University of Southern Queensland
Faculty of Engineering and Surveying

Project Topics for Prospective Postgraduate Research Students

Agricultural, Civil and Environmental Engineering

Project Description	Staff Member(s)	Email
Title: Lean construction – understanding potential through contracting strategies **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** Lean management is a common-sense proposition for achieving more with less with benefits to all parties through waste minimisation and generation of value. Inspired by success in the manufacturing industry, construction has awakened to the challenge of learning from the manufacturing industry whilst adapting to the needs of the construction industry. In traditional contracting, 'value' is generally believed to be achieved through competitive tendering though saddled with adversarial contractual relationships between different parties from time to time. Such problems seem to climax in complex projects with diminishing value to stakeholders. Consequently, a new contractual relationship has evolved wherein parties enter into pain-share and gain-share arrangements in 'alliance contracting'. Yet, initial investigations reveal that the potential of lean-philosophy has not been realised in either traditional or alliance contracting. As such, the purpose of this study is to investigate how its potential could be realised through contracting strategies.	Dr Vasantha Abeysekera	Vasantha.abeysekera@usq.edu.au
Title: Strategies for managing capital works arising from natural disaster from a lean perspective **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** The recent disasters in Queensland, Australia have affected many Australians lives, and caused considerable damage to property and infrastructure. The recovery and repair process is already underway with significant challenges on how best to commission and implement associated capital works. This study investigates this problem in depth from a construction project management perspective with the intention of developing a generic project management framework for rapid deployment of resources and completion of projects from a lean perspective where waste is eliminated and value is enhanced.	Dr Vasantha Abeysekera	Vasantha.Abeysekera@usq.edu.au

Title: Nutrient removal of wastewater using microalgae for potential biofuel recovery **Available for Major/s:** Civil/ Environmental/ Agricultural Engineering **Project Description/Direction(s)/Information:** Nutrient removal from wastewaters has been traditionally achieved by activated sludge. But, in recent years, microalgae have been exploited for simultaneous nutrient removal from wastewaters and fatty acid production for use as bio-fuel. There are limited studies available on algae production using piggery, dairy and municipal wastewater, however, the optimization of lipid production is yet to be done. Besides, the growth rates of algae in different wastewaters and potential lipid production have not been fully established. This project looks into the optimization of algal growth for maximum extraction of oils by giving environmental stress to the desired algal species in different wastewaters. It involves construction of lab-scale batch reactors, followed by continuous photo bioreactors with innovative membrane technology for algal growth and subsequent harvesting for extracting oil.	Dr Vasantha Aravinthan	aravintv@usq.edu.au
Title: Study of domestic water end use using smart metering system **Available for Major/s:** Civil/ Environmental Engineering **Project Description/Direction(s)/Information:** The prolonged drought we are experiencing currently poses great challenges to water authorities to provide potable water for the communities in a sustainable manner. Toowoomba City Council is implementing several demand management programs aiming to reduce the demand on potable water supplies. These measures include resorting to higher levels of water restrictions, offering rebate for those switching on to water saving appliances and installation of rainwater tanks etc. However, in order to achieve maximum savings in residential water consumption, the knowledge of where the potable water is used most is essential for planning and modelling purposes. This will also enable the council to take informed decisions targeting the demand management programs to those water events that consume high volume of potable water. This project involves establishing a water end use analysis using the data from smart metering system.	Dr Vasantha Aravinthan	aravintv@usq.edu.au

Title: Control strategies for public transport operation in regional cities **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** Many larger regional cities throughout the world are struggling to develop strategies which will allow the cost effective development of public transport facilities which are attractive to users in regard to both accessibility and cost. The acquisition of new, dedicated right-of-ways in existing areas is usually difficult, expensive and socially disruptive and so authorities often seek to develop public transport services which can utilise the existing road or rail infrastructure (e.g. provision of bus services). However the operation of such services is frequently hampered by the limitations of the existing networks and users perceive little advantage and less flexibility in public transport use than using private vehicles. Although some strategies have been developed which give some priority to public transport (e.g. dedicated bus lanes on major roads), the competition between public and private transport for use of the network frequently limits the effectiveness of the public transport operation. The proposed work will seek to investigate new ways of controlling both the public and private transport use of existing networks to provide competitive public transport services. It is envisaged that such control might be brought about by user pricing strategies as well as physical vehicle controls, and achieving this throughout both major and minor segments of the network to ensure an integrated overall approach.	Prof Ron Ayers Dr Soma Somasundaraswaran	ayers@usq.edu.au kathirgs@usq.edu.au)
Title: Planning of ground infrastructure to support increased air transport services **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** Air transport use is increasing rapidly around the world. Associated with this increase is the need to develop or redevelop existing air terminals and other ground infrastructure associated with the airport. A particular problem is the need to integrate the planning and development of ground transport facilities with airport development to ensure both passengers and freight are efficiently transport to and from the airport. This integration of planning and development is often difficult due to the competing demands of the airport development and the separate demands on the normal ground transport network. The proposed work will consider how the planning for the ground movement of air passengers and freight may be effectively integrated with planning for the normal ground transport network demands.	Prof Ron Ayers Dr Soma Somasundaraswaran	ayers@usq.edu.au kathirgs@usq.edu.au)

Title: Combining the concepts of 'Precision Agriculture' and 'Precision Livestock Farming' to promote pasture utilisation and production return by grazing ruminants **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** The overall aim of this research would be to use grazing animals as the indicator of pasture quality. This will be achieved by measuring animal movement as well as soil and plant composition of the pasture in order to determine the variability across the paddock. Results will be a more efficient usage of the pasture via the appropriate application of spatial operations. The specific objectives of this research are: • To monitor the animal movement on a pasture to determine areas of preferred grazing. • To establish differences in soil and plant composition between the preferred and avoided pasture areas and, thus, establish reasons for the animal's avoidance of certain areas • To utilise the gathered information to reach a more efficient usage of the pasture by applying spatial operations. • To repeat these trials on the same pasture after the application of spatial operations in order to monitor changes in animal movement behaviour, soil and plant composition. The proposed project will advance the current understanding by analysing the soil and plant compositions in the grazed and 'non-grazed' areas to understand the preferential movement of the herd. This information shall then be utilised for spatial operations aiming to increase the pasture productivity and to develop more sustainable pastures and management systems. The research will be conducted externally as on-farm research. Other facilities, such as laboratories for soil or plant sampling, are available on the university campus in Toowoomba.	Dr Thomas Banhazi Dr Troy Jensen	Thomas.banhazi@usq.edu.au troy.jensen@usq.edu.au
Title: Use of a mobile phone as a precision agricultural tool in developing countries. **Available for Major/s:** Agricultural/ Civil/ Computer systems / GIS/ Electrical/ Environmental/ Instrumentation and Control/ Mechanical/ Mechatronic/ Power/ Software/ Surveying **Project Description/Direction(s)/Information:** The implementation of precision farming in the developing world through imposition of modern precision farming technologies is unlikely to work. There are two areas of development that is considered critical to promote adoption of precision farming in developing countries. Firstly, it is about bringing awareness about the value of on-farm and spatial knowledge already possessed by the small subsistence farmers of the developing nations.. Secondly, it focuses on the development of technological aid that is practical and affordable to the farmers and yet complements with the existing mainstream technological advancement of the developing countries. Here the suggestion is towards further development of mobile phones to accommodate easy to use spatial information features that would have application in developing countries.	Dr Badri Basnet Dr Troy Jensen	badri.basnet@usq.edu.au troy.jensen@usq.edu.au

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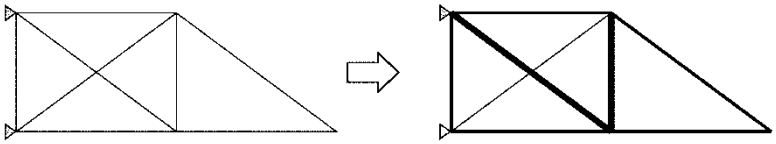
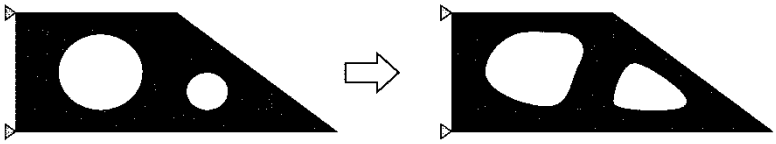
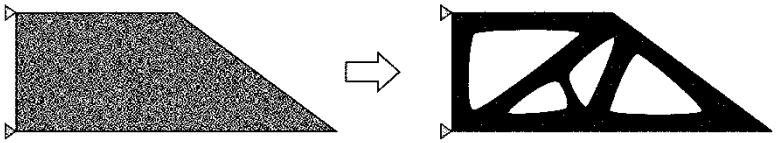
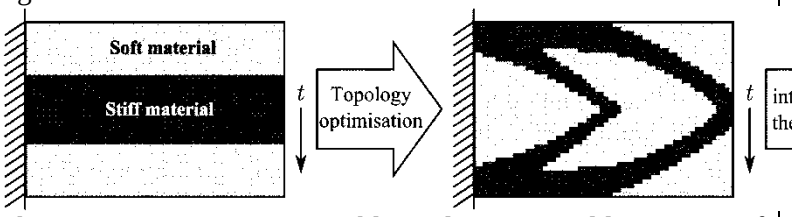
Title: Root zone interactions as influenced by the application of lime and lime/gypsum combinations to sodic soils with mildly to highly alkaline pH **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** Sodicity is caused by an abundance of excess exchangeable sodium on the clay face and affects 60 percent of soils worldwide (Tanji 1990). Consequently, these soils often become subject to dispersion upon wetting, resulting in an adverse soil environment for agricultural production. Estimated losses in Australian production due to sodicity are AUD$1025 million (Hajkowicz and Young 2005). Calcium is known to stabilise the soil through exchange with sodium that causes clay repulsive forces to be overcome. Gypsum is the most common calcium based ameliorant used, but faces issues associated with efficiency and rate of dissolution. Lime is higher in calcium than gypsum, but considerably less soluble under standard conditions. There is a dearth of information pertaining to lime and rootzone interactions with regard to sodicity. Recent research highlights the possibility of using legumes to dissolve inherent soilborne carbonates via changes in dissolved carbon dioxide through increase soil solution partial pressure (Mubarak and Nortcliff 2010), while other research shows the possibility for a synergy between lime and gypsum where gypsum aids in the dissolution of lime through proton exchange (Valzano *et al.* 2001). However, many sodic soils are alkaline and do not lend themselves to dissolution of lime, or promote precipitation of calcium. This project will investigate the rootzone effects of legumes on applied lime and lime/gypsum combinations in sodic soils.	Dr John McLean Bennett Dr Ehsan Tavakkoli Prof Steven Raine	john.bennett@usq.edu
Title: Innovative mechanical weed control using water jet **Available for Major/s:** Agricultural / Mechanical Engineering **Project Description/Direction(s)/Information:** Weed control in the agriculture can be very costly to both the farmers and the environment. The aim of the project is to develop an innovative mechanical system using high pressure water jet to devitalise weed at harvest as part of an integrated weed management strategy for long-term control of weeds and herbicide resistance. Although water jets are currently being used in the manufacturing industry and the food processing sector as cutting tools, the potential of using water jets for weed control in agricultural fields is a new concept and has not received much research worldwide, and thus this topic offers extremely good potential for a promising PhD student for further research and innovation. The project will involve the following work: (1) Conduct on-farm and lab experimentations to determine the relationship between pressure requirement (impact force) and weed seed germination rate; (2) Identify possible designs concepts (3) Analyse concepts and develop a most effective (optimized) prototype, possibly using tools such as Computational fluid dynamics (CFD) software (4) Conduct a comprehensive assessment in terms of farm economics and environmental benefits.	Dr Guangnan Chen	chengn@usq.edu.au

