Faculty of Engineering
and Information Technology

ABSTRACTS

CAPSTONE PROJECT PRESENTATIONS

Spring Semester 2009

Broadway Campus
26 & 27 November 2009
WEB BROWSING HUMAN COMPUTER INTERFACE USING HAND GESTURE
(12cp)
Adam Aishou Alamade - A09-003

Supervisor: Hung Nguyen
Assessor: Shoudong Huang
Major: Mechanical and Mechatronics Engineering

Hand gesture is one of the most natural and rudimentary forms of communication. The application of using hand gesture to interact with a PC (Personal Computer) provides an interesting alternative to cumbersome interface devices and is of particular interest in the area of HCI (Human Computer Interaction). While this has long been a fantasy of science fiction, new developments are making interaction with a PC through hand gesture a reality.

This project outlines the development of a web browsing human computer interface using hand gesture, by emulating a computer mouse. All development is done using Immersion Corp’s CyberGlove II. CyberGlove is a wireless glove with 22 strain gauge sensors, providing high accuracy joint measurements.

The software developed uses the Windows API (Application Programming Interface), which has the advantage of being flexible enough to allow any input device to be used for mouse emulation. All mouse functionality is successfully emulated with hand gestures so that there is no barrier between the user’s cognitive model (what task they want to perform) and the computer’s understanding of the user’s task. Extra features have also been added so that certain hand gestures can be used as shortcuts to perform common tasks such as checking email. This significantly reduces the need for keyboard input and cuts down the unproductive time spent navigating to perform these tasks.

Using hand gestures for mouse emulation raises several issues. Variations in the anatomy of the hand between users may trigger false outcomes. Therefore the software developed has an adaptive feature, which allows new users to optimise CyberGlove’s sensors to their own hand. The user can then save their settings to a file. This way each new user only has to run through the sensor optimisation process once only.
PRESSURE AND FLOW DISTRIBUTION IN MANIFOLDS (6cp)
John Anderson - S09-006

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Major: Mechanical Engineering

At least one of the fluids to be heated or cooled in a heat exchanger enters it though a header from which it flows into a number of smaller tubes in which the heat transfer occurs. In order to operate efficiently the flow in the each parallel paths must be approximately equal but due flow distribution within a manifold this is rarely the case.

This project was aimed at evaluating the extent of the maldistribution in a typical industrial heat exchanger manifold and developing methods of correcting the problem. In the investigation the effectiveness of previously used methods of predicting and correcting the problem were found to be inadequate.

As a consequence a numerical model has been developed with the use of computational fluid dynamics to test whether it could be used to correctly predict the maldistribution and the effect of remediation designs. In order to reduce the computational load, two-dimensional simulations were performed. These simulations were in qualitative agreement with previously published data and indicated that the proposed methods of correcting the maldistribution would perform their task sufficiently well. However, there were some unexpected results in that the flow rate through the last elements did not align with that in the others. This has also been noted briefly in the literature and will require further investigation.
EFFECTIVE OF STRESS HISTORY ON RECOMPRESSION INDEX OF CLAYS-
CASE STUDY OF BALLINA CLAY (6cp)
Abdul Razaq Anwari - S09-181

Supervisor: Behzad Fatahi
Assessor: Hadi Khabbaz
Major: Construction Engineering

The rate of consolidation settlement of soil is a vital parameter in geotechnical engineering design. It can be achieved by determining the value of the coefficient of consolidation ($C_v$) of soil. The value of $C_v$ for increasing of a specific load in the one-dimension theory of consolidation using Odometer test can be acquired throughout the standard techniques of data research and analysis.

Overall, there are two enhanced developed techniques that can be employing to determine $C_v$. One of these methods is Taylor (1992) method that proposed root of time method making using the early time (primary consolidation) response. Also Casagrande and Fadum (1940) suggested other method that called the logarithm of time method of considering both primary and secondary consolidation responses.

In both methods it is necessary to find the best appropriate curve on each load increment to calculate $C_v$. It is preferred to predict the value of $C_v$ by an equation capturing effective stress and stress history of clays for geotechnical designs.

In this project, the results of three sets of consolidation tests on Ballina clay samples carried out in UTS Soil Mechanic Laboratory are analysed and discussed. A correlation between $(C_v)_{OCR}/(C_v)_{NC}$ and Over Consolidation Ratio (OCR) is obtained. It is observed that the from above relationship is asymptotic towards higher OCR values. It should be noted the conducted tests cover OCR ranging between 1 and 15.

The practicing engineers may use the correlation in their design when they need to estimate consolidation rate of over consolidated soil similar to Ballina.
ASSISTIVE HAND EXOSKELETON (12cp)
Sanjesh Balgovind - A09-172

Supervisor : Hung Nguyen
Assessor : Guang Hong
Major: Mechanical & Mechatronics Engineering

This project looks at the development of an Assistive Hand Exoskeleton, which articulates hand grasping motion in patients who suffered from neurological damage, such as stroke. Particular focuses will be on how the design of the hand exoskeleton evolved through the project, the innovative pneumatic actuation system used, and how cost effective solutions were found for engineering problems encountered.

The human hand is one of the most versatile instruments of the human body. The ability to touch each finger tip to the thumb is unique to the human condition, and used extensively on a daily bases. It is not until we lose our ability to use the hand that we realise how big a part it plays in our lives. This is sometimes the case for those who suffer from a stroke.

A small number of these patients, with the aid of physio therapy, can regain good control of their hand. Currently, basic tools are use for exercise, and are limited to the supervision of a professional. Studies have shown that moving the hand in a voluntary natural motion for prolonged periods, greatly accelerates the brains ability to “remap” damaged motor pathways, thus re-establishing control of a stokes patient hand.

The result of this project is a prototype apparatus which is an evolution of a currently used device, the dynamic splint. The dynamic splint holds the hand in an open position via solid plastic form created individually for each patient and elastic structures, with little movement. My project is designed to replace the dynamic splint, by using the hand itself as the composition for movement, with a soft natural structure which is designed as a “one size fits all” form. It also allows for a greater deal of customisability in terms of motion, level of assistance and digit application. The use of a sensors and microprocessor makes the exoskeleton active only when the patient intent is there. This could allow the patient to take treatment beyond the limits of physiotherapy clinics.
HIGHWAY PAVEMENT TECHNOLOGY – DIAMOND GRINDING (6cp)
Tim Buckingham-Jones - S09-183

Supervisor: Prasanthi Hagare
Assessor: Ken Halstead
Major: Civil and Environmental Engineering

The significance of quality road pavement to the success of a country is vital. It is in a country’s best interests to maintain high quality wearing surfaces for a number of reasons including but not limited to:

- Lower maintenance costs for vehicles using the road.
- Higher speeds being achieved by road vehicles leading to greater efficiency in transport and distribution for business.
- Increased driver comfort and safety due to lower noise levels and improved friction between the tyre and the road surface.

In 2009 the NSW Roads and Traffic Authority trialed a new concrete pavement surface treatment technology from the United States known as diamond grinding. With a history of success as a surface treatment in the United States it has been trialed on a number of sections of highway concrete pavement in NSW.

The aim of this thesis is to explore the various options available for surface treatments on road pavement with respect to the whole road pavement including sub-grade, sub-base, base, and wearing surface.

The process of diamond grinding is explored in detail by using a project on the F3 freeway north of Sydney as a case study as well as discussing results from previous studies undertaken in the United States. The conclusion drawn is that diamond grinding is a viable surface treatment alternative for concrete pavement in need of rehabilitation. The ride quality that can be produced, although dependent on the contractor, can be compared to new pavement surface quality.
INVESTIGATION INTO THE REDUCTION OF EXHAUST EMISSIONS BY EXHAUST VALVE TECHNOLOGY IN SMALL TWO STROKE ENGINES (12cp)
David William Bywater – A09-011

Supervisor : Guang Hong
Assessor : Terry Brown
Major : Mechanical Engineering

The two-stroke engine cycle has long since been abandoned for in use motor vehicles due to its high levels of fuel consumption and exhaust emissions. However, it remains a cost-effective power source for non-road applications, such as hand-held tools and garden equipment. With the introduction by the European Union of emissions regulations for two-stroke engines, improvements to fuel consumption and hydrocarbon (HC) emissions performance are required for this basic cycle. Achieving these improvements without adding considerable manufacturing effort, costs, product packaging and maintenance issues presents a significant challenge.

Following the success of previous research projects at the University of Technology Sydney on two stroke engine HC emissions reduction by means of fixed exhaust valves and restrictions, a dynamic mechanical flap valve concept developed by Guang Hong at UTS has been selected for design, manufacture and testing.

A background understanding of the two stroke engine and exhaust emissions is developed, before undertaking baseline tests on a small two-stroke engine without exhaust modifications. A range of design and analysis tools are applied to the development of a simple dynamic exhaust valve. The design is manufactured and fitted to a two-stroke engine at UTS for testing. Data collected from these tests is compared with baseline results to determine the effectiveness of the concept for reducing two-stroke engine emissions.

The outcome indicates that a dynamic exhaust valve does contribute toward reducing specific HC emissions and fuel consumption (36.83% and 11.07% respectively, with a leaner mixture). Several head gasket failures and valve reliability issues impacted the scale and repeatability of testing. Improvements to the valve design and experimental procedures have been proposed for future work.

The outcomes and lessons learned from this Capstone Project will provide a useful foundation for continued low emissions two-stroke research at UTS through the application of simple dynamic exhaust valves.
AN EVALUATION OF THE PROPOSED AUSTRALIAN CARBON POLLUTION REDUCTION SCHEME (6cp)

Amy Chaffey - S09-020

Supervisor: Prasanthi Hagare
Assessor: Pam Hazelton
Major: Civil and Environmental Engineering

This project contains an analysis of the proposed Australian emissions trading scheme, known as the Carbon Pollution Reduction Scheme (CPRS), and a comparative analysis of the established European Union Emissions Trading Scheme (EU ETS) from a structural and operational perspective. This project provides a critical evaluation of the CPRS and its function as a mechanism for reducing greenhouse gas emissions (GHG) to subsequently ameliorate the impacts of climate change. This is done through a direct comparison with the international EU ETS, which was implemented in 2005.

