressed Sensing (CS) is a new signal processing technique for efficiently acquiring and reconstructing a signal, by finding solutions to underdetermined linear systems. In this research, CS will be applied for fast imaging in MRI.	Associate Professor Feng Liu **Electrical Engineering** feng@itee.uq.edu.au
Advanced Magnetic Resonance Imaging at 7 Tesla	Magnetic resonance imaging (MRI) is an advanced radiation-free imaging technology that plays a vital role in the diagnosis and treatment of human diseases. MRI technology has undergone a rapid evolution over the past three decades. Significant effort has focused on the development of high-field systems. Such systems hold out the promise of superior image resolution and contrast, making it possible to diagnose medical conditions for which evidence from current imaging systems is too faint or indistinct for confident judgement. With Australia's most powerful 7 Tesla human MRI research platform available for this project, we will work to improve the imaging performence by resolving the fundamental radiofrequency field-tissue interaction problem and sequence designs.	Associate Professor Feng Liu **Electrical Engineering** feng@itee.uq.edu.au
Advanced Electromagnetic Analysis and Design in Magentic Resonance Imaging	In clinical practice, magnetic resonance imaging (MRI) play a vital role in the diagnosis and treatment of human diseases. In this project, we will design new generation electromagnetic systems for better MR imaging.	Associate Professor Feng Liu **Electrical Engineering** feng@itee.uq.edu.au

Investigating the effect of power quality problems from renewables on existing grid assets (power transformers)	The electricity networks of most developed countries has undergone significant expansion since the 60s and 70s and many of these assets, including transformers, are now reaching the end of their design life. With the widespread adoption of renewable energy generation, a growing problem is how the high frequency voltages and currents from these renewables will affect the reliability of existing ageing transformers. Power electronics used in the renewables inject these signals into the grid, and such signals are known to shorten the life of a transformer, yet there has been no comprehensive study linking these concepts. These signals, also known as harmonics, increase the thermal losses within a transformer. The key objective of this project is to investigate the levels of harmonics from PV solar and wind on the thermal losses of a transformer, and thus model the overall effect of renewables on its remaining life. Solar PV arrays at the University and connected transformers can be used for real data in this analysis.	Prof Tapan Saha & Dr Dan Martin **Power and Energy Engineering** saha@itee.uq.edu.au & d.martin6@uq.edu.au
Investigation of distributed controller interaction and the corresponding control strategy design in power distribution networks.	In unbalanced distribution level power systems solar Photo Voltaic (PV), storage, Static Compensators (STATCOM), small scale wind turbines, and On Load Tap Changers (OLTC) may have control interactions, which can lead to control oscillation and stability issues. This interaction needs to be properly investigated and analysed. This project will be based on optimization methods and state space (eigenvalue) analysis, taking into account dynamic load (induction motors and others), sensor and PT/CT delays. Real Time Digital Simulation (RTDS) will be utilized for the validation of control methodologies.	Prof Tapan Saha & Dr Ruifeng yan **Power and Energy Engineering** saha@itee.uq.edu.au & ruifeng@itee.uq.edu.au
Stochastic Optimization for Power Transformer Lifecycle Cost-Benefit Analysis	Cost-benefit analysis is adopted by utilities to investigate how various measures can effectively extend transformer life either through maintenance or replacement of parts/components or better condition monitoring techniques against financial and network risk. This project will develop a stochastic optimization model to facilitate such cost-benefit analysis. The model will optimize total ownership costs that comprise initial investment in the transformer, operation and maintenance (O&M) costs including any cost for condition monitoring, as well as cost of transformer replacement and cost of failure.	Prof Tapan Saha & Dr Hui Ma **Power and Energy Engineering** saha@itee.uq.edu.au & huima@itee.uq.edu.au
Signal Processing for Real-Time Detection of Transients Induced by Power-Quality Disturbances	This project will investigate the time and frequency characteristics of transients caused by faults and power quality disturbance. Based on such investigation, it then proposes several methods including empirical mode decomposition (EMD) and mathematical morphology for detecting the transients with no time delay and high reliability. The performance of the proposed methods will be evaluated through the simulated data of different types of faults and power quality disturbances from transmission and distribution netowkrs, taking into account the effects of the fault inception angle, resistance and distance. The proposed methods will also be implemented on real time digital simulator (RTDS) for verifying their convergence in real-time.	Prof Tapan Saha, Dr Hui Ma & Dr Chandima Ekanayake **Power and Energy Engineering** saha@itee.uq.edu.au & huima@itee.uq.edu.au & chandima@itee.uq.edu.au