Title: Improving dynamic response of structures using topology optimisation **Available for Major/s:** Civil Engineering (available for both PhD and Master's level) **Project Description/Direction(s)/Information:** Structural optimisation can be divided into three levels. Sizing optimisation seeks the optimal dimensions of members with fixed shapes. Shape optimisation finds the best shapes of boundaries of members. Topology optimisation seeks the best topology, connectivity, or layout of a system. The following figure schematically illustrates these three levels.  (a) sizing optimisation  (b) shape optimisation  (c) topology optimisation Topology optimisation techniques have been successfully applied to a wide range of problems including dynamic design of structures [1,2]. They can be used for conceptual design of structural systems as well as detail design of structural members. This project aims to investigate the application of topology optimisation techniques in dynamic design of structures and use these methods to maximise the energy absorption of structural systems and individual members.	Dr Kazem Ghabraie	kazem.ghabraie@usq.edu.au

Title: Optimum reinforcement distribution using topology optimisation **Available for Major/s:** Civil Engineering (available for both PhD and Master's level) **Project Description/Direction(s)/Information:** In reinforced materials, such as reinforced concrete, finding the optimum reinforcement design is of critical importance. Topology optimisation methods can be used to find the optimal distribution of one material in a multi-material domain and thus can potentially be used to conceptualise the optimum layout of reinforcements in reinforced materials [1,2]. The following figure illustrates this idea.  This project investigates possible applications and limitations of topology optimisation techniques in reinforcement optimization. There are a number of complications which need to be addressed including non-linear behaviour of materials, cracking, and bonding between the materials. Current topology optimisation techniques will be improved and applied to reinforcement design problems. Wherever possible, the solutions obtained from the proposed approach will be compared with designs obtained via conventional methods.	Dr Kazem Ghabraie	kazem.ghabraie@usq.edu.au
Title: Sensor for remote detection of water advance for automation of surface irrigation **Available for Major/s:** Agricultural Engineering/ Mechanical Engineering/ Electrical/Electronic Engineering/ Computer system Engineering **Project Description/Direction(s)/Information:** Surface irrigation is the most common form of irrigation across the globe and is practiced on over 50% of the total irrigated area in Australia. Commonly termed "flood irrigation" this type of application is often inefficient potentially wasting hundreds of GL of Australia's limited water supply each year. However, these systems can be highly efficient when designed and managed effectively. The National Centre for Engineering in Agriculture (NCEA) based at USQ plays a leading role in developing hardware and software tools to assist in improving the efficiency of irrigation. The centre is currently undertaking a project to develop an automated real-time control system for furrow irrigation as practiced by the cotton and grains industries. Commercial application of this system is reliant on the development of an effective method to remotely sense the wetting front as it moves down the field.	Dr Malcolm Gillies	malcolm.gillies@usq.edu.au

The aim of this project is to investigate new techniques for remote sensing of the water front on the soil surface within the furrow. Existing sensors are installed within the field and hence are an inconvenience for other farm operations. Work to date has suggested potential options such as machine vision detection of the water from webcam footage, analysis of infrared images or detection of the plant response to the presence of water. This project will involve development and testing of a prototype system(s) for deployment in the field.		
Title: Precision agriculture opportunities in the Australian sugar industry **Available for Major/s:** Agricultural/ Electrical/ Environmental/ Instrumentation and Control/ Mechanical/ Mechatronic **Project Description/Direction(s)/Information:** There are several specific areas of interest relevant to this topic. These include; **1. Technologies for targeted management in sugar cane** Technologies for targeted management (e.g. VRT, ground based sensing etc.) have not been used in the Australia sugar industry. Anecdotal evidence suggests that even applying a uniform rate of a particular product (e.g. granular fertiliser – particularly in tropical locations) does in fact result in a variable application. This topic would scope and evaluate the current state of play and assess and evaluate relevant technologies and quantify their impact on production and returns to sugarcane farmers. **2. Opportunities in harvester research** Mechanical harvesting of sugarcane has been a major success story for the Australian sugar industry. However, the Australian sugarcane industry has suffered a plateau in productivity (Wilson and Leslie 1997) and there is considerable evidence that mechanisation is a component of this plateau in performance. A recent review of opportunities to improve the performance of sugarcane harvesters by Davis et al. (2010) highlighted the harvesting issues confronting industry and the rationale for future industry funded harvesting R&D. Based on this review, there are four main objectives in this project. • Build industry capacity in harvesting best practice and new harvesting technologies • Package existing knowledge on harvesting best practice and provide a mechanism for ongoing review • Implement a program of collaborative harvesting systems R,D and E with a focus on monitoring tools and protocols; performance assessment; machine design and harvesting best management practise (BMP)	Dr Troy Jensen	troy.jensen@usq.edu.au

Title: Improvements in the handling and processing of pecan and macadamia nuts. **Available for Major/s:** Agricultural/ Electrical/ Environmental/ Instrumentation and Control/ Mechanical Mechatronic **Project Description/Direction(s)/Information:** There are several specific areas of interest relevant to this topic. These include: **1. Drop analysis of pecan and macadamia nuts in the production chain.** The quality of the shelled nut is being lost due to bruising and damage that has occurred due to impact with hard surfaces in the production system. The challenge of this project is to monitor the situation to determine where this is occurring and modify the system to remediate this problem. **2. Evaluating the drivers of brown centring in macadamia nuts** Brown centring in macadamia nuts is cause by inappropriate drying conditions. The objective of this research would be to determine what the correct drying parameters are for macadamia nuts and implement these changes in a commercial operation. **3. Pecan harvester assessment** Considerable time and effort is expended on-farm in the harvesting operations of pecan nuts. Nut, leaf litter, twigs and larger pieces of branches are all processed by the harvester. The efficiency of the harvester to separate the nuts from non-nut determines how much superfluous material remains with the nuts prior entering the drying facility. Depending on the quality of the sample, additional effort may be expended screening the residual material prior to it being sent off to the processor. By improving the nut retrieval process by optimising the cleaning fan performance, it is hoped that a much cleaner and more repeatable sample can be produced by the harvester, minimising the post-harvest handling of non-nut material resulting in lowered labour and operating costs.	Dr Troy Jensen	troy.jensen@usq.edu.au

Title: Rehabilitation of old timber structures using external fibre composite reinforcements **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** There are many timber bridges around world needing rehabilitation of their old deteriorating timbers girders. In order to repair old timber structures, a suitable rehabilitation technique is required. A rehabilitation method that is getting attention in civil engineering applications recently involves bonding sheets (or bars) of fibre reinforced polymer (FRP) to the tensile face and sides of the affected beam member to improve its bending and shear strength and deflection characteristics. Fibre-reinforced polymer (also known as fibre-reinforced plastic) has been in use as a structural material since 1940s but only recently civil engineers started focusing more attention on this material due to its useful properties such as high strength, corrosion resistance and long term durability. This project involves the investigation of structural behaviour of FRP reinforced beams. Suitable analytical and numerical models will be developed to predict the bending, shear, deflection and buckling behaviour FRP rehabilitated beams with due consideration given to non-linear material behaviour of timber and linear behaviour of most FRPs. The model will be validated using available experimental results. An extensive numerical parametric analysis based on the finite element method will be carried out to show the influence of key parameters such as FRP area, FRP type and FRP layup sequence on the structural behaviour of rehabilitated beams.	Assoc Prof Karu Karunasena	Karu.Karunasena@usq.edu.au
Title: Structural behaviour of composite hybrid beams made from recycled plastics and FRP rebars **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** Recycling waste polymeric materials such as plastic bags, plastic bottles and using these materials as the major constituent component of any construction materials will have a very positive impact on both environment and energy conservation. In this project, service and ultimate behaviour of recycled low-density polyurethane (LPDE) beams made from recycled plastics and reinforced with FRP (such as fibre glass) rebars are investigated. These hybrid beams can be used as impact protection systems in many engineering applications. Few examples of possible uses of them as impact protection systems are in bridge piers, fort jetties, car parks and road side construction projects. Finite element method based numerical models will be developed to predict non-linear structural behaviour and energy absorption capability of these hybrid beams. Developed models will be verified using recent experiments results from a large experimental program. Verified numerical models will be used to predict the behaviour of different size beam configurations for relevant applications.	Assoc Prof Karu Karunasena	Karu.Karunasena@usq.edu.au