The report contains four components: an analysis of the development and framework of each scheme; a review the main problems and controversies that emerged during the EU ETS trial phase (2005 to 2007) and a review of the recommendations that have been made subsequent to the trial phase; an assessment of the elements of the CPRS that may be problematic based on the EU ETS review; and lastly an outline of modifications that may improve the CPRS model.

The evaluation provided is based on review of all official documents and through consultation with government and corporate professionals working in the industry. The White Paper, entitled Carbon Pollution Reduction Scheme: Australia's Low Pollution Future Volume 2, released by the Government in December 2008, is the primary source for the CPRS evaluation. The changes that have been made since the White Paper’s release are reflected in the CPRS Bill, released in May 2009, and are also included in the report. The EU ETS assessment is based on the European Directive 2003/87/EC and the recently proposed amendments to the directive. A number of academic papers reviewing the performance of the EU ETS from institutions such as the Centre for European Policy Studies and the Pew Centre on Global Climate Change, United States, are also sources.

The emerging issues from the EU ETS included over allocation of permits, windfall profits which were generated in the energy sector and banking and borrowing concerns which led to decreased incentives for companies to lower emissions. There were also a number of concerns with international linkage provisions.

From the analysis carried out as a part of this capstone project it is evident that the CPRS will face similar challenges to the EU ETS especially relating to the emission intensive groups such as Australia’s stationary energy sector. The process of permit allocation has the potential to lead to windfall profits which will transfer costs of pollution onto end users. The scheme will ultimately affect every Australian and inevitably increase costs of electricity, fuel and other resources.

The CPRS is an unfinished model and there are many intangible impacts of the scheme that will only be fully recognised after its implementation. The CPRS has the capacity to achieve emission reductions in Australia far beyond business as usual yet there will be a large adjustment period.
GEOTECHNICAL ASPECTS OF BALLASTED RAILWAY TRACKS:
STABILISATION USING GEOSYNTHETICS (6cp)
Gabriel Chan -S09-186

Supervisor : Hadi Khabbaz
Assessor : Behzad Fatahi
Major: Civil and Environmental Engineering

The railway network is a vital component of the transport system in NSW in both freight and passenger transportation around the country. With the majority of railways tracks in NSW ballasted, improvements to ballast and substructure technology can help improve safety, reliability and profitability for railroads. In addition with increasing traffic and loading, the stress on railways and the substructure is greater than ever.

With this increased demand on railways, the need for more investigation and improvement in substructure technology is critical. While new substructure technologies have been introduced around the world, many have not been fully tested leaving the full potential of these technologies yet to be realised. One in particular is the use of geosynthetics.

The introduction of geosynthetics in the last two decades has significantly improved substructure technology by providing products which assist in functions such as filtration, separation and reinforcement. By using geosynthetics in some soil conditions, the performance of the substructure can be improved while the cost of maintenance can be reduced.

This paper will examine the current substructure technology used in ballasted railways. Subsequently it will discuss the applications and properties of geosynthetics, focusing on the different types and the functions they perform. The effectiveness of experimental trials and case histories will also be explored. This thesis will apply the information and knowledge gathered to the NSW condition, making recommendations about how the use of geosynthetics in substructure should be approached.
HIGHER ORDER SLIDING MODE CONTROL FOR MIMO SYSTEMS (12cp)
Timothy Clancy - S09-022

Supervisor: Steven Su
Assessor: Youguang Guo
Major: Electrical Engineering

The sliding mode control methodology employs a discontinuous switching control law to drive the system states to a stable trajectory prescribed by a sliding manifold selected according to the system’s desired equivalent dynamics. Higher-order sliding mode control uses extra conditions on the higher derivatives of the sliding function being forced to zero, subject to a stable differential inclusion. This has many advantages for strong robustness and chattering reduction but may involve derivatives of the control signal. In this project, a higher-order sliding mode controller for a multiinput multioutput (MIMO) system, primarily the coupled drive system, will be investigated and simulations carried out. The choice of sliding surfaces will be parametrised to avoid the calculation of a non-singular matrix. Higher order derivatives of system states that are required for the parametric sliding surface will be estimated using Levant’s robust exact differentiator algorithms. System stability will be proven by using Lyapunov theorem where the resulting differential inclusion understood in the Filippov sense. A design procedure and results of extensive simulation using MATLAB are provided. The system responses indicate strong robustness against parameter variations and external disturbances without control chattering. Although the coupled drive system investigated in this project appears to be simple the principle can well be extended to a larger scale system i.e. conveyor belt, rolling mill etc. where insensitivity to load and parameter changes is an essential requirement.
AN EXPERIMENTAL INVESTIGATION OF TYRE GRIP FOR RACING KART
TYRES (6cp)
David Colton - S09-024

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Major: Mechanical Engineering

Tyres provide the grip critical for racing vehicles to corner at high speed. Many factors can affect the maximum grip the tyre can achieve. Parameters, such as sidewall stiffness and the chemical compounds used in the tyre affect maximum grip but are controlled by the manufacturer. The user really only has control (directly and indirectly) of the temperature at which the tyre operates which in turn effects the grip the tyre offers. Tyre manufacturers in professional racing often supply the optimum operating temperature for the tyre, which is found from the hours of testing in the development. However, in karting it is rare that such information is available and therefore optimum tyre temperature is unknown and optimum tyre grip may not be achieved accurately. This project investigated tyre temperature and grip through development and implementation of two experimental tests. Firstly a test rig was built to measure tyre friction at varying temperatures on a racing surface. Secondly tyre-cool-down rates were measured to give a cool-down-curve. When the kart is returned to the pits, the user will then have a means of estimating the tyres on-track temperature. This report can be used as a guide for all users of the test tyre (MOJO D2) to allow them to gain maximum friction from the tyre. It also gives results for tyre-cool-down rates that can be used as a guide by users to estimate the operating temperature of the tyre whilst it was in use. The project also provides a testing protocol that others can implement to determine optimum tyre performance for other tyres.
WEARABLE MEDICAL WIRELESS SENSOR NETWORK APPLICATIONS (12cp)
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Major: Computer Systems Engineering

Falling is a common cause of serious injury among the sick and aged population, often leading to hip fractures, loss of mobility and sometimes death. Swift reaction to a person falling increases chances of survival and recovery, improving all-round quality of life and decreasing medical costs for the family involved.

Current methods for improving reaction time rely on people manually calling for help, either with a nearby phone or an emergency button worn on the person. This paper presents a possibility to automatically alert emergency services of a fall via a wireless sensor network worn on the body.

A prototype system was created composed of the Toumaz Sensium chip, an ultra-low-power microcontroller and transmitter, and a digital accelerometer. This was used to collect example data of falling, exercising and daily activity, which was then used to devise an algorithm to discern whether or not the wearer has suffered a fall.

The result of this work is a system which is able to differentiate common types of falls from daily activity, and alert a base-station computer with then contacts emergency services or a nominated person to inform them of the accident.

In conclusion the author has created a product which improves the reaction time when a fall occurs by continuously monitoring an individual’s activities. This product can be further developed to be a truly mobile wearable device, with minimal power requirements and no technical expertise required by the wearer. If such a device were to be used it would reduce fall-related injuries and fatalities, decreasing the cost of medical services.
PRELOADING FOR SOFT SOIL IMPROVEMENT (6cp)
Thomas Cuniowski - S09-027

Supervisor: Behzad Fatahi
Assessor: Hadi Khabbaz
Major: Civil Engineering

Soft soils are identified as being soft clays, clayey silts, and peats and they exhibit undesirable characteristics and properties for engineering and construction. Soil improvement needs to be undertaken to increase and enhance the soil properties, so that post construction performance is acceptable. Soft soil improvement can be broken up into the following categories: densification, consolidation, weight reduction, reinforcement, chemical treatment and thermal stabilisation.

Preloading is the most common form of soil improvement by consolidation, and is a popular choice for improving soft soils. The main aims of preloading are to increase bearing capacity of the soil, and to reduce settlement due to consolidation and creep. Preloading can also provide lateral stability to the soil via different construction methods. Preloading will produce an over-consolidated soil with greater density and strength.

There are three main techniques of preloading, namely traditional preloading, preloading with prefabricated vertical drains and vacuum consolidation. Traditional preloading relies on the soils own vertical permeability, preloading with vertical drains introduces artificial drainage paths that combines vertical and horizontal drainage, and vacuum consolidation introduces a negative pressure to enhance the pore pressure dissipation.

This paper aims to present a background to soft soils, and the methods available for improvement. Emphasis is placed on the theories regarding preloading, and the different design and construction methods for the three preloading techniques. A sample preloading design is also attached to this paper as an appendix, to give a greater understanding of preload design. Practicing geotechnical engineers can utilise this critical review for ground improvement design using preloading.
TESTING NEW DESIGN STATOR-DIFFUSER UNIT OF THE LABORATORY AXIAL FLOW PUMP (12cp)
Anna Czlonka - A09-020

Supervisor : Phuoc Huynh  
Assessor : Quang Ha  
Major: Mechanical Engineering  

The project involved performance testing of a new stator-diffuser unit design for the laboratory axial flow pump. The new part was designed in the 90’s by Mr. Hugh Nelson who also donated the axial flow pump to the university.

The new design was assessed by comparing standard pump performance characteristics of the existing pump configuration with available manufacturer’s curves. During standard pump performance testing, measurements of the swirling angle at the outlet of the pump and hydraulic grade line (HGL) along pump assembly, were also taken.

Although a comparison of the pump efficiency curves for the new and existing designs showed that the new stator-diffuser is slightly less efficient (about 2%), some interesting characteristics were found during evaluation of the swirling angle and HGL data. From the obtained results it can be concluded that new stator-diffuser meets its design objectives, however overall performance is not optimal. More research should be undertaken in order to improve this new design, especially with regard to the matter of interference between impeller blades and stator inlet.