Reasoning about concurrent programs	Concurrent programs are becoming more widespread with the rise of multi-core architectures but concurrent programs are notoriously difficult to get correct due to the inherent non-determinism of interleaving processes. This project looks at techniques based on the rely-guarantee approach to reasoning about concurrent programs using variants of interval temporal logic and separation logic. The project would suit a student with an interest in in formal methods of program development and program verification.	Prof. Ian Hayes **Software Engineering** ian.Hayes@itee.uq.edu.au
Static analysis of programs	Static analysis techniques have been successfully applied to find potential bugs in program code, such as null pointer dereferences, by analysing the program source (rather than running test cases). There are a number of areas that could be tackled, for example, analysing programs to find concurrency bugs or security flaws.	Prof. Ian Hayes **Software Engineering** ian.Hayes@itee.uq.edu.au

Reconfigurable antennas for satellite communications	This project aims to design and develop a compact, low-profile and reconfigurable antenna for satellite communication on-the-move systems. The developed high-performance antenna system should be suitable for placement on mobile platforms such as vehicles, airplanes, ships or trains. The main purpose of these terminals is to provide a continuous broadband wireless link to satellites while the vehicle is in motion.	A/Professor A. Abbosh **Microwave & RF Engineering** a.abbosh@uq.edu.au
Tunable microwave filters	A tunable bandpass filter with a wide tuning range for both the center frequency and passband is needed for compact microwave transceivers. The device can be used in different applications, such as microwave imaging, telecommunications etc. Planar structures are to be used in the design to realize a compact size with low cost.	A/Professor A. Abbosh, **Microwave & RF Engineering** a.abbosh@uq.edu.au
Microwave imaging systems for medical applications	The design and development of portable microwave-based imaging systems as a diagnostic tool for medical applications, such as the detection of brain stroke, heart failure,...etc. This project can be divided into several research topics, such as antenna array, signal processing, image processing and formation.	A/Professor Amin Abbosh **Microwave & RF Engineering** a.abbosh@uq.edu.au
Compressive sensing for microwave imaging	To improve the capability of microwave imaging systems in medical applications, many pre- and post-processing techniques can be utilized. In this project, the use of compressive sensing will be investigated.	A/Professor Amin Abbosh **Microwave & RF Engineering** a.abbosh@uq.edu.au
Design of wideband microwave transceivers	One of the main elements required to build portable microwave systems, such as medical imaging or telecomm, compact microwave transceiver that operates across wideband is needed.	A/Professor Amin Abbosh **Microwave & RF Engineering** a.abbosh@uq.edu.au
The Architectural Expression and Construction of Science	Contemporary institutions for experimental and applied science are increasingly investing in expressive, and expensive, architectures to give a persuasive face to its activities. What of earlier periods? The architecture of the laboratory from the alchemist's den of the 16th Century to the pharma campuses of the 21st requires greater attention that it has so far received in the History of Science. This project would complement current research on the contemporary laboratory.	Professor Sandra Kaji-O'Grady **Architecture** sandra@uq.edu.au
Sustainable Heritage Management	Cultural landscapes are a relatively recent addition to the way heritage is conceived. Illustrative of the evolution of a society over time under the influence of nature, the historic values of cultural landscapes are complex to define and difficult to manage. This area of research considers the sustainable management of complex industrial and other types of cultural landscapes. Issues that might be investigated include the economic, environmental, political and social forces that impact on heritage; heritage and social inclusion, community engagement and capacity building; heritage policy and planning including tourism and regional development; legislative, regulatory, institutional and traditional systems of heritage management.	Dr Chris Landorf **Architecture** c.landorf@uq.edu.au
Architectural management and practice	Architecture is a field known more for creative skill than management competency. To this end, approximately half of any architecture program is comprised of design courses that develop skills in experimentation, problem solving and critical self-reflection. Design is an exciting, iterative process that can overshadow the more practical skills required by an architect in practice. Architects still need to manage a business, work with people and construct projects on time, within budget and to a set quality. This area of research considers the business and project procurement contexts of architectural practice. Issues that might be investigated include alternative models of architectural practice; generating, costing and managing work in a practice; project briefing, property development and feasibility analysis; alternative models of project procurement.	Dr Chris Landorf **Architecture** c.landorf@uq.edu.au