Title: Effect of confinement on composite tubes filled with polymer based fillers **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** Composite tubes have been using around the world for many engineering applications. In marine and ground-zone environments, fibre composite tubes are more favourable because of their corrosion and pest resistance. Using composite tubes in bridge/ boardwalk rehabilitation is an innovative method. Conventional method is to use concrete as the filler material. However in this particular bridge pile rehabilitation process, filler material must have qualities like good workability, less curing time, fair compressive capacity and reasonable pumpability. Polymer based fillers would be suitable to be used for in-filling composite tubes. However, unconfined polymer based filler is ductile and its use is limited by a concern regarding a lack of understanding of the behaviour under complex multi-axial loading conditions. The issue of ductility is extremely important and a well known method of improving ductility is the use of lateral confinement. In this situation, composite tubes are used as the method of confinement. This study aims at investigating the effect of level/ type of confinement on these composite tubes filled with polymer based fillers.	Dr Weena Lokuge	weena.lokuge@usq.edu.au
Title: Structural performance of expanded polystyrene sandwich panels **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** The use of sandwich panels in structural wall systems, slabs and roofs is popular due to their lightweight, cost effectiveness and thermal insulation capability. Aim of this research is to study the structural behaviour of Expanded Polystyrene (EPS) sandwich panels. They are made of expanded polystyrene core and steel wire meshes on either side of the core and cement mortar as the outer layer on both sides of the panel. Normally a thicker panel with stiffer face and higher core density is more advantageous as it will give more flexural and shear rigidity. . However panels have to be lightweight too. Panels with fixed core density and different mortar thicknesses can be tested for elastic modulus and shear modulus. Using the experimental results for both large and small panels, the results could be produced in a more generalised form by eliminating the size effect. By analysing the test results, optimum panel design with optimum core and panel thickness for stiffness and minimum density can be found. These panels would be ideal for structural applications especially in developing countries.	Dr Weena Lokuge Assoc Prof Karu Karunasena	weena.lokuge@usq.edu.au karu.karunasena@usq.edu.au

Title: Performance evaluation of the emerging composite wall systems **Available for Major/s:** Civil Engineering, Structural Engineering **Project Description/Direction(s)/Information:** Several construction and building systems are now being developed from new and emerging materials like fibre composites, geo-polymer concrete and other economically competitive, environment friendly materials. An increasing range of panel products made from these materials are available for structural applications like roof, wall, and subfloor covering. In wall system application, the current design and construction methodologies using these new materials follow that of conventional materials as there is limited knowledge on the performance behaviour of these composite construction systems under imposed loads. Moreover, the design of wall frames does not utilise the strength contributions of these high-strength and lightweight panel products in carrying the loads leading to a high cost structural system. There is a need therefore to fully understand the performance behaviour of emerging composite wall systems to effectively design this new method of construction with emphasis placed on the end-use and the associated performance requirements. This study will investigate the systems performance of the composite wall systems through simulated service testing to develop both prescriptive and performance-based design criteria which will be useful to the construction industry. This evaluation could also provide essential data on the performance of composite wall systems for a more cost-effective option and to further increase the acceptance of these new construction systems in residential and building construction.	Dr Allan Manalo	manalo@usq.edu.au
Title: Simplified Design Concepts for Composite Sandwich Structures **Available for Major/s:** Civil Engineering; Structural Engineering **Project Description/Direction(s)/Information:** Composite sandwich construction offers a more functional and efficient structure because of their high strength and bending stiffness to weight ratios. However, the lack of appropriate design guideline is a significant barrier to their widespread utilisation in civil infrastructure. Accordingly, there is an industry need to develop calculation methods that capture accurately the mechanical response of sandwich structures while being relatively straightforward to implement. This project aims to provide an understanding with the necessary tools to develop simplified and practical approaches to the analysis and design of sandwich structures in civil engineering applications. The effects of the constituent material properties, geometric configurations and laminating together a number of sandwich panels on the failure mechanisms and the overall behaviour of a sandwich structure will be evaluated systematically and will be presented	Dr Allan Manalo	manalo@usq.edu.au

in easy-to-follow design charts. This research includes numerical and theoretical case studies to establish the simplified design philosophies and develop engineering design tools for sandwich structures with different geometries and material systems followed by experimental validation. Furthermore, the results of this study can be a guide for best practice for a more effective design and utilisation of fibre composite sandwich structures.		
Title: Assessing the performance of Variable Rate Irrigation equipment applied to a pivot irrigation system for dairy fodder production **Available for Major/s:** Agricultural Engineering/ Instrumentation and Control/ Agronomy, Soil and Water **Project Description/Direction(s)/Information:** This project is related to the performance of hardware, software, and sensors to vary the rate of irrigation application in response to in-field soil variability, topography and crop performance. This Dairy Industry project is to determine the feasibility (agronomically, technically and economically) of using variable rate irrigation in fodder production. Automated VRI systems rely on prescription maps, which are developed over time by the operator/irrigator, which infers trial and error over a number of seasons. Initial inputs are generally based on low resolution soil maps, NDVI or other third party spatial data sets which only have a tenuous relationship with on-site irrigation performance and crop yield. This project will use the computer model Variwise, which integrates APSIM to analyse the feasibility of applying different VRI strategies to fodder production over a range of climate and production scenarios. Once strategies are selected, the role of this project is to assess the applicability to the farmer's operational requirements and crop performance. Therefore the project has a number of elements: assess the performance of the irrigation system (including VRI), compilation of spatial data sets, selection of irrigation strategies based on modelling outcomes, and ground-truthing the application of strategies based on operational requirements.	Dr Allen D. McHugh	mchugha@usq.edu.au
Title: Identification of social and environmental benefits of water trading **Available for Major/s:** Water Resources/ Resource Economics/ Environmental Science; Land and Water Management **Project Description/Direction(s)/Information:** Water trade it encourages water to move the most highly value among competing users and uses. Water markets premise that trading provides economic benefits to buyers and sellers, and to society as a whole, including environment. However, there have been concerns that changes associated with water trading might have adverse economic, social and environmental impacts. Until now considerable attentions have been paid in understanding the farm-level financial impact of water trading. However less	Dr Shahbaz Mushtaq Dr Ian Brodie	Shahbaz.Mushtaq@usq.edu.au Ian.Brodie@usq.edu.au

attention has been pain in understanding the social and environmental impact. Water trading out of the region could have adverse impact on the land values and local industry, although it may have positive impact on environment. This graduate research project aims to identify both positive and negative impact of water trading on communities and environment.		
Title: Application of shakedown concept in the design of road pavements **Available for Major/s:** Geotechnical Engineering **Project Description/Direction(s)/Information:** Most pavement design methods currently used around the world are largely empirical. For example, in the current design practice of road pavements, it is assumed that "failure" occurs when the vertical *elastic* compressive strain at the top of the subgrade reaches a critical value so that a relationship between the magnitude of the strains and the number of repetitions to cause rutting failure can be empirically established. However, failures of pavements associated with moving repeated traffic loads are typically caused by gradual deterioration rather than sudden collapse. This type of failure behaviour is mostly due to the accumulation of plastic strains under repeated loadings. They are different from the geotechnical engineering solution of the stability problems of soil masses under simple loading programs. An excellent review of the current practice of pavement engineering has been given by Brown (1996) in the 33rd Rankine Lecture to the British Geotechnical Society. He emphasizes that practice is lagging behind knowledge of the behaviour of road materials obtained from laboratory experiments and that theoretical models need to be improved. This project thus aims at developing a novel elasto-plastic design approach of road pavements based on shakedown theorems which consider the effect of repeated moving traffic loads. **Significance and Innovation** For flexible pavements, the most common causes of failure are rutting or cracking of the wear surface. To avoid this type of damage, which is usually very expensive to repair, road designers must be able to estimate the maximum cyclic load capacity of a pavement accurately and reliably. The shakedown method proposed here will provide a rational basis for resolving this question, as it can be used to predict the maximum level of repeated loading that a pavement can sustain without suffering excessive permanent deformation. The method will enable road engineers to perform parametric studies that investigate issues such as the optimal properties of the pavement material, the optimal layer sequences, and the optimal layer thicknesses. **Approach** There are two basic approaches that can be used to obtain shakedown limits. The first one employs conventional	Dr Jim Shiau	jim.shiau@usq.edu.au

elastoplastic finite element analysis to trace the complete deformation path, and requires each load cycle to be broken up into a discrete number of steps.
After each increment is applied and the load cycle reaches its maximum amplitude, the sign of loading is reversed and the structure is unloaded in an incremental fashion. This process is repeated for a large number of load cycles and plots of the load--deformation response and cumulative plastic dissipation are produced (Cochetti and Maier 2000). Shakedown occurs if the deformations and residual stresses no longer change from one cycle to the next, and is also signalled by constant plastic dissipation with time and contained plastic flow. If these conditions do not arise, the structure eventually undergoes incremental collapse and it is necessary to repeat the whole process with smaller load amplitude. Due to the large number of load steps required, and the need for a trial--and--error strategy to locate the shakedown limit, this type of approach is both time consuming and costly. If it is used to perform parametric studies, where the material and geometric properties are varied in an effort to isolate an optimal configuration, the costs can be prohibitive.
The second approach, which is more elegant than the first, makes use of the shakedown theorems to obtain upper and lower bounds on the shakedown load directly. These analyses employ similar methods to the limit theorems, which are widely used for predicting static collapse loads. Though
the latter are powerful techniques for performing stability analysis of structures under static loading (Sloan 1988 and 1989), they are of limited use for predicting the behaviour of structures subjected to repeated loading where other forms of collapse may occur. The shakedown theorems for an elastic--perfectly plastic continuum have been given by Melan (1938) and Koiter (1956) and may be stated as:

Melan's static shakedown theorem (lower bound). "If any time--independent distribution of
residual stresses can be found which, together with the elastic stresses due to the load, constitutes
a system of stresses within the elastic limit, then the system will shakedown". In other words, the elastic stresses associated with the maximum load, together with any distribution of residual
stress, which nowhere violates the yield condition, will give a lower bound to the shakedown limit.