In order to perform necessary tests, the laboratory test bay had to be upgraded because at the commencement of the project there was no reliable method of measuring pump flow rate, or suitable equipment to measure swirling angle. Therefore a considerable part of the project was devoted to the design, manufacture and calibration of suitable equipment in order to make pump testing possible.

Two flow rate measuring instruments were designed, venturi tube and multi-Pitot tube. Due to funding constraints, the first design was rejected.

A Fechheimer probe was designed to measure residual swirl in the flow and discharge pipe adapter prior to installing a new stator-diffuser. Both items have been manufactured and installed and are now an integral part of the test rig.
INVESTIGATION OF CHLORIDE DIFFUSION IN CONCRETE INCORPORATING DIFFERENT POZZOLANS (6cp)
Max Da Costa - S09-028

Supervisor: Kirk Vessalas
Assessor: Abhi Ray
Major: Civil Engineering

The durability of concrete is one of the most important factors in its use as a construction material. The ability or rather ill capacity of concrete to stand harsh environmental effects is particularly important to the engineer, whom must design structures with regard to the effect that ecological media will have on concrete. This is particularly pertinent in chloride saturated environments.

To date, there have been various methods used in an attempt to gain a better durability in these surroundings, although these have achieved limited success.

Through the use of trialing two different pozzolanic materials in various concrete mixes, it will allow a more accurate understanding of how the diffusion of chloride particulates flow through concrete, and whether these pozzolans will be beneficial to the durability of the concrete.

The various mixes will be assessed through the use of chloride diffusion which will be conducted through ANSTO, the Australian Nuclear Science and Technology Organisation. These tests will be performed at different curing periods to consider the effects of chloride as concrete hardens on the various mixes.
INFLUENCE OF YOUNG’S MODULUS OF SOIL ON THE DYNAMIC RESPONSE OF CONCRETE STRUCTURES UNDER EARTHQUAKE LOADING (6cp)
Nader Dabit - S09-029

Supervisor : Behzad Fatahi
Assessor : Hadi Khabbaz
Major: Civil Engineering

The behaviour and response of structures subjected to dynamic loading is vastly different depending on the material on which it is founded. This difference is mainly due to the interaction between the structure and the soil on which it is founded, a phenomenon known as ‘soil-structure’ interaction. During many design practices, simplified equivalent static methods such as those outlined in Australian Standard AS1170.4 are substituted for an equivalent dynamic analysis, which in situations can grossly underestimate the applied forces and the produced deformations. Hence a large emphasis is gradually being placed upon the field of seismic engineering to capture within the engineering design a more accurate representation of the potential effects of an earthquake episode and the soil-structure interaction.

Within this research, it is aimed to study the dynamic response of structures under earthquake loading through the use of both 5 and 10 story 2D frames, tested under varying Young’s modulus of soil conditions. Namely, these soil types, due to the varying Young’s modulus values, are stipulated in AS1170.4 as, ‘Class C – Shallow Soil Site’, ‘Class D – Deep or soft Soil’ and ‘Class E – Very Soft Soil’. Ductile reinforced concrete moment resisting frames will be modelled using a fixed base, and subsequently modelled using the aforementioned soil types and subjected to earthquake loading. The fixed base model will serve as a control test within this research, while soil classes C, D and E have been identified to be of most concern and hence warrant further investigation and comparison using dynamic analysis.

This research deduced that an increase in value of Young’s modulus of soil, i.e. stiffer soil, results in an increase in base shear, while a decrease in Young’s modulus of soil results in an increase in relative lateral story drift a structure experiences during a seismic event.
Playgrounds are very common place for child’s growth and enjoyment as well as injuries. In 0-14 year’s age group, 54% of injuries occurred during playground activities. There is a definite relationship between these injuries and child’s clothing material. All slides used in Australian playgrounds are made keeping the Australian playground standards AS4685.3:2004 for children’s safety in mind. But in recent years there have been cases of accidents on slides leading to serious injuries. Several investigations and studies are being carried out to find the reason behind the accidents. This safety concern justifies our project undertaking. Playground safety on slides is our focus of study using the experimental method of friction testing. We aim to bring out patterns of different common clothing fabrics and mass (child’s weight).

This project aims at getting some useful findings and recommendations for children safety on slides by scientific approach. We developed two different experiments for determining static and dynamic friction. We incorporated factors such as the nature of fabric wore by the slider and the material characteristics-friction dynamics of the slide material in our experiment and recording the results. In the experimental test rigs an identical slide with fixed constraints was used (as used by McDonalds).

The variables used in the experiments were mass and fabrics. Commonly worn fabrics cotton, Denim, Silk, Jute, Lycra, Polyester were incorporated in the experiments. With different combinations of weight and fabric different patterns and behaviors were observed which can lead us to more useful tips for safety. It was consistently observed that children with different clothing have different frictional behavior on slides. The statistical readings recorded were used in finding static and dynamic co-efficient of friction, average velocity and graphs to find out patterns in fabric material behavior.

The findings/results of the experimental data established micro-level relations between the surface area of the fabric depending on its threads constitution and its area of contact with the slide. From the findings many generalized recommendations and conclusions can be made which can be followed for better child safety on slides. Many other logical relations can be developed using the statistical data and it can be used for future study.
AUTONOMOUS OUTDOOR VEHICLE FOR ASSISTING WITH GARDEN WASTE COLLECTION: MECHANICAL SYSTEM DESIGN (12cp)
Luke Di Palma- A09-022

Supervisor: Jaime Valls Miro
Assessor: to be confirmed
Major: Mechanical and Mechatronic Engineering

Professional landscapers and gardeners are continually required to walk to or carry a waste bin for garden waste, often having to carry significant weight, and maneuvering in tight places or climbing stairs, possibly causing injury to themselves whilst doing so. A novel idea was proposed to develop a system to aid landscapers and gardeners in their duties by carrying a waste bin for them, thus reducing the risk of injury.

This paper details the mechanical aspect of the design, development and testing of a semi-autonomous robotic vehicle to aid landscapers in their day-to-day duties. The system is intended to carry a large waste bin for the user, and follow them around a yard, thus preventing heavy lifting and making placing waste in the bin more convenient. The vehicle must also be able to traverse over rough and uneven terrain, whilst maintaining stability.

Outlined is the process undertaken to assess existing technologies through a literature, and assessing their usefulness in this project. An evaluation and synthesis of the many ideas from this literature review and the student’s own ideas, with several concept ideas are then presented.

The major decisions as to the selection of a concept to progress to a final design, so as to satisfy the requirements of the project, are presented. The major requirements of the project are achieved via a passive rear-pivot suspension design and an innovative method of mounting the waste bin, using a 2-gimbal system, so that the bin remains vertical, even when the vehicle underneath is on sloped terrain.

A prototype of the vehicle was developed by the students. The manufacturing process undertaken and how considerations for manufacturing affected the system design are also offered.

Finally, results of testing the effectiveness of the mechanical system, and a conclusion on the success of the project are discussed. Also possible future developments for the project are presented.
Despite the use of many socio-technical systems in bushfire prone regions of Australia, the annual bushfire season continues to see the destruction of property and pose a danger to human life, most recently exemplified by the loss of life in the 2009 Black Saturday Bushfires in Victoria, Australia. Although the answers to this problem are complex, research indicates that early warning and accurate information regarding new and existing fire fronts is crucial to fire suppression efforts and dramatically aids decision making in emergency situations for affected communities.

This project proposes a system built on Wireless Sensor Network (WSN) technology as a possible complementary component of existing bushfire monitoring systems. The Bushfire Detection WSN is a wide area network of low-power ‘sensor nodes’ that provides accurate and timely information about the behaviour of bushfires. The system reports and updates such data through channels such as Email, SMS and web-based services, informing the decisions of civil service agencies and the general public.

Due to the investigative nature of the project, a semi-agile, iterative approach has been employed in developing the components of the final product. A targeted simulation framework has been implemented in order to aid the development and testing of the design.

The project has developed a generalized, hardware-agnostic architecture and an implementation of a system that performs the adaptive sensing and routing necessary for reliable performance in a bushfire environment. Particular attention has been paid to ensuring a distributed, homogenous, event-driven design which demonstrates robust behaviour in multiple configurations and operating environments. The project has also managed to port the design to Meshnetics Zigbit hardware modules, which is a first step in validating the system as a real-world solution.

This project has demonstrated that WSNs can provide high fidelity information across large and possibly remote areas, and that they can provide information and warnings about potential dangers autonomously. As such, they are a useful and viable candidate for integration with existing bushfire monitoring and warning systems. The system has been developed as a proof of concept prototype and illustrates that there are many avenues for further research. These include further optimisation of the distributed algorithms; more detailed economic and reliability-sensitivity analysis; and more extensive hardware testing in real-life environments.
Anthropogenic climate change attributable to greenhouse gas emissions is a topic which is currently receiving a great deal of attention. In Australia, one of the largest contributors of greenhouse gas emissions is the energy sector, which encompasses the electricity generation market. Electricity generation in Australia is largely dependent on black and brown coal combustion, although gas as a fuel source has increased in recent years.

To address the potential social, economic and environmental impacts of climate change and energy supply security governments, regulators and businesses across the world are introducing climate change targets, policies and adopting initiatives in an attempt to curb and stabilise greenhouse gas emissions.

In 2008, The City of Sydney released a planning document titled Sustainable Sydney 2030: The Vision in which it specifies a target of 25% of electricity used within the local government area is to be derived from renewable sources by the year 2020. While an admirable target, the council has not determined how this target is to be met.

This study examines the possible options available to the City of Sydney to meet their renewable energy targets. There is existing technology and a large amount of research and development is occurring within the renewable energy market. This study investigates the current status of technology and infrastructure within Australia and attempts to find a suitable solution which could be applied to The City of Sydney.