New technologies for the production of titanium intermetallic foams	This project aims to develop new technologies for the production of intermetallic foam materials suited to extreme environments. In comparison to dense materials, foams exhibit lower densities, superior energy absorption capacities, reduced thermal conductivities and enhanced acoustic damping capabilities. Currently metallic foams are finding widespread usage; however, if metals are substituted with intermetallic compounds they could be used in more severe environments such as for thermal barrier coatings in extreme temperature applications such as high speed aerospace transport. The proposed research will develop novel methods to produce TiAl intermetallic cellular foams from elemental foil precursors through the integration of accumulative roll bonding and reactive thermal annealing.	Dr Damon Kent **Materials Engineering** d.kent@uq.edu.au
The fluid mechanics of tornados and other rotating fluid systems	The fluid mechanics of tornados are poorly understood. Essentially the question is: Why do the systems remain closely wound rather than spreading out at the top. The question is suitable for a PhD study which is partly numerical, partly laboratory experiments.	A/Prof Peter Nielsen **Civil Engineering** p.nielsen@uq.edu.au
Suspended sediment concentration profiles in steady flows and under waves	Concentration profiles of suspended sediment in steady flows are typically upward concave when plotted in the usual format with log-concentration horizontally and linear elevation vertical. Concentration profiles over rippled beds under waves are very different, they can be straight and even upward concave depending on the wave period and the bed roughness. The difference is thought to come from the different ways in which eddies interact in oscillatory versus steady boundary layer flows. The problem is suggested for a PhD study, partly analytical, partly numerical.	A/Prof Peter Nielsen **Civil Engineering** p.nielsen@uq.edu.au
Air bubble entrainment in plunging jets	When a plunging jet impinges into a pool of liquid, air bubble entrainment takes place if the inflow velocity exceeds a threshold velocity. This study investigates air entrainment and bubble dispersion in the developing flow region of vertical supported plunging jets. In this Ph.D. project, the candidate will undertake detailed air-water flow measurements in a large-size facility to characterise the air-water-turbulence modulation.	Prof. Hubert Chanson, **Civil Engineering,** h.chanson@uq.edu.au
Energy dissipation and air entrainment in hydraulic jumps	The optimum design of hydraulic energy energy dissipation systems can provide an economical solution for additional water resources & more efficient water distribution systems. Applications range from rural to large water systems including urban drainage networks. Their turbulence characteristics & energy dissipation performances are critical issues that are poorly understood. This project aims to gain new expert knowledge & to develop new radical design guidelines for the design of hydraulic jump energy dissipators used for spillway, water supply & drainage systems. This will be achieved through a Ph.D. research thesis	Prof. Hubert Chanson, **Civil Engineering,** h.chanson@uq.edu.au
Fish passage in culverts: hydraulic engineering	This project will review the design of culvert to facilitate fish passage. After a review of the literature, the project will focus on desings suitable to the Australian environment and the Australian fauna. This will be achieved through a Ph.D. research thesis with a strong focus on physical modelling, turbulence measurements and interactions with biologists.	Prof. Hubert Chanson, **Civil Engineering**, h.chanson@uq.edu.au
Non-uniform, unstable pore-water flow in intertidal wetlands	Salt marshes are important coastal wetlands characterised by strong, dynamic surface water and groundwater interactions. Such interactions lead to complex flow and transport processes that underpin the functionality of the salt marsh, affecting the marsh plant growth and exchange with coastal water. In this project, the PhD student will combine field monitoring and numerical simulations to investigate unstable porewater flow in salt marshes that are influenced by density gradients and soil heterogeneity. The research will fill a key knowledge gap and generate new insight into the link between the marsh hydrology and ecology.	Professor Ling Li **Environmental Engineering** **Civil Engineering** l.li@uq.edu.au

Processes underlying hydraulic fracturing	The hydraulic fracturing technique has been applied to enhance the hydraulic conductivity of resource-bearing rocks by injecting high pressure fluids. However, the underlying processes are not well understood. The technique causes concerns with possible leakage of used chemicals to overlying aquifers, unwanted seismic events and surface subsidence. In this project, the PhD student will combine experimental and computational investigations to establish fundamental understanding of key processes controlling fracture formation in brittle materials (coal seams and porous rocks) under the action of hydraulic fracturing, in particular, the coupling of hydro (fluids) and mechanical (solids) processes.	Drs. Alex Scheuermann, Dorival Pedroso, Sergio GalindoTorres and Ling Li, **Civil Engineering** l.li@uq.edu.au