Koiter's kinematic shakedown theorem (upper bound). "Shakedown will not take place if any kinematically admissible cycle of plastic strain can be found in which the work done by the elastically imposed stresses exceeds the internal plastic work".To provide solutions that are useful in practice, Melan's static shakedown theorem should be used in tandem with Koiter's kinematic shakedown theorem so that lower and upper bounds on the shakedown load are obtained. These 'direct methods' clearly have great advantages over incremental elastoplastic finite element analysis as they avoid tracing the complete loading history.

This project is concerned with applying finite element

formulations of Melan's and Koiter's theorems to the design of pavements under repeated loadings. **Procedures** The followings show the step-by-step procedures to achieve the goal towards my PhD study at USQ: 1. Review of current pavement design methods. 2. Review of shakedown theorems. 3. Design and construction of a Track Model for the investigation of road pavements under repeated surface loads. 4. Application of lower bound shakedown analysis to the design of road pavement. 5. Application of upper bound shakedown analysis to the design of road pavement. 6. Production of design charts based shakedown methods.		
Title: Developing physical and numerical models for geotechnical teaching and research **Available for Major/s:** Geotechnical Engineering **Project Description/Direction(s)/Information:** In a geotechnical teaching curriculum, the basic concepts of Geomechanics are usually first introduced, accompanied with some standardized soil tests for measuring the index properties, permeability, consolidation, and shear strength of soil. More advanced geotechnical and foundation engineering courses are then presented by introducing more complex boundary value solution techniques and numerical methods to different forms of geotechnical structures. The transition from basic Geomechanics into the analysis and design of geotechnical structures can be challenging for students and at this stage the role of physical models becomes important as part of the student's learning process. Large centrifuges are often used in research laboratories to study the self-weight stress induced failure of geotechnical structures. While most academics recognize the importance of geotechnical teaching by using the centrifuge technology to demonstrate the behaviour of geotechnical problems, the cost of servicing this teaching aid is prohibitive in many universities. In this proposal, we present the concepts involved in designing inexpensive laboratory equipment which can be used to perform demonstrations and research experiments on the ultimate behaviour of various geotechnical structures under external loadings. Such equipment can be efficiently used to complement the theoretical approach and serve to visualize phenomena of geo-structural failures. To date, a number of large centrifuges have been established in research laboratories around the world to study the self-weight stress induced failure of geotechnical structures. While most researchers recognize the importance of geotechnical teaching by using the centrifuge technology to demonstrate the behaviour in geotechnical problems, the cost of servicing this teaching aid is prohibitive in many universities.	Dr Jim Shiau	jim.shiau@usq.edu.au

The main objective of this research is to present the concepts involved in designing inexpensive laboratory equipment which can be used to perform demonstrations and research experiments on the ultimate behaviour of various geotechnical structures under external loadings. Such equipment may include models for ultimate bearing capacity of a footing near a slope, active and passive earth pressures on retaining walls, stability of geotextile-reinforced soil, uplift and lateral resistance of soil anchors and buried pipelines, and the behaviour of pile foundations under lateral loadings. This research will show that such equipment can be efficiently used to complement the theoretical approach and serve to visualize phenomena of geo-structural failures in two- and three- dimensional space.		
Title: The effect of second-hand vehicles on road crashes and safety interventions **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** In developing countries, vehicle usage is associated with income levels, and in general, second-hand vehicles including second-hand motorcycles are relatively cheaper and is often the only affordable means of transport for poor people. However, the growing use of these venerable vehicles is associated with a higher death or injury risk compared to other modes. Particularly, several developing countries are now overflowing with a large proportion of second hand vehicles whose growth in numbers has been associated with a rapid rise in fatal injuries. The objective of this research is to investigate the effects of second-hand vehicles on road crashes and fatalities, and subsequently on safety interventions. Specifically, this research seeks to examine associations between poor standard vehicles' fatalities and how this interacts with policies to reduce fatalities, such as seatbelt legislation and graduated driving licence.	Dr. Soma Somasundaraswaran Prof Ron Ayers	kathirgs@usq.edu.au ayers@usq.edu.au
Title: Analysis of traffic characteristics of mixed flow during traffic congestion **Available for Major/s:** Civil Engineering **Project Description/Direction(s)/Information:** The effective usage of highway networks in urban area is of great importance in our daily life as it influences delay, travel times, costs, and other environmental concerns. In recent years, the increasing amount of vehicular traffic has led frequent traffic jams on urban highways. In contrast to past practices, it is no longer possible to react to this traffic congestion by construction of new highways. Several control strategies have been implemented to use the existing network more efficiently such as coordinated and adoptive signal control, variable speed and message signs, and route guidance. This study will examine the effect of mixed traffic on highway capacity from the analysis of traffic characteristics, speed volume, occupancy, and concentration of mixed vehicles flow.	Dr. Soma Somasundaraswaran Prof Ron Ayers	kathirgs@usq.edu.au ayers@usq.edu.au

Result from this study will facilitate to define the capacity with mixed ratio of passenger cars. In addition it helps to make more efficient traffic operational decisions along highways, for example, application of variable bandwidth progression in traffic operation where signalized intersections are in proximity to each other, and or introducing different operating speeds for inbound and outbound traffic segments.		
Title: Effect of irrigation by coal seam gas produced water on soil infiltration capacity under a sequential rain–irrigation system **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** Growing attention to domestic energy production in Australia has resulted in the rapid development of a Coal Seam Gas (CSG) industry. The industry recovers natural gas (methane) from water-saturated coal seams. One key element crucial to the success of the CSG industry is the safe management of the saline and sodic water produced by CSG extraction. Currently irrigation of agro-forestry systems by CSG water is a key option for beneficial use. This project will address the current deficit of scientific knowledge in relation to the sustainable beneficial use of associated CSG water via irrigation. It is well recognized that the salinity of irrigation water and the sodium adsorption ratio (SAR), have an interactive effect on soil physical properties. However, most water quality criteria are based on short-term laboratory experiments with continuous water flow in packed soil columns. Information is lacking on suitable water quality criteria when waters of elevated SAR are irrigated under climatic conditions where rain events occur during the season. This project will be designed to test infiltration and hydraulic conductivity of the near surface horizons of soils from the sites that are irrigated with simulated CSG waters with differing EC and SAR levels and subjected to alternating rainfall.	Dr Ehsan Tavakkoli Mr Dan Rattray Dr John Bennett Prof Steven Raine	Ehsan.tavakkoli@usq.edu.au
Title: Determining crop tolerance to salinity stress using electromagnetic induction sensor (EM38) **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** Salinity tolerances of crops have seldom been determined by field experiments because of the variability of saline soils. In the traditional field plot experiments the crop is grown on a uniform or near uniform site. The spatial variability of saline soils makes it difficult to select a uniformly saline site for field plots. Much of the data on salinity tolerance has been obtained from plants growing in controlled experiments in sand cultures in greenhouses or using lysimeters. These sand cultures are often salinised by circulating the concentration of saline solution required to provide the level of salinity desired. The salinity tolerances determined in these sand cultures or lysimeters differ from the salinity tolerances a farmer encounters in the field. The electromagnetic induction meter permits rapid collection of soil	Dr Ehsan Tavakkoli Mr Dan Rattray Dr Troy Jensen Prof Steven Raine	Ehsan.tavakkoli@usq.edu.au

salinity information in the field. The project aims to determine the salinity tolerance of crops by mapping of soil salinity on a partially saline field with an EM38 meter and yield is mapped using a yield monitor on a combine, both techniques use GPS. Then, a relationship between salinity and yield can be determined. Also, given that EM38 readings are influenced by soil temperature, moisture and texture, the project aim to develop a calibration system to isolate the contribution of these parameters.		
Title: Non-destructive phenotyping of stressed cereals **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** Plants use different mechanisms to survive salinity and water stress: osmotic tolerance, shoot Na^+ and Cl^- exclusion and ion tissue tolerance. Until recently, however, it has been difficult to separate these mechanisms from each other, due to the destructive sampling methods involved. We have recently developed techniques for the non-destructive analysis of plant growth and health using an image capturing device. This allows us to measure a plant's response to stress over time and separate the mechanisms which occur early in stress, from those effects, which happen later. The project envisioned here will involve designing a variety of computational approaches for data analysis of the images obtained from the plant Scanalyzer. These will be used to create new parameters for measuring salinity and water stress. As such, the project will make substantial use of the new technologies to rapidly phenotype a variety of parameters for plant health, including shoot and root growth rates, areas of tissue damage, transpiration rates and chlorophyll fluorescence.	Dr Ehsan Tavakkoli Dr Troy Jensen Prof Steven Raine	Ehsan.tavakkoli@usq.edu.au
Title: Abiotic stress to plant growth in alkaline soils **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** High pH soils (>8) occupy about 25% of the land area in Australia and about one third of the world soils are also alkaline. Problems commonly associated with alkaline soils include poor soil structure, low water infiltration capacity, nutrient deficiency and toxicity of Al, Fe and carbonate species. Studies on alkaline soil chemistry are very limited, particularly the investigations on different ionic species occurring at different pH values in the range of 8 to 11. This project aims to undertake a critical evaluation of different abiotic stresses to plant growth in relation to pH in the alkaline range in soils to classify these soils in relation to plant productivity and soil management. As well, while detailed studies on the reclamation of acid soils have been undertaken, reclamation of alkalinity is unknown in soil management. The project will investigate the reclaiming alkalinity techniques using chemicals, organic amendments, micro- biological methods or using plants that secrete acids in root exudates for the management of alkaline soils and their productivity.	Dr Ehsan Tavakkoli Dr Pichu Rengasamy Prof Steven Raine	Ehsan.tavakkoli@usq.edu.au