While renewable energy technology may be available, its application must also be viable in an economic and environmental sense. These aspects have also been considered in this study.
DEVELOPMENT OF A HOSPITAL RESOURCE TRACKING SYSTEM AND SIMULATING IT USING INTELLIGENT AGENTS (12cp)
Jimmy Duong - A09-028

Supervisor: Zenon Chaczko
Assessor: Xiaoying Kong
Major: Software Engineering

As a business grows, so does the amount of resources needed to operate its core business functions. As a result, the business itself must implement some sort of system to manage its resources or manually manage them.

The second option may carry many detrimental implications with the obvious being financial. Constantly having to search for resources wastes valuable time and causes the efficiency of resources to gradually drop. That is the problem that most hospitals face today.

Hospitals carry very expensive equipment which can cost up to millions of dollars and very critical resources that are required to save lives. With so many resources within a hospital being so mobile, it is impossible to guarantee that the resource is readily available when required unless every area is permanently fitted with all required resources. However that is obviously not feasible and highly impractical.

Current resource tracking systems which include bar-code and infra-red based solutions are only sufficient to prevent the loss of equipment, but not the problem of low resource use efficiency.

With the use of relatively simple technology, it is possible to implement a system that solves not only the problems of losing equipment and maintaining high resource use efficiency, but also acts as a planning agent to help with deciding where resources should be placed.

That is the purpose of this capstone project. The outcome, a working prototype being applied to a hospital scenario, is to demonstrate the idea of a possible solution to problems that affects so many businesses where the amounts of mobile resources are high. It aims to save time by allowing users of the system to pinpoint the location of resources in real-time, retrace the movements of any tracked resource and provide a real-time anti-theft mechanism.
A WIRELESS SENSOR BASED FRAMEWORK FOR DETECTING A MEDICAL EMERGENCY (6cp)
Manosh Fernando – S09-042

Supervisor : Bruce Moulton
Assessor: to be confirmed
Major: Electrical Engineering

There is currently a significant elderly population who live alone and who are susceptible to falls and other types of medical emergencies. Many elderly people who suffer from falls require the assistance of another person to stand up and medical attention due to injuries suffered from the fall. This is an issue if the victim is living alone as they are unable to get medical attention. This situation can result in death, serious injury and psychological trauma to the victim. If a carer is contacted in the event of a medical emergency, they can ensure the victim receives medical attention.

Many solutions for the detection of falls require the user to wear a sensor on their person. Elderly people who suffer from impaired cognition may forget to wear their sensors. These people also have a higher risk of having a medical emergency. Most proposed solutions also don’t consider the communication to the carer in detail once a medical emergency has been detected.

The goal of this capstone is to develop a prototype wireless sensor based architecture for the detection of a medical emergency. The architecture is to be scalable to accommodate the detection of various types of medical emergencies through wireless sensors. The architecture should also define an effective communication mechanism to the carer.

In addition to the architecture, this capstone also includes developing methods to detect two types of medical emergencies through the use of wireless sensors. The first method is ability to detect victim inactivity through room entrance monitoring. The second method is the ability to detect when a victim has fallen. The ability to detect a victim falling will involve developing methods to classify events when a victim has fallen.
AN INVESTIGATION OF PROJECT FAILURE AND SUCCESS USING SYSTEM DYNAMICS (12 cp)
Stuart Fowler - A09-032

Supervisor: Ravindra Bagia
Assessor: Mary Walmsley
Major: Mechanical & Mechatronic Engineering

In recent years, the proliferation of systems engineering methodologies on large projects has improved the success rate of complex engineering projects. However, professional project managers continue to implement the tools and methodologies that they use on smaller projects, and many complex projects continue to fail. Perhaps the reliance of project managers on these traditional tools may be partially responsible for these failures.

This project aims to examine the applicability of dynamic system modelling to the issues faced by project managers on complex projects. Traditional project management tools are confined to the static relationships between sectors of the project, but this report contends that a complex project is a highly dynamic system full of feedback loops and dynamic relationships where variations of one sector of the project can have propagating consequences on the other parts of the project. The basis of the report is to explore these dynamic relationships and see whether these relationships, and by extension, the inability of traditional project management tools to capture these relationships may be responsible for project failure.

A dynamic system model of a generic project was developed and an investigation into the reasons for project failure and success was undertaken through the use of case studies and first-hand interviews with experienced project managers. Many of the reasons uncovered by this research could not be captured in traditional project management tools, so their true impact on the project outcomes was analysed using the generic model that was developed.

Further analysis of the model was conducted to gain an appreciation of the other important dynamic relationships captured in the model, as well as to highlight the areas of the model which are most sensitive to inaccurate estimations in order to effectively direct future modelling efforts.
HEART RATE CONTROLLER FOR THE TREADMILL EXERCISE MACHINE (12cp)
Harshan Indika Gankanda - A09-144

Supervisor : Steven Su
Assessor : Hung Nguyen
Major: Electrical Engineering

The intended aim of this thesis is to implement a heart rate controller for the treadmill exercise machine during exercise. Throughout this project, estimation of the heart rate signal and the pace rate signal were given a major emphasis. Experimentally, healthy subjects were tested to tune the PI controller, while extension of analysis could have a practical usage on unhealthy subjects as well.

Considering the pace rate period estimation analysis, numbers of filtering methods were experimented to find the stable period. To acquire signals, Alive Bluetooth heart rate monitor was used and LabVIEW™ graphical users interface was used as a main tool in this process. This pace rate detection method will be used in the next stage of this project to find the correlation between pace rate, heart rate and speed of the treadmill. The actual implementation was conducted in the Bio-medical Health Technologies centre at the University of Technology, Sydney, involved with fine tuning the process for ECG signal and Controller parameters.

Different approaches were done previously, to conduct various control algorithms. However, performance of the controller purely depends on the stability of the ECG signal. Much emphasis has been placed on making the heart rate model linear and stable. The Heart rate period detection, pace rate detection and PI controller are developed in LabVIEW™ which is robust and functionality is complete in practise. This implementation is capable of controlling the heart rate successfully with target values entered by the participants.

From the final implementation, a number of new control methods can be applied to further expand on this research both analytically and practically.
GROUND ANCHORS USED IN THE CIVIL AND CONSTRUCTION INDUSTRY (6cp)
Matthew Garden - S09-045

Supervisor: David Eager
Industry Co-supervisor: Bob Stoddard
Assessor: Ken Halstead
Major: Civil Engineering

Ground anchors are a versatile tensile reinforcement utilised broadly in the civil and construction industries throughout the world. The mechanisms of load transfer and failure are both highly complex and variable; whilst also influenced by localised geotechnical ground conditions. Due to a number of reasons including the inherent inconsistencies involved in physical anchor performance there is no specific Australian Standard. Most practical ground anchor design is referenced to existing knowledge and experience and reliance on empirical relationships.

The purpose of this thesis is to investigate and document the theory and industry based design and construction of ground anchors in the Australian civil and construction industries. The resulting document is intended to serve as a dynamic theory and design guide; retaining the ability to be further developed with time. The document will provide a competent resource for a civil contractor, detailing the building blocks necessary to ensure a competent engineer can understand, design and construct ground anchors, whilst retaining the ability to be further developed as understanding of ground anchors develops.

The outcomes of this thesis were achieved through a comprehensive review of existing literature published over the past forty years of research; combined with a specific investigation of the methods employed in site based anchor design and construction by a current civil engineering contractor.

This thesis documents a detailed analysis of the specific theory behind the design and construction of ground anchors in the civil and construction industries, combined with an analysis of the relationship with current industry based practices. The resulting document provides a step by step manual for design and construction of ground anchors in the civil and construction industries.
DESIGN, BUILD AND TEST A HYDRO-POWER STORAGE SYSTEM FOR UTS BUILDINGS (12cp)
Mina Ghobreal – A09-162

Supervisor: Jafar Madadnia
Assessor: to be confirmed
Major: Mechanical and Mechatronics Engineering

Power stations produce electricity at a known quantity on a consistent basis, however the variations in electrical load created by supply requirements of society. Scaling back the electricity produced during this time and having to revert to a higher figure a short time later is highly inefficient and a time consuming, even though the supply loads decrease during known periods of the day (known as off-peak). Therefore, during off peak periods, power stations dispose of excess power to maintain the load on the generators. During opposite periods of the day where extra power is demanded of the generators (known as peak periods), additional electrical load can potentially over-load the generators.

For this project, i am to design a system of this nature that can pump water to higher reservoir for storage before being released to pass through a turbine to produce electricity. The system is to function automatically. That is, the system should detect an increase or decrease in electrical load or a change in peak or off-peak periods to determine which component to operate.

Nowadays, the Michell-Banki turbines are being utilized for small scale energy generation in small hydroelectric power plants. This turbine features low manufacture, operation, and maintenance costs. In addition to this, this turbine can operate in wide intervals of flow rate without varying its efficiency. Due to this advantage, the Michell-Banki turbine is an excellent and appealing subject for research. I have selected specific measurements to the system out of hundreds of calculations as they are the most compatible, sufficient and reliable ones. It is one of the simplest and most efficient types of water turbine for small-scale use in Australia. This is easy to construct in a backyard workshop.

I developed a hydraulics analyses of the Michell-Banki turbine with the added radial pump part, with the purpose of know that way this arrangement affect the behavior of the turbine and pump and their mains project extents. I developed the design of the turbine as I included an extra draft tube in the front of the turbine to work as an inlet suction for the radial pump. In this particular case, the outlet of the pump will be the inlet of the Banki turbine however the reverse direction of the impeller, clockwise direction.
Many organisations are nowadays working with teams who are cross-located between different physical locations, and collaboration is now more possible thanks to the development of faster internet speeds and video conferencing. It is very common that parts of cross-located teams feel like their opinions do not matter when working on projects due to their lack of input, usually caused by no or minimal cross-collaboration tools. So far, the most popular tools for cross collaboration to date include Microsoft’s SharePoint, online discussion forums, and Google Docs.

My objective is to create simple and easy to use software, CrossCollaborate, which will improve teamwork, increase levels of group collaboration, and provide an overall improvement in the different levels of the software development lifecycle (e.g. during the analysis phase).