Composite origami structures	The field of origami engineering is rapidly expanding. It involves the use of folded sheet geometry to engineering applications and researchers at the University of Queensland have developed numerous geometric assembly and fabrication methods for a range of structures, including deployable structures and lightweight energy-absorption devices. Ongoing research questions relate to the use of composite sheet materials for the design, manufacture, and analysis of large-scale structural engineering applications (facades and long-span beams). A PhD student who undertakes this project will use experimental, numerical, and geometric analyses to develop such applications.	Dr Joe Gattas & Dr Dilum Fernando Civil Engineering j.gattas@uq.edu.au
FRP-timber utility pole analysis and manufacture	Australia has widespread use of solid-timber utility poles. These are ageing and are soon to be replaced, however the use of solid-timber in replacement is unfeasible. Using composite fibre-reinforcement, it should be possible to use lower-grade timber or waste-wood as a new type of utility pole. These would be cheaper and more sustainable, however significant research questions remain related to their manufacture and structural performance. A PhD who undertakes a research project to answer these questions will use experimental and numerical analyses to develop in-depth understanding of their structural performance and sustainable manufacturing methods.	Dr Dilum Fernando & Dr Joe Gattas Civil Engineering dilum.fernando@uq.edu.au
Measurement of water content profiles using Time Domain Reflectometry	TDR is a well-established and widely accepted method for measuring water contents in soils. So far, primarily rod sensors with relatively short rod lengths are used for this kind of measurements. In current research projects TDR is used in combination with cable sensors to measure water content distributions for example in roads to investigate the effect of moisture on the strength and performance of roads or in the field for conducting infiltration test to determine soil hydraulic parameters such as the soil water retention curve. The project deals with the implementation of experiments using TDR, the analysis of the results.	Dr Alexander Scheuermann **Civil Engineering** a.scheuermann@uq.edu.au
Use of Elelectrical Resistivity Tomography for geoenvironmental problems	Electrical Resistivity Tomography (ERT) is used in geoenvironmental engineering to identify differences in the distribution of the electrical resistivity. The distributions of the electrical resistivity can then be used to investigate the infiltration of water into the ground, to localise the distribution of contamination in water saturated aquifers or to identify preferential flow patterns. The success of the application of ERT for these kinds of problems is strongly connected to the knowledge of the electrical parameters of the soils for different water contents, densities and salinities. On the one hand, the project deals with the calibration of different soils for the application of ERT. On the other hand, laboratory experiments will be carried out on a small flume for different geoenvironmental problems.	Dr Alexander Scheuermann **Civil Engineering** a.scheuermann@uq.edu.au

Characterisation of soft soils	The characterisation of soft soils plays an important role in soil mechanics and geotechnical engineering. For the identification of the consistency of a soil, the water content of a soil in situ is usually compared with the so-called Atterberg Limits defining the water contents at which the consistency of a soil changes e.g. from a suspension to a soft soil, or from a soft soil to a plastic soil. There are different methods available to determine these consistency limits. However, they are too laborious to be effectively used under field conditions. Measurements of the dielectric parameters may help to easily define the consistency of a soil in a fast and reliable way. The project deals with the characterisation of soft soils with water contents higher than the plastic limit. Different methods for the determination of the consistency limits are applied and compared with results from dielectric measurements.	Dr Alexander Scheuermann **Civil Engineering** a.scheuermann@uq.edu.au
Hydraulic experiments and particle transport	A numerical model based on Smoothed Particle Hydrodynamics was developed for investigating scour around offshore structures. This model has to be calibrated with well-defined hydraulic experiments and experiments aiming at the transport of individual or several particles. The project deals with the implementation of these experiments. There is also the possibility given to conduct numerical calculations.	Dr Alexander Scheuermann **Civil Engineering** a.scheuermann@uq.edu.au