Title: Irrigation water quality and soil structure **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** About 35% of total land area in Australia is affected by different categories of salt-affected soils. Apart from natural salinity, a significant proportion of the cultivated land has become saline due to irrigation, particularly when groundwater or recycled waste waters were used. Recent reports draw attention to elevated concentrations of potassium (K) and/or magnesium (Mg) in some soils which arise naturally and also as a result of increasing irrigation with waste or effluent or recycled water in Australia. There is also a tendency in industries to use K or Mg salts instead of Na during recycling processes to prevent the increase in Na concentration in effluents. Long term application of such wastewaters may lead to build up of exchangeable K and Mg in soils which both can also cause effects similar to sodium, but has been neglected because of low amounts usually present in salt-affected soils. Therefore, there is a need to derive and define a new ratio of these cations in place of SAR, which will indicate the effects of Na, K, Mg and Ca on soil structural stability. This will be achieved using a formula analogous to the SAR but which selectively incorporates the dispersive effects of Na and K on the one hand with the flocculating effects of Ca and Mg on the other. This project aims to designs experiments for development of such a formula in relation to the cation ratio of soil structural stability and in comparison to SAR in soil solutions in their relationship to clay dispersion and soil hydraulic conductivity.	Dr Ehsan Tavakkoli Dr Pichu Rengasamy Prof Steven Raine	Ehsan.tavakkoli@usq.edu.au
Title: Quantification of plant response to abiotic stresses (soil salinity, water stress and heat stress) **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** Abiotic stresses such as salinity and drought, salinity and heat, and distinct combinations of drought and temperature, or high light intensity are common to many agricultural areas and could affect plant productivity. It was recently shown that the response of plants to a combination of salinity and heat stress is unique and cannot be directly extrapolated from the response of plants to salinity or heat stress applied individually. Because different abiotic stresses are most likely to occur simultaneously under field conditions, a greater attempt must be made to mimic these conditions in laboratory studies. The timing of the salinity stress event with respect to the developmental stage of the plant should also be addressed. Although plants can differ in their sensitivity to various abiotic stresses during different developmental stages including germination, vegetative growth, reproductive cycle, and senescence, from a strictly agronomic point of view there appears to be only one main consideration: How would this interaction between stress and development affect overall yield? The aim of this project is to design experiments to characterise the soil-plant relations under such conditions.	Dr Ehsan Tavakkoli Prof Steven Raine	Ehsan.tavakkoli@usq.edu.au

Title: Simultaneous measurements of soil water content and salinity using the Time-Domain Reflectometry method **Available for Major/s:** Agricultural Engineering **Project Description/Direction(s)/Information:** Growing attention to domestic energy production in Australia has resulted in the rapid development of a Coal Seam Gas (CSG) industry. The industry recovers natural gas (methane) from water-saturated coal seams. One key element crucial to the success of the CSG industry is the safe management of the saline and sodic water produced by CSG extraction. Currently irrigation (dripping) of agro-forestry systems by CSG water is a key option for beneficial use. Drip irrigation systems are usually operated intermittently and consist of point or line source emitters, which are sometimes arrayed and interacting. During infiltration, the soil water content and salinity changes both spatially and temporally and redistribution of water and salt in the soil is strongly dependent on the irrigation method, soil type, vegetation root distribution and rates of water application. Spatial variations in soil properties induce spatial variations in water distribution patterns between drippers and consequently sensor placements to detect soil wetted volumes around drippers become challenging. Moreover, interpretation of profile soil salinity and water content measurements and soil water spatial distribution provide key information in drip irrigation scheduling, because they determine emitter layout and discharge rates. This project aims to develop techniques for quantitative understanding of the dynamics of the water and salt regimes by measuring water content and salinity simultaneously and in a non-destructive fashion using time domain reflectometry probes (TDR) which can be useful for purposes of calibration and verification of theoretical flow and transport models.	Dr Ehsan Tavakkoli Mr Dan Rattray Prof Steven Raine	Ehsan.tavakkoli@usq.edu.au
Title: The effects of seeds graining process on the tribolgoical characteristics of components in agriculture machines **Available for Major/s:** Agricultural Engineering/ Mechanical Engineering **Project Description/Direction(s)/Information:** In this work, the effect of third body presence such as dust and seeds powder on the trobological behaviour of agriculture machines should be investigated. There are many components exposed to relative motion under applied load, i.e. adhesive tribolgoical loading. The presence of third body in the rubbing area transforms the adhesive wear into three body abrasion which in turn accelerates the wear process. Such phenomenon is not desired. Therefore, a study should be conducted to prevent or reduce the effect of the third bodies on the tribological performance of those components. There are several methods which can assist to enhance the tribological performance of the agriculture components, i.e. preventing the presence of the third bodies, reduce the effect of those bodies, replace the components with better counterparts, ...etc.	Dr Belal F. Yousif	Belal.Yousif@usq.edu.au

Title: Seismic retrofitting of existing masonry structures using fibre reinforced polymer (FRP) **Available for Major/s:** Civil/ Mechanical Engineering. **Project Description/Direction(s)/Information:** Masonry is one of the most commonly used materials throughout the world for the construction of low rise buildings. Even though the history of past earthquakes has shown that masonry buildings suffer the maximum damage and also account for the maximum loss of life, they continue to be popular. It was evident from the past earthquake that most unreinforced masonry structures were seriously damaged. Therefore it is an important issue to retrofit and strengthen existing masonry structures to resist the potential earthquake damages. The basic concept of seismic retrofitting is to upgrade the structural strength and improve the inelastic deformation capacity of the structure. In the last two decades, several seismic retrofitting techniques for masonry structures have been developed and practiced and fibre reinforced polymer (FRP) material has been increasingly used due to their high strength/stiffness to mass ratio and easy application. Although much research has been carried out on FRP strengthening of unreinforced masonry (URM) structures, most of them have been experimental studies to investigate the effectiveness of retrofitting techniques rather than the development of a rational design model. This proposed research will be focused on the development of a design model for FRP retrofitted masonry structures. A series of experimental testing will be conducted to investigate the failure mechanism of the structures, followed by the development of the numerical model using finite element method. A design formula will be developed at the final stage of the project.	Dr Yan Zhuge	zhuge@usq.edu.au

Title: Development of a natural fibre reinforced sandwich panel against earthquake **Available for Major/s:** Civil / Mechanical Engineering. **Project Description/Direction(s)/Information:** Fibre composite (FRP) sandwich panels have been used in different applications such as aerospace, automobile and building constructions. FRP composite sandwich panel has a high structural strength to weight ratio, and high energy absorption which made is perfect for earthquake resistant design. However, the high cost of FRP has made it very difficult to promote the design and construction of this type of structure among the developing countries. The main objective of this research is to develop a new hybrid sandwich panel incorporating a bio-based material derived from renewable resources and therefore to reduce the cost. This research work will be mainly based on a series of laboratory experiments and numerical studies. The expected outcome from this research is a new sustainable hybrid sandwich panel which has a better structural performance to against earthquake and low cost.	Dr Yan Zhuge	zhuge@usq.edu.au

Electrical, Electronic and Computer Engineering

Project Description	Staff Member(s)	Email
Title: Micro-grid regulation with smart dispersed VAR control. **Available for Major/s:** Power Engineering/Electrical **Project Description/Direction(s)/Information:** The use of the full 4 quadrant operation of micro-grid connected PV and Wind inverters potentially allows for enhanced system stability, protection and improved voltage regulation. At this stage regulations do not permit this operation and detailed simulation and experimental validation are essential before larger scale usage is allowed. A number of intelligent inverters may need to work as a group to meet this objective. The network requirements, sequence logic and resulting impact on stability and protective devices will require analysis.	Dr Les Bowtell	bowtelll@usq.edu.au
Title: An investigation of the wide-scale impact of plug-in hybrid electric vehicles on the electricity network **Available for Major/s:** Electrical/Mechanical Engineering **Project Description/Direction(s)/Information:** Plug-in hybrid electric vehicles (PHEVs) can be connected to the power grid for either charging or discharging. Wide-scale deployment of the technology can aid to improved grid services. The study is based on simulations covering prolonged time	Dr Fouad Kamel	kamel@usq.edu.au