This can be achieved through the use of the software’s whiteboard tool where team members can contribute to a project, as well as use this to communicate a project’s goal and purpose through the use of the screenshot function. Screenshots of the whiteboard can be used in visual communication methods such as emails, newsletters, websites etc making it an effective tool. Users can also save their notes for historical archiving and future reference.

The software engineering methodology adopted to deliver this project is Scrum, an Agile software methodology which focuses on single requirements at a time based on the real-world progress on a project. The Agile Manifesto introduces principles such as honesty, value, and fairness, therefore working Scrum means greater flexibility as the direction of work could easily be adjusted according to the amount of completed work made on the project, not based on estimates or forecasts, while delivering real value to the end customer.

The outcome of this tool is expected to improve current communication methods between teams and members for any project.
ACTUATOR TORQUE VARIFICATION SYSTEM (6cp)
Oui King Gour - S09-050

Supervisor: Phuoc Huynh
Assessor: Hao Ngo
Major: Mechanical Engineering

The need of this project rose from Optimum Control’s customer needing to verify the torque output of Pneumatic actuators used in critical parts of their plants. The critical information needed for these actuators were mainly found on their safety shut off valves. Although torque output and actuator specifications are provided by the manufacturer it is important for customers to check against the manufacturers specifications to make sure the equipment acquired will perform the task.

The “actuator torque verification system” will allow torques of 50Nm and up to 10 000Nm to be tested. The test rig that has been design will not be limited to one specific type of pneumatic rotary actuator or manufacturer as it was designed to be flexible. There has been a substantial design process and analysis of 5 different design concepts to develop the final rig. Each test rig was put through a design analysis in Solid works to test for the best suited design.

Through the development of this project verification can be made with other models or methods of testing torque in the process control industry. The results obtained from the test will then be compared to a calculated value developed in the project and also the specification provided with the equipment being tested. Future development will also be possible as the grounds of testing actuator torque in this project maybe used as a benchmark.
STATIC AND DYNAMIC MODELLING OF A TIMBER BRIDGE USING FINITE ELEMENT ANALYSIS (6cp)
Joel Gruber - S09-051

Supervisor: Ali Saleh
Assessor: Jianchun Li
Major: Civil Engineering

According to Samali, Crews and Al-dawod (2007), 70% of the 20,000 timber bridges in Australia are ageing timber bridges. Possible increased loading as well as environmental factors can cause degradation in timber bridges. As part of management of maintenance and rehabilitation it often required to determine the load carrying capacity of these bridges. A dynamic approach can be applied to provide various properties of the bridge under testing including capacity as well as locations of damage.

This investigations aim was to gain a greater understanding of the behaviour of timber bridges under minimal dynamic loading to gain greater insight into this testing method. This was conducted by creating a finite element model using the finite element analysis program, ANSYS. This model was designed to recreate and verify results from modal testing and experimental modal analysis presented in ‘Assessment of the Structural Integrity of Timber Bridges using Dynamic Approach’ by Dr Fook Choon Choi (2007).

Finite element modelling was conducted using a systematic approach, starting with a simple model and building upon discoveries to create a model that most closely represented the behaviour of the experimental results.

Boundary conditions and other connection points in the timber bridge system provide areas of slippage, and possible gaps or contact. The use of variables in the finite element model to capture this behaviour, allowed for optimisation of the model against the experimental results using the ANSYS inbuilt optimisation processes.

This report presents the progression and findings made during the modelling process resulting in a final model and knowledge of timber bridge behaviour that can be used in further studies to develop understanding of the dynamic method of testing timber bridges.
BIO-INSIPRED ROUTING ALGORITHM FOR WIRELESS SENSOR NETWORKS
(12cp)
Georges Haidar - A09-130

Supervisor : Robin Braun
Assessor : Zenon Chaczko
Major: Computer Systems

Wireless Sensor Networks (WSN) are mesh networks consisting of sensors (sources) that monitor various physical processes and transmit the sensor data wirelessly to other nodes in the network (sinks). These nodes consist of a transceiver, microcontroller, and sensor (for sensor nodes) and powered by batteries. Since energy is finite, nodes need to employ a very efficient power consumption scheme. Furthermore, the WSN needs to continue functioning in the face of node failures, which may be caused by nodes running out of power or damaged by environmental effects. In order to achieve these goals, several routing algorithms were developed for WSN’s that attempt to minimise the power consumption of nodes when performing routing decisions, while creating a self-healing and fault-tolerant network.

This thesis explores an alternative data-centric routing algorithm by observing the behaviour of ants in nature. Ants work collaboratively to find the shortest path from a food source to the ant nest. The ants achieve this by laying down volatile pheromone trails between the two landmarks - the shortest pheromone trail attracts more and more ants, hence being reinforced over time, while other weaker trails evaporate away. This behaviour can be translated into a routing algorithm whereby packets (analogous to the ants) decide the path to traverse through the network and attempt to enforce the shortest path, independent of the state of the nodes in the network.

The project shall rely on various simulations to compare the ant-based routing algorithm to a pre-existing routing algorithm. The simulations will encompass various network sizes (both in the number of nodes and geographical areas). Simulation results will then be used to calculate metrics such as transmission delay, power consumption and packet statistics (e.g. packet drop rate). The results will determine the efficiency of the algorithm and its suitability for use in WSN’s.
ENTERPRISE TRAINER: A WEB BASED TRAINING SOLUTION – (12cp)

Nam Hoang - A09-136

Supervisor : Lian Loke
Assessor : Steven Murray
Major: ICT (Software) Engineering

Computer Systems Australia (CSA) runs an internal training and competency program known as the Competency Assessment Labs (CALs) for their Engineers. A CAL is allocated to an engineer for them to carry out in order to improve their skills or gain competency in a specific methodology/technology.

Upon being allocated a CAL the engineer must traverse through a large CAL repository in order to locate the CAL definition which contains the objectives of a CAL. When the engineer has completed the CAL objectives, the engineer needs to notify HR, who then have to notify the assessor for that CAL to organise a time to assess the engineer.

At present this program is administered by technology team leaders and human resources. Most tasks involved are manual and this has proven to be both inefficient and hard to maintain due to the large number of records and documents. It is also hard to gauge the overall effectiveness of the program without having to go to great length to analyse the large and dispersed subsets of data.

*Enterprise Trainer* is a web based software solution which provides a central web interface that allows engineers to: retrieve up-to-date CAL definitions, submit assessment requests, define CALs and request approval, run reports on their history and competency progression.

It also allows managers to allocate CALs, store, organise, search and edit CAL definitions. On top of this the data is stored in a central relational database which offers managers reporting and business intelligence capabilities which have not existed previously.

In conclusion, Enterprise Trainer is a software solution which allows CSA to rationalise their CAL program to make it both transparent and easy to administer. This thesis will discuss the design, implementation and system evaluation details (including user survey and usability evaluations).
EFFECT OF STRESS HISTORY ON RECOMPRESSION INDEX OF CLAYS- CASE STUDY OF BALLINA CLAY (6cp)
Minh Bao Huynh- S09-056

Supervisor: Behzad Fatahi
Assessor: Hadi Khabbaz
Major: Civil Engineering

Determination of Recompression Index ($C_r$) is very important to design settlement on overconsolidated soils. Overestimate of Recompression Index $C_r$ may cause ground improvement application before construction. Base on the method used to determine the recompression index, the different between the minimum and the maximum $C_r$ value can be significant.

This project will focus on a developing method for determining the recompression index of overconsolidated clay soil, particularly Ballina Clay. The one-dimension theory of consolidation using Oedometer test will be applied to Ballina Clay specimen to estimate the several important parameters which are used in the prediction of consolidation settlement magnitudes and settlement rate. These parameters are Compression Index ($C_c$), Recompression Index ($C_r$), coefficient of consolidation $c_v$ and preconsolidation pressure ($\sigma_p$).

In this project, the results of consolidation tests on Ballina clay samples conducted in UTS geotechnical laboratory are presented and discussed. A hysteretic slope of Recompression Index $C_r$ is obtained by $e$-$\log \sigma'$ plot. The equation to resolve the hysteretic slope is developed and is verified using the available data from literature.

The innovation and knowledge contribution of this project is to reduce the cost of construction and limit the delay by restraining the ground improvement before construction.
CHILD RESTRAINTS FOR PREMATURE OR LOW BIRTH WEIGHT INFANTS
(12cp)
Linda Huynh - A09-048

Supervisor: Garry Marks
Assessor: Terry Brown
Major: Mechanical & Mechatronics Engineering

The principle behind child restraints is that they are used for protecting babies and young children in vehicles. There are a variety of restraints to choose from for children of different height, weight and age. Selecting and using a restraint correctly therefore significantly increases a child’s safety during a collision.

Most premature or low birth weight infants, including full term infants cannot be released from in-hospital care unless there is a safe way to transport them, even if they seem stable and healthy.

Safely transporting premature infants in vehicles safely is a problem which demands solutions that are much better than those which currently exist. Child restraints that are marketed today are not sized or designed to restrain these smaller than average size infants and protect them from serious injury during collisions.

The objective of this project is to investigate and justify the need for the child restraints directed towards premature or low birth weight infants. A concept design will be developed based on the information gathered. The project involves research and analyzing the current type of child restraints available, gaining an understanding about premature or low birth weight infants and the risk and complications they face and the dynamics of child restraints.

The concept design of the child restraint has been undertaken with the aid of consultation with medical professionals, mothers of premature or low birth weight infants, the road safety groups and biomechanics engineering consultancies.

Hence, by improving and redesigning the child restraint intended for premature or low birth weight infant will overcome this problem and also reduce the risk faced by mainly by premature infants such as breathing problems and respiratory instability.

Several recommendations were made for the future to continue work and awareness on this issue faced by premature infants.
IEEE 802.15.4 is a developing standard that aims to define the physical and MAC layer specifications for low rate personal area networks. The implementation and future applications of personal area networks are important topics for discussion. However it is more important to set a fundamental platform in the physical layer with proven capability to enable and facilitate these applications. In order to prove this capability, there is a requirement for a simulator that can be adapted for various scenarios and environments.