Particle Imaging Velocimetry for investigating erosion of granular soils	Partitle Imaging Velocimetry (PIV) is used to investigate the onset of erosion of a granular soil under the influence of flowing water. Filter material is simulated using jelly beads, which are transparent under water. The fine fraction is modelled with glass beads, which can be tracked using a camera. The project deals with the implementation of experiments and their analysis.	Dr Alexander Scheuermann **Civil Engineering** a.scheuermann@uq.edu.au
Mechanical behaviour of rock and substitute materials	Hydraulic fracturing test will be conducted on rocks and substitute materials to investigate the fracture development in briddle materials. In order to determine the mechanical behaviour of these materials standard tests such as unconfined compression strength tests, Brazilian tests and point load tests will be conducted and analysed for different rock and substitute materials.	Dr Alexander Scheuermann **Civil Engineering** a.scheuermann@uq.edu.au
Detection of delamination damage at fastener holes in composite laminates using guided wave ultrasonics	The assembly of composite materials still make frequent use of mechanical fastening, which requires drilling of holes. The stresses created by the cutting tool during the drilling process can create delamination damage at the border of the hole. These delaminations together with the stress concentration at the hole, make them critical areas that limit the strength and life-time of the structure. The aim of the project is to investigate the potential of guided wave ultrasonics in the context of structural health management applications to detect and characterise these types of damages. This requires numerical simulation and experimental testing to characterise the scattering patterns of different types of waves and the optimisation of measurement locations and signal processing methods to reliably detect these damages.	A/Prof. Martin Veidt **Mechanical Engineering** m.veidt@uq.edu.au
Application of non-linear ultrasonics for the evaluation of residual stresses in shrink fits.	Shrink fit connections are important components of many different expensive mechanical infrastructures, for example in the areas of energy production, manufacturing and transportation. The quality of shrink fits depends on the level of residual stresses produced during assembly. The aim of the project is to investigate the application of non-linear ultrasonics to measure these residual stresses non-destructively and in-situ. This requires the development of analytical and numerical tools to calculate the influence of the residual stresses on the propagation of ultrasonic waves and experimentally validate these predictive tools before a measurement system can be designed and tested.	A/Prof. Martin Veidt **Mechanical Engineering** m.veidt@uq.edu.au

Low cost and high efficient perovskite solid-state solar cels	High efficiency perovskite solar cells (PSCs) have attracted much recent attention due to its low fabrication & materials costs and >19% efficiencies for solar electricity generation, while the utilization of toxic lead in perovskite is the major concern for the practical application of DSSCs. This CSC project will investigate the viability of lead-free pervoskite for solid state PSC applications. Such a device is expected to exhibit comparable performance over current PSCs but more environmentally friendly at lower cost. The expected outcome will lead to better understanding of the all solid-state solar cells design and possible breakthrough in efficiently utilizing clean solar energy for sustainable PV application.	Professor Lianzhou Wang **Chemical Engineering** l.wang@uq.edu.au
New electrode material development for high performance rechargeable battery application	The exhausting supply of conventional fossil foils and corresponding environmental issues have triggered global R&D demands towards zero-emission electric vehicles (EVs). The biggest challenge for EVs is to develop cheap and high-energy density batteries with good safety and reliability. This CSC program aims to investigate new generation of cathode materials with long cycling stability, high rate capability for potential practical application in the EVs. The project is expected to deliver (1) fundamental understanding of the key issues in new cathode materials for lithium ion batteries and sodium ion batteries; and (2) new methods to optimise the electrochemical performance and ultimately produce reliable and high energy density batteries which could lead to 400-500 km driving range for EVs.	Professor Lianzhou Wang **Chemical Engineering** l.wang@uq.edu.au
Design visible light active photocatalysts for solar-driven hydrogen production	The existing photocatalysts are known to work mainly in the Ultra-violet region of the solar spectrum. This CSC proposed project addresses a major research question on how to better use solar energy for photocatalytic water splitting to generate solar fuels such as hydrogen. The key concept is the doping (non-metals and metals) of a series of nanstructured semiconductors. The synthesis strategies developed in this project will also be applicable to a number of metal oxide compounds, providing new approach for significant increase of the photocatalytic water splitting efficiency.	Professor Lianzhou Wang **Chemical Engineering** l.wang@uq.edu.au