periods to obtain an accurate assessment of the impact of the technology. It is anticipated that uncoordinated/uncontrolled charging of PHEVs in distribution grid can lead at times to local grid congestions. Therefore, coordinated charging and discharging is proposed by the study. Investigation of grid performance, stability and reliability is carried out based mainly on voltage constraint and power flow. The study aims to estimate the magnitude of PHEVs the distribution grid can handle without reinforcements. The study involves as well renewable energy participation in the distributing grid. The study anticipates that there could be a maximized use of PHEVs as they can provide storage to renewable energy sources. This can represent an added value to both renewable energy sources and PHEV as well.		
Title: Feasibility study of water desalination powered by renewable electricity from sea/ocean **Available for Major/s:** Electrical/Mechanical Engineering **Project Description/Direction(s)/Information:** Within most areas in the world, the supply of natural fresh water is limited to meet an increasing demand for agricultural, industrial and domestic uses. There are numerous projects underway to supplement fresh water supply where it is needed, for example via desalination of sea-water. The commercially favoured Reverse Osmosis technology for fresh water production from sea saline water requires large amounts of energy in the form of electricity. Like water, the demand for electricity is also increasing driving an expansion in electricity generation capacity. Environmental considerations relating to climate change and resource depletion are also driving demand for sustainable and lower emission electricity generation technologies as well as decentralised electricity generation to reduce transmission losses. Within this context, combined desalination and power generation is a technology of great interest and with potentially high value and wide application. This study portrays different methods of generating electricity from sea/ocean water movements to supply desalination of waters from the particular sea/ocean location. The study involves economic and environmental sustainability studies about the technology as well.	Dr Fouad Kamel	kamel@usq.edu.au
Title: Energy efficient network optimisation **Available for Major/s:** Computer Systems Engineering/ Electrical and Electronic Engineering **Project Description/Direction(s)/Information:** In light of the global focus on greenhouse gas emissions, energy consumption of communication networks has become an important research area. Computer and communication networks are major consumers of energy and have become critical infrastructure. Networks are generally dimensioned for peak loads. For extended periods, resources consume power, but are lightly or unused. The research project proposes and analyses communication networks that can dynamically change the	Dr Alexander Kist	kist@usq.edu.au

number of active devices according to traffic and resilience requirements. It will combines teletraffic engineering, routing and network equipment in a novel way to achieve major energy savings in networks. Outcomes will include original mathematical models to quantify gains, mechanisms to change systems dynamically and a comprehensive measurement study to verify energy savings and network robustness. The project will enables major energy savings in communication networks, reducing energy cost as well as greenhouse gas emissions.		
Title: Energy efficient server clusters **Available for Major/s:** Computer Systems Engineering/ Electrical and Electronic Engineering **Project Description/Direction(s)/Information:** Energy consumption and carbon footprints are rapidly gaining importance from an environmental but also from an economic perspective. It has been estimated that currently 2% of global carbon emissions are due the ICT sector, an order similar to the aviation industry. The power consumption of server systems used as part of online services is an important problem as these have become major energy users. Generally, such systems are dimensioned for peak loads and typically have average utilisations of 20-30%. A recent research project (Kist 2011) has proposed a simple routing mechanism that uses overflow techniques to assign requests to these servers. As these mechanisms employ a staged process, idle systems can be suspended. Request distribution is implemented by a router device; servers report their utilisation to the router. Idle systems suspend their operation; suspended systems are returned to the active state by the Wake-on-LAN function. This project focuses on the broader research area of energy efficient server clusters, their performance modelling and optimisation.	Dr Alexander Kist	kist@usq.edu.au
Title: Adaptive rate allocation for ADSL and wireless **Available for Major/s:** Electrical/ Electronic Engineering/ Computer Science **Project Description/Direction(s)/Information:** Asymmetric Digital Subscriber Line (ADSL) connects a large proportion of internet users worldwide. In the case of ADSL over copper telephone lines, the subchannels carry a variable bit allocation based on the measured signal to noise ratio (SNR). This bit rate per subchannel is set according to the SNR using a bit-loading algorithm, and is subject to the maximum power constraint of the channel. For guaranteed delivery channels such as TCP, this scheme works well. However where there may be some tolerance for bit errors, particularly in video on demand, the scheme of bit allocation is suboptimal. In other words, a lower SNR subchannel could be utilized to carry a greater bit-loading, with no impact on the user's perception of the delivered content. The aim of this project is to investigate such adaptive bit-loading. It is novel in that the physical layer channel needs to co-operate with the higher-layers of the protocol stack in order to negotiate an acceptable bit error rate (BER).	Assoc Prof John Leis	leis@usq.edu.au

Title: Laser-spectroscopic and laser-acoustic approaches to methane gas detection **Available for Major/s:** Electrical, Electronic Engineering/ Mechanical/Mechatronic Engineering/ Computer Science **Project Description/Direction(s)/Information:** Measuring gas concentrations in mining, transportation and other industries is vitally important to ensure safety. Moreover, the measurements need to be intrinsically safe - that is, no electrical connection to the sensing environment. Thus, laser light coupled with fibre-optic transmission is one avenue which presents itself. The aim of this project is to investigate novel, in-situ and electrically isolated measurement techniques for explosive gas detection in hostile environments. Problems include the sensitivity, selectivity, calibration of the instrument. A primary aim is the development of acoustic signal processing techniques which are suitable for laser-modulated photoacoustic gas sensing. The focus could be one or more of: signal processing design, the fundamental physics of the optoacoustic method, the mechanical design of the resonator, and novel measurement algorithms such as frequency-sweep and adaptive phase-lock.	Assoc Prof John Leis Prof David Buttsworth	leis@usq.edu.au
Title: The monitoring and automatic control of depth of anaesthesia during operation **Available for Major/s:** Electrical, electronic/ Computer Engineering/ Mechatronic Engineering **Project Description/Direction(s)/Information:** Nowdays, physiological monitoring is imperative for the safety of medical operations. During surgery, doctors heavily depend on monitors to detect as quickly as possible the change of patients' conditions. The difficulty in monitoring and automatic control of depth of anaesthesia is the inherent patient variability due to differences in demographic and drug tolerance. These discrepancies are translated into the pharmacokinetics-pharmacodynamics PKPD(s) dose-response model uncertainty that may affect the stability of the closed loop system. This research aims at developing mathematical models and design predictive controllers using Internal Model Control, Model Based Predictive Control, robust control and fuzzy control techniques. The objective of this project is to develop patient dose-response models and to provide an adequate drug administration regimen for the anaesthesia to avoid under or over dosing of the patients. The controllers are designed to compensate for patients inherent drug response variability, to achieve the best output disturbance rejection, and to maintain optimal set point response.	Assoc Prof Paul Wen Dr Tony Ahfock	pengwen@usq.edu.au tony.ahfock@usq.edu.au

Title: Real-time control system research based on unreliable network links **Available for Major/s:** Electrical, electronic/ Computer Engineering **Project Description/Direction(s)/Information:** A Networked Control System (NCS) is a control system wherein the control loops are closed through a real-time network. The defining feature of an NCS is that control and feedback signals are exchanged among the system's components in the form of information packages through a network. The insertion of the communication network in a control system makes the analysis and design of an NCS more complicate, since it imposes additional time delays and even packet drop in control loops. That brings a lot of challenges in control and network engineering research. These challenges include NCS related new control techniques, reliability and security of communications, bandwidth allocation, development of data communication protocols, corresponding fault detection and fault tolerant strategies, real-time information collection and efficient processing of sensors data. Depending on the application, time-delays and/or packet drop could severely degrade the system performance. This project is to develop and design and analysis method for NCS systematically. The applications of NCS covers a broad range of industries such as: space and terrestrial exploration, GIS based environment monitoring, access in hazardous environments, factory automation, remote diagnostics and troubleshooting, experimental facilities, domestic robots, aircraft, automobiles, manufacturing plant monitoring, nursing homes and tele-operations.	Assoc Prof Paul Wen Assoc Prof Armando Apan	pengwen@usq.edu.au armando.apan@usq.edu.au
Title: Fountain codes-based approach for multimedia contents delivery over IP networks: a revolutionary application-layer forward error correction paradigm **Available for Major/s:** Telecommunications Engineering/ Electronic Engineering **Project Description/Direction(s)/Information:** The proposed PhD project *aims* to address a significant research problem of multimedia content delivery over IP networks based upon a conceptually new application-layer forward error correction technology termed fountain codes. With the rollout of the National Broadband Network (NBN) in Australia, telecommunication operators are presented with the opportunity to provide high-definition (HD) and 3-D digital video services to consumer televisions using IP-based networks (IPTV services). The significance of this technology lies in that it will contribute to the release of precious bandwidths occupied by current analogue and digital TV channels, which could otherwise be utilised by other wireless services. However, new technology faces new technical challenges: one	Dr Wei Xiang	wei.xiang@usq.edu.au

of the most prominent problems for deploying high-quality IPTV services is insufficient video quality manifested as noticeable artifacts in the video caused by packet loss. IP-based networks were initially designed following the principles of an economical best-effort network, which is difficult to support stringent QoS requirements boasted by conventional dedicated TV broadcasting systems. Consequently, this calls for advanced application-layer error control technology to guarantee video quality. This project aims to address this significant problem based upon a conceptually new technique called fountain codes which is also known as rateless codes.		
Title: Cooperative MIMO wireless communications for 4G cellular networks **Available for Major/s:** Telecommunications Engineering/ Electronic Engineering **Project Description/Direction(s)/Information:** Due to physical limitations, wireless agents may not be able to support multiple antenna so as to reap the transmit diversity gained in multiple-input and multiple-output (MIMO) systems. Cooperative wireless communications allow single-antenna mobile terminals to reap some of the benefits of MIMO systems. The essential idea underlying cooperative wireless communications is that single-antenna mobiles in a multi-user scenario can share their antennas in a manner that creates a virtual MIMO environment. Cooperative devices are growing in value with respect to wireless communications and networks. They substantially enhance system performance by decreasing power consumption and packet loss rate, and increasing system capacity and network resilience. Cooperative wireless communications has wide application in next generation (4G) mobile networks. This PhD project involves studying into the theory and practices of cooperative MIMO communications systems. Novel designs of cooperative MIMO systems are expected out of this project, which are able to demonstrate considerable performance gains.	Dr Wei Xiang	wei.xiang@usq.edu.au