Body Area Networks require a set of unique requirements due to the constraints of power, size and wearability of devices around the human body for various applications. The wireless channel or environment of operation is also highly dynamic due to the mobile nature of the user. These aspects need to be incorporated into a simulator used to model body area networks.

This project aims to compare current models that have been developed for modeling body area network channels, with particular reference to NICTA's simulation of small scale fading of BAN channels in a dynamic environment. The project looks to review the validity of the models in terms of theoretical principles related to statistics and their application to small scale fading predictions. Where statistical data is generated, an assessment of the validity of the experimental setups used to generate measurements is one of the objectives of the project. This includes analysis of antennas as well as the frequency response of the environment over the proposed range that the model is applicable for.

A goal of this project is to also assess true capacity of the models for use in the real world under realistic non-ideal scenarios and circumstances to characterise true limitations of the models. This project is targeted at being useful to people who want to use these models as they will be provided with a verified boundary of conditions and practical use for which these models can be applied. The project's goal is to also look at limitations of models and to provide possible strategies of improving the model or creating further research avenues.
THE SCENARIO ANALYSER AND TEST EXECUTOR: APPLICATIONS OF
SUPEROPTIMISING AND TEST-DRIVEN DEVELOPMENT IN DISTRIBUTED
EMBEDDED SOFTWARE DEVELOPMENT (12cp)
Anthony Ishran Joseph - A09-050

Supervisor: Peter McLean
Assessor: Zenon Chaczko
Major: Software Engineering

In order for industrial and consumer electronics products to compete in today’s marketplace, they often need to satisfy contradicting system qualities: these products need to be fast, use less memory and energy and have high reliability. However, embedded software engineering is historically limited to peephole optimisation, focussing on performance. Consequently, it is very difficult to optimise programs to meet non-functional requirements whilst executing its intended functions.

This project will involve creating a new tool: Scenario Analyser and Test Executor. It is a distributed, web-based system using superoptimising to compare all possible programs against a baseline program. It then uses test-driven development to determine the optimal program subject to the non-functional requirements. To prove this tool has a practical application in an engineering project, a simple program for the Lego NXT Mindstorms and LeJOS firmware has been written to drive around an oval track. It will be optimised to minimise its object code size and algorithm execution time.

An iterative lifecycle model was used to develop the software system using object-oriented techniques and implementation in Java and JavaServer Pages. The scientific method was used to investigate the Lego NXT Mindstorms program. Due to schedule constraints, it was only possible to test a subset of the instruction set using the LeJOS emulator.

The current system configuration implements 80% of the specified functionality. The Lego NXT Mindstorms experiment resulted in a 39-byte reduction in the object code generated, a 1-millisecond reduction in algorithm execution time and the program successfully performs its intended function.

This project has resulted in a successful development of a tool to support generic superoptimisation and test-driven development in a timely fashion by distributing the tests and scenarios on multiple resources. Furthermore, this project has provided an example of the relevance of superoptimising in today’s embedded software engineering industry.
Aeropone Systems provide a dirt-free growing environment for plants inside houses. It involves the use of specially designed pods where the seeds are planted and suspended in air. Timer controlled nozzles are used to create nutrient enriched spray of water, which is sprayed in the growing plants. However, the system is a closed box system which lacks real-time feedback.

This research aims to study the application of wireless sensors to provide real-time input to the control system as secondary system to the timer controlled environment. It also aims to extend the solution by providing an alternate control system that correlates the inputs from different sensor types – light, temperature, moisture to control the frequency and volume of spray.

It also provides video surveillance of the system where an ordinary web camera is configured to take regular snap shots of the system. Lighting for the system is also configured to be controlled by the secondary system.

It also provides a remote monitoring system, where the user can connect to the system using its web interface and view the system. The system is capable of suggesting the user to place sensors at certain locations for optimization of system use. The user can also view archives of the system, and a real-time sensor map.

This research also aims to extend the architecture of the system to monitor and control much bigger systems, and provide interfaces to connect commercially available sensors from different vendors. Future work on the project should include integration of multiple vision control systems and possibly some functionality related to image processing.
USER CENTERED DESIGN ISSUES RELATING TO SYSTEMS THAT DETECT FALLS AND MEDICAL TRAUMA IN THE HOME AND USE OF PEER-TO-PEER ALERTS (6cp)
Zaaheer Khalfan – S09-060

Supervisor: Bruce Moulton
Assessor: Zenon Chaczko
Major: Telecommunications

As Australia’s population continues to get older and the improved technologies in health alert systems and sensor alert systems become more reliable and common place, a growing need has risen for these technologies to meet aged care needs. There is a vast range of ways in which these technologies could potentially help in facilitating the needs of the ageing population and help reduce the certain increased strain on the Australian health system. Integrating these networks into society is an integral part of this in moving the industry forward and helping to solve some of the issues that exist in our systems and in particular health and emergency assistance.

An area which is currently being facilitated by some institutions is in using these self alert systems by emergency services or caring facilities of an accident in the home of an aged person. However, it has been identified that these existing alert services are subscription based and that they face a yearly cost combining for an often impersonal and expensive experience by the end user. Hence this project aims at researching a group of individuals in the target market to study the applicability of a low cost self installed aged care peer to peer sensor alert system vs. the existing products and to explore some of the factors that may distinguish the need for each service individually. It also aims at utilising the highly valued opinions of medical practitioners who are at the frontline of falls and medical trauma in developing these products with a user centered approach and the wider community at mind.

This presentation will present the results of a survey of 57 elderly people, 20 younger people and 12 practitioners. It will also discuss a literature review concerning some of the health issues surrounding the growing age of the Australian population, its strain on the already overexacerbated health industry and how some technologies explored by the university plan to help achieve a reduction in this stress. The findings suggest that the largest constraint on the aged people installing these systems is cost, and that often the existing products run through a pendant system are ineffective due to the associated affects of a fall or medical trauma making it impossible to actually manually press a button. It is concluded that there is a demand for sensor-based systems to automatically register these events send alerts to peers.
CLOSED MSW LANDFILLS – SETTLEMENT AND ENGINEERING PROPERTIES (12cp)
Chanky Khurana - A09-053

Supervisor: Hadi Khabbaz
Assessor: Bezhad Fatahi
Major: Civil Engineering

The municipal solid waste is decomposed or dumped in a controlled manner at landfills so that it is in accordance with safety and environmental regulations and to keep in mind its future use. Past studies have shown that the operation or functioning of landfill is a challenging task which needs continuous monitoring by experts from different fields. It is made sure that the operation of landfills is safe and well engineered, which draws a major difference between a local disposal site and engineered landfill.

The life of the landfill is approximated to be 20 – 30 years and during that time physical, chemical and biological changes of the solid waste occur on the site. The properties of the waste change significantly from the time when it was dumped and at the closure of landfill.

Many engineering hours have been spent by people in the industry to analyse the change in the properties of waste and the factors accounting for it and how can that be controlled. In the past, landfills have failed because of high leachate pressures being generated at the site. Therefore the design of the landfill is the most crucial facet, which should be done keeping in mind the generation of gases, formation of leachate, stability of slope and its optimal use in future.

The capstone project documents three important topics - design of landfill, engineering properties of landfills and settlement of the waste layer and foundation soil of the landfill. In this project, more detailed information has been provided about the factors that cause settlement of landfills and how it can be measured. The report includes different models proposed to determine settlement of landfills in the past. A computer program using MATLAB software has been developed to capture these models.
PLUG AND PLAY’ MINI-GRIDS FOR USE BY LOW-INCOME EARNERS IN DEVELOPING COUNTRIES (12cp)

Jessica Kleinberg - S08-034

Supervisor: Rob Jarman
Assessor: Tim Aubrey
Major: Electrical Engineering

Access to electricity is an important element for economic and social growth. However, approximately one-quarter of the world’s population do not have access to electricity. Low-income earners in developing countries face many problems in obtaining an electricity connection. As a result, there is a strong reliance on fuel-based energy sources, which cause both health and environmental problems.

This capstone investigates if a ‘plug and play’ mini-grid is a suitable and affordable electrification solution for low-income earners in developing countries. A mini-grid is a decentralised, small-scale electricity network often used when connection to the central grid is unavailable. Power generation is done close to the loads and electricity is supplied to homes within a village or neighbourhood.

The ‘plug and play’ mini-grid is modular in nature and incorporates design solutions to overcome the typically high costs associated with electrification. The ‘plug and play’ wiring and components allows users with limited electrical skills to install the system in a safe and pre-determined way. This reduces the need for trained electricians who may be too expensive to hire or unwilling to travel to rural areas. The ‘plug and play’ nature also allows the system to be upgraded and parts to be replaced easily.

A concept design for the ‘plug and play’ mini-grid was undertaken and a tool developed to identify suitable cable sizes. The design was developed according to Australian wiring standards and incorporates suitable protection measures to minimise the risk of system faults and harm to the users. A financial analysis was conducted to determine the system’s viability and it was confirmed that, with the aid of micro-finance loans or other innovative billing techniques, the infrastructure is affordable for low-income earners living in a typical rural community.
AUTONOMOUS OUTDOOR VEHICLE FOR ASSISTING WITH GARDEN WASTE COLLECTION: ELECTRONIC & CONTROL SYSTEM DESIGN (12cp)

Samuel Klistorner- A09-54

Supervisor: Jaime Valls Miro
Assessor: to be confirmed
Major: Mechanical and Mechatronic Engineering

Currently there are little to no robotic vehicles to help gardeners and landscapers in the workforce. In this field of work the workers lift and carry heavy loads and perform repetitive tasks on a daily basis. One such task involves the workers carrying large and heavy bins around the garden.

As a team we have investigated robotic solution to the issue of the workers having to continuously lift and carry the large bin by finding pre-existing platforms. After discovering there were no sufficient platforms we decided to build our own. We attempted to design an autonomous vehicle that is able to follow the user around the garden while carrying a bin for the user. The vehicle is able to traverse over uneven and sloped terrain while maintaining a relatively heavy payload.

This capstone outlines the process undertaken in designing and implementing of electronics and control involved in this autonomous vehicle.