Understanding coal pyrolysis/carbonisation using high temperature rheometry	Rheology is the study of how unusual materials deform/flow, and is becoming increasingly important to a wide range of industries. This project is relevant to the coking and iron/steel industries. When coal is heated in the absence of oxygen, chemical reactions and phase changes occur that convert the coal into a viscoelastic foam. Upon further heating, the foam cures yielding porous coke, which is used to make iron. Rheometry provides a unique fundamental understanding of the microstructure and has enabled us to understand process problems and also predict and control final coke properties. The PhD candidate will be specifically involved in developing new ways to make high strength coke and developing useful and reliable ways to predict coke strength. The PhD candidate with work closely with Dr Karen Steel in addition to colleagues at the University of Newcastle and CSIRO in addition to various coal export industries in Australia.	Dr Karen Steel Chemical Engineering karen.steel@uq.edu.au
Development of novel methods to stimulate coal seams and increase coal permeability	The coal seam gas industry is growing very quickly in Queensland, Australia, and the Schools of Chemical Engineering and Earth Sciences are working closely to assist industry (www.ccsg.uq.edu.au/Research). For many of the coal seams there is a lot of gas trapped, however, productivity is limited due to the coal's low permeability. This PhD project will investigate the causes for low permeability and develop novel technologies to increase permeability. Typical experiments involve flooding coal cores with chemicals and measuring changes in permeability from which to develop a fundamental understanding of the reasons for permeability changes. The PhD candidate will join a highly multi-disciplinary team of chemical engineers and coal scientists and will present their findings to both the industrial and academic communities.	Dr Karen Steel **Chemical Engineering** karen.steel@uq.edu.au

Conversion of CO_2 into stable mineral carbonates	The School of Chemical Engineering at UQ is actively developing a low-energy means to convert power station CO_2 into stable Mg-carbonate using Mg-silicate. Currently, there is a technological barrier to conversion associated with the difference in pH between magnesium dissolution and carbonate precipitation. This project will examine a novel concept for overcoming this barrier. The student will present their findings to both the industrial and academic communities in Australia and internationally.	Dr Karen Steel **Chemical Engineering** karen.steel@uq.edu.au
A Novel Forward Osmosis (FO) Membrane based Technology for Wastewater Treatment and recourse recovery	Climate change, water shortage, and energy deficit are driving a paradigm shift in the goal of wastewater treatment towards to energy intensive and recourse recovery process. Forward osmosis (FO) membrane process, by which water passes from a solution at lower concentration towards a solution at higher concentration through a semipermeable osmotic membrane, is a promising technology with much lower energy cost compared with many other wastewater treatment processes This project will focus on direct sewage filtration by forward osmosis (FO) with the aim of concentrating pollutant in sewage into a small volume of energy source. The concentrated pollutant will then be removed or recovered in the subsequent process. The FO membrane fouling and its control will also be investigated.	Dr Karen Steel **Chemical Engineering** karen.steel@uq.edu.au
Characterisation of porous carbons	The pore structure of carbons is critical to its adsorption properties, and the characterisation of this structure using adsorption has been the subject of much attention. Here we will use a detailed model of CO2 and develop characterisation methods based on high pressure adsorption at ambient temperature, using a simulation technique that considers the atomic detail of the carbon surface. This characterisation will be validated by prediction of the adsorption of other gases, and used to investigate carbon dioxide capture in some novel emerging carbons.	Professor Suresh Bhatia Chemical Engineering s.bhatia@uq.edu.au
Fundamental studies of desalination	Desalination is a growing area of research, given then insufficiency of water resources in many areas of the planet. Here we will use molecular simulation tools to investigate the desalination process using boron nitride and silica as well as carbon nanotube-based membranes. Strategies for achieving enhanced salt rejection capabilities of the membranes, such as surface functionalisation, will be explored using molecular dynamics simulations, and optimal materials identified.	Professor Suresh Bhatia Chemical Engineering s.bhatia@uq.edu.au
Molecular modelling of carbon nanostructure, and application to CO2 capture	Carbons are among the most promising candidates for emerging applications involving gas storage and separation. This project aims to develop atomistic models for novel carbons synthesized in our laboratory, and to investigate adsorption and diffusion of important gases such as CH4 and CO2 as well as H2O in these model structures via simulation methods. The results will be compared with experimental data. Once validated, the models will be used as a platform for advancing the application of these carbons for CO2 capture and gas storage. Both virgin and suitably functionalised carbons will be examined, in particular for their advantage of hydrophobicity, since flue gas is always water saturated.	Professor Suresh Bhatia Chemical Engineering s.bhatia@uq.edu.au