Mechanical and Mechatronic Engineering

Project Description	Staff Member(s)	Email
Title: Applications of machine vision and mechatronics **Available for Major/s:** Electrical/ Software/ Mechatronics Engineering **Project Description/Direction(s)/Information:** Within the National Centre for Engineering in Agriculture many interesting problems emerge. These have in the past ranged	Prof John Billingsley	billings@usq.edu.au

from the use of structured light to determine the 'quality' of cattle, the use of machine vision to identify species, the use of microspectral techniques to identify weeds, with the accompanying electromechanical systems to put them to practical use. Students with potential aptitudes in such areas can be launched into appropriate programmes of research. If possible, they should bring an application area of their own, which need not be specifically agricultural.		
Title: Development of Smart Composite Structures **Available for Majors:** Mechanical/Civil/Materials/Chemical **Project Description/Direction(s)/Information:** Advanced composite structures has been widely using in a variety of engineering applications including aerospace, automobile, petro-chemical and civil infrastructures for a few decades. At present there is a great demand for intelligent/smart composite structures in these fields which are possible to maintain more effective and efficient manner. The development of advanced composites are becoming more feasible with the recent development of active and passive sensor systems and other materials such as shape memory alloy. However, the development of smart structures depends on the nature of the application. This project is not limited to a single component/structure and can be tailored for many projects depending on the application.	Dr Jayantha Epaarachchi Prof Alan Lau	eparracj@usq.edu.au Kin-tak.Lau@usq.edu.au
Title: Development of Structural Health Monitoring Systems (SHM) for Advanced Composite Structures **Available for Major/s:** Mechanical/ Civil/ Materials/ Chemical **Project Description/Direction(s)/Information:** The detection of structural damage such as cracks and delamination in beams remains an important problem in structural health monitoring and is an active area of research. There are various methods for structural damage detection like non-destructive testing methods such as strain field analysis, modal analysis, acoustic and ultrasonic methods are some of the emerging structural health monitoring methods that are technically mature enough to be used as structure integrated damage monitoring system. Using the recent advancements in active and passive sensor systems such as fibre optic sensors and the advanced modelling and analytical tools this project can be tailored to many projects on the development of SHM systems for various structures/components depending on their applications.	Dr Jayantha Epaarachchi Prof Alan Lau	eparracj@usq.edu.au Kin-tak.Lau@usq.edu.au
Title: Power generation using solar-gas hybrid technologies **Available for Major/s:** Mechanical Engineering,/ Power Engineering **Project Description/Direction(s)/Information:** Concentrating Solar Power – Parabolic Trough (CSP-PT)	Mr Steven Goh Dr Ian Craig	steven.goh@usq.edu.au ian.craig@usq.edu.au

installations consist of linear parabolic mirrors which concentrate solar energy to heat tubes of oil or salt to high temperatures, typically to several hundred degrees centigrade. The thermal energy produced can be stored to enable continuous 24-hour operation of the turbine generator, but this option is generally expensive. As an alternative considering the vast natural and coal-seam gas footprint in Australia, an approx 20% boost from natural gas can be deployed, which enables the plant to operate continuously. The purpose of this research is to investigate if the CSP-PT +20% gas boost technology would present the best option (as a feasibility study and conceptual design) for Australia and potentially other parts of the world to address the growing global energy demand.		
Title: Development of Fibre Composite Road Tanker **Available for Major/s:** Mechanical Engineering / Civil Engineering **Project Description/Direction(s)/Information:** The main aim of this project is to establish research for the development of application systems for fibre composite materials in the transport industry for corrosive liquid road tankers. Currently the transport industry is utilising tankers that are expensive to purchase and have high maintenance costs from a very early life span. This project will aim to resolve which materials best suit the required production system that will result in longest life span capability in respect of corrosive liquids. The intention of this project is the study and application of fibre composites directly in relation to corrosive chemicals as used extensively in the agri-business market throughout Australia. Examination of fibre composites used in production of liquid road tankers reveals that there is no current method in place to determine life-span or long-term effects of corrosive chemicals on tanker linings. The intended project will analyse current data and determine through experiments which composite materials and systems of application will deliver best result in corrosive resistance and develop a prediction model on the long-term effects of such liquids on differing materials.	Dr Mainul Islam	mainul.islam@usq.edu.au

Title: Development of a Natural Fibre Composite Artificial Reef **Available for Major/s:** Mechanical Engineering / Civil Engineering **Project Description/Direction(s)/Information:** The main aim of this project is to develop a fibre composite artificial reef (CAR) system using natural fibres for sea water cleanup and other purposes. This project will use natural fibres mixed with PLA or PBA or other biodegradable polymer to fabricate a new type of composite artificial reef (CAR). The project methodology includes studying the type of natural fibre which is good for this purpose (good natural degradability in sea water without generating any harmful effect to micro-organisms (sea), say using seaweed fibre), designing the architecture of the reef for CAR through experimental, theoretical and computational approaches, their effectiveness in trapping rubbish (actual size of the rubbish should be known and studied), manufacturing process, mixture process and composition of fibre and polymer, the growth rate of coral may also issue to be studied, site tests are required to study the effectiveness of the designed CAR.	Dr Mainul Islam	mainul.islam@usq.edu.au
Title: Machine vision-based weed spot spraying **Available for Major/s:** Mechatronic/ Electrical/ Computer systems **Project Description/Direction(s)/Information:** This project aims to develop machine vision-based precision spray technologies for the Australian sugar, cotton and/or grains industries in response to increasing pressures on herbicide use. Currently there exists no commercial technology that can reliably distinguish green plants based on visual features (e.g. spectral response, shape and texture) and success in this area represents a major technical breakthrough. The research will involve the development of new technologies for detecting weeds in a crop.	Ms Cheryl McCarthy	cheryl.mccarthy@usq.edu.au
Title: Porous media for radiation blockage and particle filtration in large size applications **Originator**: **Available for Major:** Mechanical Engineering **Project Description/Direction(s)/Information:** Porous materials are widely used for sifting solid particles from fluids, filtering bacteria, membrane systems and separation of various fluids and gases. They are also used in heat transfer applications such as cooling towers, liquid rocket engines and building protection industries. Recent studies show that they can be very effective to protect objects against radiant heat fluxes. In this project, computational and experimental approaches will be used to determine, monitor	Dr. Ahmad Sharifian	sharifia@usq.edu.au

and improve the performance of porous material at large size applications which require radiation blockage and mass filtration simultaneously. The project includes the following key steps; 1. Establishing the correlation between porosities and particle sizes (high temperature wind tunnel), 2. Finding the relationship between porosities and blockage of passing radiant heat fluxes (ANSYS and pyrometer), 3. Obtaining the relationship between porosities, material properties and radiant heat fluxes from porous material at elevated temperature (ANSYS , pyrometer and radiometer), 4. Determining thermal stresses of porous material at high radiant heat flux environment (ANSYS, MATLAB and tensile test machine), 5. Finding the relationship between porosities and drag forces (FLUENT and wind tunnel), 6. Design of the optimal configuration for a particular high temperature application (MATLAB, AUTOCAD, ANSYS), 7. Prototype manufacturing (workshop). The results of this work particularly will improve high temperature applications of porous material such as design of cooling towers, jet engines, automobile industry, fuel transportation systems, burner designs, and building protection against bushfires.		
Title: Design of high performance short towers for solar tower plants **Available for Major:** Mechanical Engineering **Project Description/Direction(s)/Information:** The production and use of fossil fuels contributes to environmental pollution and is unsustainable. A Solar Tower Plant (or Solar Chimney Plant) is a renewable energy producing power plant that comprises the chimney effect, the greenhouse effect and the wind turbine technology. Air is contained in a large greenhouse structure around the base of a tall tower or chimney. Sun heats up the air and reduces its density. The warm and light air rises up in the tower and the airflow drives turbines and produces electricity. The output power of a Solar Tower depends on the height of the tower and the collector area under a specified metrological condition. Solar Tower Plants offer several advantages, such as no requirement to high tech material (as they require mainly concrete and glass) and no requirement to cooling water. The main disadvantage of Solar Tower plants is their requirement to tall towers. The aim of this study is to model and optimize the system and determine the possibility of shorten the height of the tower in order to reduce initial construction cost. Several computer simulation codes (ANSYS, FLUENT and MATLAB) will be developed that will describe the main components, their performance, and their interactions. The accuracy of the code and the results will be verified by experimental studies using a small-scale model in the labour.	Dr. Ahmad Sharifian	sharifia@usq.edu.au