The vehicle employs various arrays of sensors for user detection, obstacle avoidance and surrounding environment awareness. This report shows how the students prototyped different setups to determine the correct sensors to use and which configuration worked best.

From various prototypes and tests technologies such as ultrasound were used for user positioning, infrared was used for obstacle avoidance and accelerometers for tilt sensing. All the calculations and processing was done on various microprocessors to easily be able to program and manage the different modules.

The report also discusses how the students designed a development board to connect all the sensors and developed a central systems where all the separate modules (user following, obstacle avoidance, environmental awareness etc) would communicated between each other.

Finally the report finishes on limitations and proposed future work and areas that can be further developed by other capstone or post graduate students in the years to come.
DYNAMIC AND STATIC FINITE ELEMENT ANALYSIS OF A MULTISTORY CONCRETE BUILDING (6cp)
Christopher Koenig - S09-065

Supervisor: Ali Saleh
Assessor: Jainchun Li
Major: Civil Engineering

From a structural engineering perspective, the concrete walls which combine to form the lift core in a multistory building are the primary source of lateral stability for the entire structure. Lateral forces are induced into a structure in the event of either high wind pressures or ground excitation as a result of an earthquake. Due to the complex and chaotic nature of both these lateral loading events, the direction, magnitude, and acceleration of the resulting forces are continually fluctuating with time. This type of loading is referred to as dynamic loading and this thesis will use computer modeling, through the application of a range of finite element analysis techniques, in conjunction with results obtained from physical testing, to determine the dynamic response of the multistory building when subjected to ground excitation.

The physical results have been provided by the UTS structural engineering team who performed dynamic testing on a partial segment of a typical lift core of the multistory building. However, these test results only provide information on a single component extracted from the complex system of structural elements which combine to form the structural framework of the building. Therefore, this thesis will use finite element modeling to extend the results obtained from the component testing to ultimately determine the dynamic response of the entire building.

This investigation will explore advanced finite element modeling techniques such as Static, Modal, and Transient Analyses to obtain essential information which will enable the integral processes required to determine the dynamic behaviour of the entire building. The report will also use the information obtained to provide recommendations to the UTS structural engineering team as to the feasibility of making structural modifications to the component testing to obtain a dynamic response which simulates that of the entire structure.
SMS MICROCONTROLLER (JSM-09A) (12cp)
Jet Graham Le - A09-56

Supervisor : Steven Su
Assessor : Adel Ali Al-Jumaily
Major: Electrical Engineering

Security has become a major issue where crime is increasing and everybody wants to take proper precautions to prevent intrusion. Imagine going out on a trip and then realising that you have forgotten to activate the home security system or that your vehicle has been stolen. This is where the SMS Microcontroller (JSM-09A) comes in handy. You can activate your home security alarm system or switch off the vehicle’s engine by just sending a text message to the module to activate a relay. Other applications includes opening your gates for authorised users, usage as a dialer to call out, usage as a switch when fault sensors trigger such as water level sensor activates and turns a pump on automatically. The possibilities for integrating the applications of the JSM-09A module into your lifestyle are countless.

The goal of this project is to design an embedded module which can control up to two devices by sending a specific SMS message from a cell-phone. To implement this, a GSM modem is connected to a programmed microcontroller which would receive the SMS from a reference cell phone. The control signal part of the received SMS from the modem is extracted and changed into microcontroller preferred format. AT commands are used for controlling the functionality of the modem. The JSM-09A also includes 3 inputs which can be linked to an existing alarm systems or sensors. The modem would wait for an interruption from one of the inputs and then send an alert message on incidents to the user such as “pump full” or “intruder alert!”.

The outcome of the project allows me to build a prototype and demonstrate the multiple commercial possibilities for the JSM-09A GSM technology. I have selected GSM because the ubiquity of its standard makes international roaming very common between mobile phone operators; the mobile technology can be implemented and applied to endless possibilities; it can help hospitals and industrial workload become increasingly safe and efficient; and enabling people to use their phones in many parts of the world.
PRINT RESOURCE OPTIMISATION (12cp)
Jensyn Luc - A09-062

Supervisor : David J Davis
Assessor : Zenon Chaczko
Major: Software Engineering

Businesses and educational institutions print large amounts of hardcopies to assist in their day to day operations. Often, that printed information includes redundant whitespace, headers, footers, images and advertising, which results in wasted paper, ink and money.

This capstone developed a model, architecture and design for the Print Resource Optimiser (PRO), aimed at optimising ink and paper usage for draft computer-based printing by producing printed pages similar to “Printer-Friendly” webpages for any type of document.

A research phase was conducted, which analysed existing literature in the research area and existing products on the market. It was found that the project could be further subdivided into the areas of document image understanding and analysis; junk filtering and page layout optimisation.

PRO contains the following core functionality. When a document is printed, it is converted to an image. PRO optimises the ink and paper usage by producing a new document image which contains only “important content”. It was found that a document image’s physical and logical structure could be extracted through document image understanding and analysis as a hierarchy of regions. The regions are then filtered for “junk” by analysing their content for the presence of specific terms. Specified region types are also removed, such as the header and footer. The resulting regions are formatted for efficient resource usage, by minimising whitespace, converting images to greyscale and using minimal resource usage fonts.

To allow any document type to be optimised, PRO was designed as a printer driver, with the quality attributes of performance, usability, extensibility and portability.

A proof of concept was developed, containing core functionality, to test the design. The results were optimistic, with future development focusing on deploying PRO as a distributed printing system and embedding the resource optimisation functionality directly into all future printer drivers.
PUBLIC TRANSPORT IN SYDNEY – A GLOBAL COMPARISON (6cp)
Justin Lum – S09-074

Supervisor: Hadi Khabbaz
Assessor: Behzad Fatahi
Major: Civil Engineering

Public transport efficiency in Sydney has been criticised for many years, both by urban planners as well as the general public. For a city of Sydney’s size and economic importance, its public transport lags behind its global counterparts. As part of the ‘Sustainable Sydney 2030’ document, some major transport issues have been addressed, most notably the extension to the light rail infrastructure and the construction of a new Metro system. This paper will highlight some possible inclusions that could be considered for the document. In an age with growing environmental concerns and high fuel prices, alternatives to the private car are highly desirable. The overall aim is to attempt to increase patronage on Sydney’s public transport system by providing efficient and convenient service.

This project focuses on transport modes and models, which have been implemented by other major cities, and have proven themselves to be successful in providing an efficient, mass-transit system with high numbers of patronage. Some problems currently plaguing public transport in Sydney will be looked at, as well as some initiatives recently being introduced which suggests that Sydney is heading in the right direction.

Specific case studies involving ‘integrated transport’ and ‘free enterprise’ models will be taken from Toronto and South-East Asia. Analysis of the rail and metro network in Tokyo are looked at, as well as the ‘bus rapid transit’ system currently running in Hong Kong and Brazil. The strong points of these transport models are highlighted, and issues and barriers involving their feasible implementation in Sydney’s context are discussed.
WEARABLE WIRELESS MEDICAL SENSOR NETWORK WEB INTERFACE (12cp)
Lukshayeni Mahendran - A09-158

Supervisor: Bruce Moulton
Assessor: Zenon Chaczko
Major: ICT Engineering

Remote monitoring will play a substantial role in the future in the care of the aging population. The use of this technology within households would improve the quality of life of both patients and caregivers, removing the need for around the clock care and enabling assistance to be provided as necessary. This would also relieve the strain on healthcare facilities.

This project was aimed at designing, implementing and testing a web system for household use that interfaces with sink nodes in wearable wireless medical sensor networks in order to communicate alerts via SMS and E-mail to nominated remote caregivers when the sensors trigger due to abnormal readings. This system attempts to extend the alerting capabilities of local sensor networks to remote monitoring capabilities. Since this system was designed for household use, the major considerations during the design were reliability, availability and affordability.

The major challenges faced in this project include designing the system with access restrictions for the various users of the system and determining the relevant information that need to be made available for the different types of users. Cost constraints also played a large role in the design decisions and this needed to be weighed against the reliability and availability requirements which should not be compromised in such emergency related systems.

The project was undertaken by first investigating the possible technologies that could be utilised to build the system based on security, reliability, availability, affordability testability and maintainability considerations. This was followed by the building of prototypes using the selected technologies which were then tested based on these key considerations.

The RemoteALERT web system developed in this project functions in a secure and reliable manner allowing the users to remotely manage sensitive information related to specific sensors/users and receive immediate alerts when the relevant sensor is triggered.
BULK MATERIALS HANDLING AND PROCESSING: A REVIEW OF SELECTION DESIGN OF MINING VIBRATORY EQUIPMENT (SCREENS) (6cp)
Joel Mautsa - S09-164

Supervisor: John Dartnall
Assessor: Garry Marks
Major: Mechanical Engineering

Vast amounts of raw materials amounting to billions of tones are mined and processed yearly worldwide. Most of this material passes through screens and other processing equipment during processing before finding its way to finished products. Screening is the process of separating bulk material particles by size. Vibratory screens which are the most common, widely used and available of the industrial screen types are highly efficient large volume or capacity processing and handling machines.

This project starts with a survey of the available screen types and traditional vibratory screen size selection methods, calculations, concepts and considerations. The project reviews and analyses how they have been incorporated in the minerals processing industry taking into account recent thoughts and developments with a view to optimize and maximize vibratory screen capacity.

A review of today’s screen selection capacity calculations gapingly reveals the exclusions of some of the factors which are deemed to affect screen efficiency and performance. This is because they were developed with a view to keep them short and manageable for manual calculations. The advent of modern computer technology means that even complex screen capacity calculations can now be considered and concluded in comparatively shorter times. The additional factors which innovatively increase the accuracy and adequacy of screen size selection can now be included.