Simulation of carbon supercapacors	Carbon-based supercapacitors have numerous applications in systems where high power is needed for short periods. Applications include hybrid electric vehicles, consumer electronics, industrial power and energy management. Despite the large application base a proper understanding of their behaviour is still to be achieved, and as a result their optimal design is still empirical and not possible from fundamental principles. Here we will use molecular simulation tools along with a realistic model of the carbon structure, to explore carbon supercapacitor behaviour and to develop a deep understanding of the mechanisms and energy barriers affecting the adsorption and transport of ions in the carbon nanostructure. The results will be used in the development of a device level working model for supercapacitors.	Professor Suresh Bhatia Chemical Engineering s.bhatia@uq.edu.au

Dynamics of adsorption in nanoporous materials	In recent years several newer silicas such as those of the MCM-41S family and other nanoporous materials such as templated carbons and carbon nanotubes have been developed. Such materials have high surface areas with pore sizes tunable in the nanoscale region. This project focuses on understanding the dynamics in such materials, which is challenging both from a fundamental and applications viewpoint. A novel new theory of pure component diffusion and transport of adsorbates in such materials has been developed. The new studies now proposed focus on binary systems, and the new theory developed will be extended to multicomponent systems in conjunction with molecular dynamics simulation and experiments. It will also be extended for transport in carbon nanotubes.	Professor Suresh Bhatia Chemical Engineering s.bhatia@uq.edu.au
Adsorption of carbon dioxide and methane in coals in the presence of moisture	The adsorption of carbon dioxide while displacing methane in coals is of increasing interest as a potential means of geosequestration with coal seam methane production. The role of water vapour in the gas phase is considered very important from a process standpoint, but little is known about its influence. Here we will study the equilibrium and dynamics of the adsorption of carbon dioxide and methane in the presence of moisture using novel hydrophobic carbide-derived carbons synthesised in our laboratory. Hierarchical mesoporous-microporous carbon monoliths will be synthesised and used in this work. Experiments will be done using a high-pressure adsorption apparatus in our laboratory, and the results interpreted using suitable models for the isotherms as well as diffusion.	Professor Suresh Bhatia Chemical Engineering s.bhatia@uq.edu.au
Gas Hydrate Formaiton and Utilisation	Natural gas hydrate (ice that burns) occures abundantly in nature and is a potential source of clean energy. Formation of gas hydrates can be utilised as an alternative technology for energy recovery and greenhouse gas mitigation. Inhibition of gas hydrate formation is a challenging task in oil and gas transportation. This project employs advanced spectroscopic and modelling techniques to investigate gas hydrate formation and dissociation and develop methods to utilise and manage gas hydrates.	Dr Liguang Wang Chemical Engineering Liguang.Wang@uq.edu.au
Improved models to describe relative permeability in unconventional gas reservoirs	This project will examine the flow of water through artificially constructed flow paths (of approximately 200 micron in aperture) within blocks of coal that form a micro- fluidic experimental set up equipped with digitally recorded microscopy capability to view the flow. The hypothesis to be tested is firstly whether coal type influences the flow of water and secondly the extent that coal type influences the flow of water. A new high pressure microfluidics cell will be constructed for this project to investigate water-gas wetting of coal at reservoir conditions.	Professor Victor Rudolph, Dr Tom Rufford Chemical Engineering v.rudolph@uq.edu.au
Low cost plugging and abandonment technologies for unconventional gas wells	This project involves research aimed at a cheaper and more effective method to plug and abandon coal seam gas wells and most other oil and gas wells. Currently coal seam gas wells and all oil and gas wells are required to be plugged with cement. But this process has limitations because cement is expensive and prone to cracking and unsealing. Our plan is to use a naturally occurring clay called bentonite to plug the wells. Bentonite is cheaper and easier to handle and when hydrated it creates a more reliable plug because it is malleable and self-healing when disturbed.	Professor Brian Towler Chemical Engineering b.towler@uq.edu.au