Title: Analysis of performance issues with internal combustion engines **Available for Major:** Mechanical Engineering **Project Description/Direction(s)/Information:** With continuing questions about the long-term reserves of fossil fuels and the environmental impacts of their use, it is important to try to utilise this resource in the best way possible. Automobiles are a major contributor to the consumption of fossil fuels and because of the unique requirements of the transport industry (relatively high power with relatively low weight), the overall efficiency of internal combustion engines is significantly lower than for fixed power stations, so continuing research is required. There is potential for a number of students to research the latest technological developments in this industry by undertaking modelling work using Computational Fluid Dynamics (CFD) and/or experiments. Some of the work currently being undertaken involves usage of new engine operating techniques (HCCI: Homogeneous Charge Compression Ignition), alternative fuels (such as natural gas) and conventional fuels with additives (such as hydrogen and natural gas).	Dr Andrew Wandel Dr Talal Yusaf	andrew.wandel@usq.edu.au talal.yusaf@usq.edu.au
Title: Geopolymer --- a green alternative to ordinary cement and concrete **Available for Major:** Mechanical Engineering **Project Description/Direction(s)/Information:** Cement/concrete is the second largest volume materials (after water) used globally. Annually, world consumption of cement is 3 billion ton. Because the cement manufacturing process involves high temperature calcinations, the industry is the third largest industrial consumer of energy. It contributes about 10% of the world's CO_2 emission. Geopolymer uses fly-ash and slag to react with alkaline liquids at temperatures below 50ºC and produce a cement-like binder paste. When it hardens, it behaves as cement or concrete if it is mixed with aggregates. Geopolymer can be a revolutionary material as the green alternative to cement. In addition it uses industrial by-products as raw materials (fly-ash from power station and slag from smelter).	Dr Hao Wang	hao.wang@usq.edu.au

Title: Natural fibre composites and natural polymers **Available for Major:** Mechanical Engineering **Project Description/Direction(s)/Information:** Composite materials suppliers, manufacturers and end-users have a significant un-met demand in environmentally friendly technologies, particularly materials from renewable sources. Research has shown that there is significant potential for natural fibre composites to replace glass fibre composites, wood and other non-structural and semi-structural materials. This research theme aims to develop composite materials based on renewable naturally-sourced fibres and resins, and to improve the design methodologies, manufacturing processes and the performance of the natural fibre composites. It extends USQ's recognised research strength on fibre glass composites and uses natural fibres, such as flax, hemp and jute, to replace the synthetic fibres as reinforcement in composites.	Dr Hao Wang	hao.wang@usq.edu.au
Title: Biodiesel fuel - microalgae - for internal combustion engine **Available for Major/s:** Mechanical/ Chemical/ Agricultural Engineering **Project Description/Direction(s)/Information:** Biodiesel fuel - Microalgae - for Internal Combustion Engine (production, harvesting, extraction). Microalgae can be used in either blend form with diesel fuel or as an emulsion in combustion engine. Mechanical engineering background is important. Agriculture engineering knowledge is positive.	Dr Talal Yusaf	yusaft@usq.edu.au
Title: Mechanical treatment for microorganism disruption **Available for Major/s:** Mechanical/ Chemical/ Agricultural Engineering **Project Description/Direction(s)/Information:** Mechanical treatment for microorganism disruption, a three suggested method to identify the real cause of cell wall disruption using ultrasound, these three methods are shear stress, strain energy and shock wave. The background is chemical and mechanical engineering. Knowledge on biology is positive.	Dr Talal Yusaf	yusaft@usq.edu.au

Surveying and Spatial Science

Project Description	Staff Member(s)	Email
Title: Remote sensing and GIS application to agriculture **Available for Major/s:** GIS/ Remote Sensing/ Geomatic Engineering/ Agriculture/ Environmental Science **Project Description/Direction(s)/Information:** A postgraduate research project can be developed between Dr. Apan and the prospective applicant on a topic that involves the use of remote sensing (satellite imagery) and/or geographic information system (GIS) to agriculture. Some of the broad areas include: • Remote sensing of crop stress (due to disease, water, nutrition, soil, etc.) • Crop yield estimation and monitoring using remote sensing and GIS • Drought monitoring using remote sensing and GIS • Flood risk mapping modelling using remote sensing and GIS • Plantation mapping and monitoring • Spatial technologies for precision agriculture • Soil erosion and desertification studies involving the use of imagery and GIS A specific topic can be tailored according to the interest and expertise of the postgraduate applicant.	Assoc Prof Armando Apan	apana@usq.edu.au http:/www.usq.edu.au/users/apana
Title: Remote sensing and GIS application to environmental management, ecology, and natural resources **Available for Major/s:** GIS/ Remote Sensing/ Geomatic Engineering/ Environmental Science/ Ecology/ Forestry **Project Description/Direction(s)/Information:** A postgraduate research project can be developed between Dr. Apan and the prospective applicant on a topic that involves the use of remote sensing (satellite imagery) and/or geographic information system (GIS) to environmental science, ecology, forestry, etc. Some of the broad areas include: • Remote sensing and GIS to observe terrestrial ecosystems (e.g. productivity, biodiversity, etc.) and their responses to environmental / climate change • Vegetation, forestry and habitat mapping/modelling using GIS and remote sensing • Drought effects, modelling, impact assessment, etc., using geospatial technologies • Biodiversity assessment using geospatial technologies • Land use/cover change analysis using GIS and imagery • Soil erosion and desertification studies involving the use of imagery and GIS • Flood risk mapping, impact assessment, etc. using geospatial technologies	Assoc Prof Armando Apan	apana@usq.edu.au http:/www.usq.edu.au/users/apana

A specific topic can be tailored according to the interest and expertise of the postgraduate applicant.		
Title: 3D land mapping of Kurdistan using photogrammetry, remote sensing, Lidar, terrestrial scanner and GPS methods **Available for Major/s:** Spatial Science **Project Description/Direction(s)/Information:** This research involves development of new methodologies in spatial data capture and statistical analyses of spatial data uncertainty and accuracy. It may involve land mapping, land erosion, water course and natural disaster study, terrain modelling and urbanization modelling. The research is aimed at Masters and PhD level.	Dr Albert Chong Dr Xiaoye Liu Assoc Prof Kevin McDougall	chonga@usq.edu.au Xiaoye.liu@usq.edu.au Kevin.mcdougall@usq.edu.au
Title: 3D modelling, 3D positioning and analysis (human body man-made or natural structure, artefact, manufacturing, tooling, defence and surveillance) using image processing techniques. **Available for Major/s:** Spatial Science/ Electric, Electronic and Computer Engineering **Project Description/Direction(s)/Information:** The research involves the development of new methodologies in the 3D modelling, 3D positioning and analysis of physical objects including images captured by visible light, near-infrared, X-ray and sound sensing devices. Research in human exercise and physical impairment study may include the spine, muscles and limbs (in conjunction with the School of Physiotherapy and Exercise Science (Griffith University, Gold Coast). The research is aimed at Masters and PhD level.	Dr Albert Chong Assoc Prof John Leis Assoc Prof Kevin McDougall	chonga@usq.edu.au john.leis@usq.edu.au Kevin.mcdougall@usq.edu.au
Title: Carbon accounting and modelling from different types of farming systems **Available for Major/s:** Carbon Trading/ Environmental Science/ Agriculture Science/ Forest Science/ GIS and Remote Sensing **Project Description/Direction(s)/Information:** Agricultural productivity in the world has been growing mainly due to the result of the intensification, mechanisation and the modernisation of agricultural systems, which might be expected that this would result in a net increase in greenhouse gas (GHG) emissions per hectare. More intensive land use might involve more fuel, farm machinery and agrochemicals and the production, packaging, transportation and application of these requires significant energy resources leading to an increase in GHG emissions. Continuing cultivation results in a loss of soil carbon that adversely affects soil fertility, the soil water holding capacity and plant-available water capacity. Several aalternative farming systems have been developed all around the world so that they could help restore soil carbon levels and solve these problems. The aim of this graduate research study is re-evaluate different types of farming systems including GHG values. The	Dr Tek Maraseni Assoc Prof Armando Apan	Maraseni@usq.edu.au apana@usq.edu.au

specific objectives are:
• To assess GHG emission and sequestration dynamics of different farming systems
  − To assess GHG emissions related to production, packaging, storage and transportation of agrochemicals (fertilisers, herbicides, insecticides, fungicides etc)
  − To assess N_2O emissions from soils associated with the use of N fertilisers
  − To assess trends in soil carbon amounts on farms
  − To assess fuel and electricity-related GHG emissions
  − To assess machinery related GHG emissions
• Re-evaluate the economics of different farming systems including GHG values
• To develop an integrated matrix from farming system to determine the trade-off between productions, GHG emissions, N_2O emissions and soil C dynamics, as a result of changes in the farming system.		

Title: Exploring the manmade causes for air pollution and its seasonal fluctuations in Kurdistan through GIS **Available for Major/s:** GIS **Project Description/Direction(s)/Information:** In 1952, an unprecedented number of people, about 4,000, killed in just within one day in Kurdistan region due to air pollution related implications. Black smoke clouds over the main cities of Kurdistan region are increasingly degrading the human health where ever increasing use of used vehicles and influence of continental climate on air and cloud movements. In a large area with its political boundary issues, remote sensing data and GIS (Geographical Information Systems) is a suitable combination to use for exploring the impact of this polluted clouds over the region on human health. Satellite data can be used to map the region and GIS data layers will administrate to identify the distribution and gains of the pollution. Inclusion of field observations with air quality measurements will increase the value of the research.	Dr Kithsiri Perera	perera@usq.edu.au
Title: Mapping the Kurdistan region land cover under FAO LCCS using high resolution satellite images **Available for Major/s:** GIS **Project Description/Direction(s)/Information:** The region under Kurdistan has imprecise landmass between 190,000 km² to 390km². This ambiguity of the land area has unquestionably given numerous issues for land cover and land use planers. Due to the different administrative influences, available regional land cover mapping products may also have inherited the differences in quality as well as methodology. This study will focus on mapping at least two distinct locations of the region (agricultural mountainous and semi-urban flat lands) under the FAO land cover classification system. Depending on the available funds, satellite images will be selected for the study. The standardization of land cover mapping process will help ongoing mapping works of the region while supporting	Dr Kithsiri Perera Assoc Prof Amando Apan	perera@usq.edu.au apana@usq.edu.au

comparative studies with surrounding regions and countries.		

Staff Research Interests http://www.usq.edu.au/engsurv/research/strengths