Development of Nanofluids for the Mitigation of Fines Migration in Coal Seams	This project will examine the development of nanofluids to stabilise the smectite clays that appear to be the primary cause of fines appearing in the production stream. The first stage of the project needs to determine the nanoparticle size and surface properties that will make up the nanofluid. Then lab experiments will be conducted to determine the effect these nano fluids are having on the fines migration andstabilization.	Dr Tom Rufford and Prof. Brian Towler Chemical Engineering t.rufford@uq.edu.au

Artificial lift technologies for coal bed methane fluids	There is a need for improved mathematical models to estimate pressure losses in CSG wells and allow better predictions of production from thick reservoir sections. Flow patterns of water and gas phases through the concentric annulus of a coal seam gas (CSG) well depends on the fluid properties, the pressure and temperature conditions, the flow velocities and the geometry of the production system. A range of correlations and mathematical models have been developed in the conventional oil and gas industry to describe these flow regimes and calculate pressure losses along the wellbore. In addition, lifting solids from the well is a potential operational problem in CSG wells. This project will explore artifical lift technologies for lifting fines from CSG wells and improved models to predict flows with solids-water-gas in pumped CSG wells.	Professor Brian Towler Chemical Engineering b.towler@uq.edu.au
Hierachical porous carbon foams for CO2, N2 and He removal from natural gas	This project will (1) develop advanced icroporous carbon foam materials from biomaterials and waste industrial products and (2) evaluate performance of these materials in novel pressure swing adsorption processes. The project involves lab work to synthesis nanomaterials and process simulation work to evaluate industrial scale gas separation processes.	Dr Tom Rufford Chemical Engineering t.rufford@uq.edu.au
Biomethane production from coal	Contact v.rudolph@uq.edu.au for more details	Professor Victor Rudolph Chemical Engineering v.rudolph@uq.edu.au
Upscaling issues in laboratory measurements and reservoir simulation for coal bed methane and other anisotropic formations	Contact v.rudolph@uq.edu.au for more details	Professor Victor Rudolph Chemical Engineering v.rudolph@uq.edu.au
Stimulation of tight gas and shale gas reservoirs by foaming chemicals	Contact v.rudolph@uq.edu.au for more details	Professor Victor Rudolph Chemical Engineering v.rudolph@uq.edu.au
Improved methodologies for measurement and prediction of the gas mixture adsorption in coal seam gas reservoirs	Contact t.rufford@uq.edu.au for more details	Dr Tom Rufford and Prof. Brian Towler Chemical Engineering t.rufford@uq.edu.au
Well production management in unconventional gas developments feeding LNG plants	Contact b.towler@uq.edu.au for more details	Professor Brian Towler Chemical Engineering b.towler@uq.edu.au

Flotation separation of coal and minerals	Froth flotation is a separation method using air bubbles which is widely employed in the coal and mineral industry. Flotation works efficiently with the particle size between 10 microns and 100 microns. To improve flotation of fine and coarse particles, a better understanding of the physical, chemical and engineering aspects of flotation is urgently needed. In this project, the PhD candidate will use various experimental and modelling techniques to gain a better understanding of many critical factors influencing flotation of fine and coarse particles of coal and sulphide minerals. The final aim is to develop innovative flotation processes for the mineral industry to minimize solid waste and water usage, and maximize energy efficiency.	Professor Anh Nguyen Chemical Engineering anh.nguyen@eng.uq.edu.au
Separation, capture and storage of greenhouse gases by hydrate method	Green house gases (carbon dioxide and methane) are the main cause of the climate change. This project aims to develop a new method for separting, capturing and storing greenhouse gases using its solid (ice-like) crystals, known as the gas hydrates, obtained at high pressure (10 MPa) and low temperature (2 ^{o}C). The project aims to find efficient ways to achieve a significant reduction of greenhouse gases discharged from coal power stations into the atmosphere. Specifically, the project will (1) investigate the new methods to separate and capture CO2 in its hydrate form which is suitable for depositing in the deep oceans or reservoirs, and (2) establish optimal conditions to make the process practically applicable and cost-effective.	Professor Anh Nguyen Chemical Engineering anh.nguyen@eng.uq.edu.au
Understanding the interaction and deposition of foliar fertilisers on the leaf surface	Foliar fertilizers are supplied in the form of sprayed solutions or suspensions to the plant through the leaves. They provide important tools for managing nutrient deficiencies or boosting crop yield and quality in agriculture and horticulture. However, they have relied largely on empirical development. In this project, the PhD candidate will use various experimental and modelling techniques to understand the interaction and deposition of foliar fertilisers on the leaf surface. The final aim is obtain an effective adhesion of foliar droplets onto the leaf surface and uniform distribution of fertilizer crystals on the leaf to maximize the delivery efficiency and minimize the loss.	Professor Anh Nguyen Chemical Engineering anh.nguyen@eng.uq.edu.au