Increased accuracy in screen size selection methods, concepts and considerations will result in optimally sized vibratory screens to do the duty. Under sized vibratory screens result in reduced plant output whilst on the other hand, over sized vibratory screens call for high capital investment and resulting in high operational costs.
EXPERIMENTAL STUDY OF THE FRICTIONAL PROPERTIES OF SLIDES (12cp)
Vallari Mejiyatar - S09-082

Supervisor: David Eager
Assessor: Christopher Chapman
Major: Mechanical Engineering

Playground slides are the most common and simplest playground equipments but injuries occur on them frequently. Although the slides are manufactured and installed following the AS4685-2003, still there are reasons why injuries occur. Nearly 10% of all child injury hospitalizations are playground related out of which slides constitute 18% of the total playground injuries. These injuries are due to some controllable as well as uncontrollable reasons.

The mating surfaces on slides are the plastic surface of the slide and the fabric worn by children. The material of the slides remains constant while the fabric worn is the variable part amongst the two. This fact is the basis of my project undertaking to understand how different fabrics behave on playground slides. To determines the behavior of fabrics with different sets of weight we used fixed experimental slide setup. We used this experimental setup to record the time taken from start to stop and the distance it covers from the run out. Using the recorded observations we calculated average velocity, and determined the dynamic and static coefficients of friction.

The results of the experimental recordings and calculations were used to interpret the relationships between the fabrics and the weight. Different trends and patterns were observed and logical and theoretical reasons were found behind them. Graphical representation of the results was used for establishing these patterns and trends.

The findings of this project can be used as a guide to form a recommendation chart stating which fabric is safer for subsequent weights. The results of this project can be used by amusement parks, schools and public playgrounds for further investigation into the subject and form suggested list for fabric to be worn for different weights.
MINERAL PROCESSING TRAINING SIMULATOR- CRUSHER MODEL
DEVELOPMENT (6cp)
Jason Mendoza - S09-083

Supervisor: John Dartnall
Assessor: David Eager
Major: Mechanical Engineering

Mineral Processing Training Simulator- Crusher Model Development is a capstone project undertaken by Jason Mendoza. The project continues from a previous capstone project, Development of a Mineral Processing Training Simulator, by Nick Gray. Nick Gray’s capstone lays the foundations of a long term project developed by Techcomm Simulation; to produce an accurate simulator, recreating the operational conditions of a mineral processing plant.

Techcomm has a rich history in the development of simulators for coal-fired power stations and has a range of software that can be utilised for a mineral processing simulator. Due to high demand and various expressions of interests, now would be the time for Techcomm to enter the market of mineral processing simulators. The benefits of using a simulator are paramount. It has long been recognised that maintaining and achieving an efficient process is too demanding and complex. Adopting a simulator allows for real time feedback, immediate tuning as well as operator training for everyday and rare events. With a simulator, multiple solutions to a problem can be identified and tested without any physical change to the process.

As the basis of the project has already been outlined, there is now a need to continue creating mathematical models for this specific simulator. A sequential approach has been adopted, thus the next major model that requires development is the Gyratory Crusher. The main purpose of the crusher is to repeatedly compress the material, until the product is less than the open side-set of the crusher.

This project features a comprehensive investigation regarding the gyratory crusher; mainly its structure, operation and mathematical representation. Moreover, topics relating to the development of the model will also be discussed; mineral processing theory and mathematical model development with the use of the C programming language.
INNOVATION AND CAD ANALYSIS OF REINFORCEMENT BAR COUPLERS (6cp)
Alexander Micallef - S09-084

Supervisor : John Dartnall
Assessor : Gary Marks
Major: Mechanical

As virtually all major high rise or civil construction projects around the world require reinforced concrete in one form or another, improving the way steel reinforcement is implemented into these concrete structures can provide vital benefits to mankind. The major area for improvement in current steel reinforcement applications is the method of joining or ‘coupling’ two rebars together. Currently over 80% of all coupling is done by simply overlapping rebars. This overlap distance can range between different applications, such as 12 – 24% of the length of the rebar being used in vertical reinforcement. This overlapped length is effectively wasted steel which can have negative effects such as congestion and unwanted structure weight increases.

There are various coupling solutions for rebars that exist today, however due to reasons such as cost, extra skill and tool requirements, or simply substandard performance; they are normally ignored as a solution to the tried and true overlap method.

This project endeavours to develop upon researched existing reinforcement coupler designs to a point whereby an optimal coupler can be created. One which can perform to the required strength expectations, whilst costing less than the existing overlap method in all time, skill, steel, greenhouse gasses and money.

The selected designs have been tested using Finite Element Analysis on the Solidworks COSMOS package in order to evolve and finally verify that the selected coupler design meets the standard performance criteria. This criteria being that the reinforcement bar itself should fail before the coupling mechanism does.

Furthermore, the commercial manufacturing and marketing aspects of this product are also analysed as the manufacturing methods will largely determine the cost of production which directly affects its industry marketability.
Currently, the world is locked into what can appropriately be named as a “fossil fuel economy”. Today’s automobiles, trains and planes are almost exclusively fuelled by petroleum products like gasoline, kerosene and diesel. The majority of power plants also use oil, natural gas and coal as their fuel. There is now increasing pressure from society to shift our energy production, and hence our economy, towards a sustainable, renewable and feasible technology.

Today, the predominant method of extracting hydrogen is via the industrial reforming of fossil fuels (hydro-carbons). This process is widely known for its pollution and contribution to the global warming phenomena. An alternative to this method is the electrolysis of water to produce hydrogen and oxygen gas. This process, although “cleaner”, is relatively inefficient compared to the more common methods such as industrial reforming and coal gasification.

This project aims at investigating the feasibility of producing hydrogen from water, using “alternative” electrical methods. Various unconventional methods have been documented and investigated by many amateur experimentalists. Advertised throughout the internet are their results and some claims of a more efficient electrolysis process (especially with tap water), which appear to violate a number of established scientific laws, principles and theories. On the other hand, similar experiments have only been attempted by a handful of accredited academics.

By adopting some of the methods and procedures outlined by various amateur experimentalists (as well as a handful of academics), this project will attempt to investigate the application and performance of these unconventional methods in the production of hydrogen gas from water. The project requires the design of a dynamic experimental program, as well as the design and construction of a demonstration rig using various equipment configurations.
THE DEVELOPMENT OF PERVERIOUS MORTAR (6cp)
Lam Dinh Nguyen – S09-094

Supervisor: Sri. Ravindrarajah
Assessor: to be confirmed
Major: Civil Engineering

In urban environment, surface water runoff increasingly affects the drainage system infrastructures due to large amount of rainfall runoff over the impervious surface. Therefore, the idea of allowing the water to soak through the surface pavement will significantly reduce the excessive load that could damage the urban drainage system. Pervious mortar is then developed which can be used with the pervious concrete for the construction of permeable concrete pavement. Pervious mortar is considered to be a green product which reduces the pollution carried with the water runoff that has been washed off from roads, pavements and roofs.

This project takes a significant amount of time in designing the pervious mortar and undergoing multiple tests in order to examine the properties of permeable mortar with a parallel understanding of pervious concrete previously developed at UTS. Pervious mortar is developed using cement, fly ash, aggregates and water with the ratio of 0.5:0.5:4.3:0.35 in order to achieve the void content of more than 15%.

The pervious mortar specimens had undergone a compressive strength test, a shrinkage drying test and a water permeability test. The main objective of this project is to measure the rate which the water soaks through the permeable specimen under clean water and dirty water. The specimen is put inside a test apparatus which is sealed off and water permeable rate is measure under falling head method. The mortar specimen is prepared with two different aggregates, featuring angular and round structures, for comparison to determine the effect of aggregates structure on water permeability

In complying with relevant Australian Standard in performing the tests, the properties of pervious mortar allows significant water permeate through the surface with a rate of 1 to 10 mm/s. however, due to low strength (5-10 Mpa), pervious mortar can only be used on car parks, driveways... this project explores the fundamental properties of pervious mortar, further researches should be substantially undertaken to fully develop the pervious mortar.
UTS RVC: A CONTROL SYSTEM FOR THE RECONFIGURABLE VERTICAL CLIMBER FOR INSPECTION OF THE SYDNEY HARBOUR BRIDGE (12cp)
David Pagano - A09-081

Supervisor : Dikai Liu
Assessor : Kenneth Waldron
Major: Mechanical and Mechatronic Engineering

At the moment, hazardous maintenance and inspection jobs are being performed by workers on the Sydney Harbour Bridge.

This project is to develop a semi-automated, reconfigurable vertical climber robot (RVC) to climb the Sydney Harbour Bridge and inspect it for rust, paint and maintenance needs. Although this scenario is specifically targeted towards the Sydney Harbour Bridge, the RVC can be deployed on any steel structure. This robot is intended to be modular in design; allowing attachments and modifications to be interchanged depending on the application. It will be a multi-legged robot, with each leg having three degrees of freedom provided by servo motors at the joints. A sensor package will allow the robot to both inspect the structure and provide feedback for the motion model of the system.

Having a robot performing inspections on the bridge, which is at some points over 130 metres high, provides not only safety for personnel, but can also save on maintenance costs and ensure the integrity of the bridge itself, without obstructing traffic or having to rely on climbing equipment, thus problem areas can be identified quickly and be rectified earlier.

To determine if basic motions could be replicated in the current prototype design of the robot, an analysis into the motion of insects and existing multi-legged robots was performed. From this, a motion model was created in Matlab, using Denavit-Hartenberg principles and geometric analysis. Simulink was used to develop the control system architecture which interacted directly with the motion model of the system.

System testing was performed using visual simulations which allowed the robot’s gaits, orientation transitions and end-effector coordinates to be displayed in real-time without a hardware connection. This control system, once tested, was successfully implemented into the current prototype RVC.
STABILIZATION OF LANDFILLS (12cp)
Mohit Pahuja - A09-082

Supervisor : Hadi Khabbaz
Assessor : Behzad Fatahi
Major: Civil Engineering

Waste should ideally be reduced or avoided at the point of generation. Where generation of waste cannot be avoided, opportunities for reuse and recycling should be diligently pursued. Where none of the above is feasible, the final destiny of waste is usually disposal in a landfill. Landfills are not just the holes in the ground. Landfills are sites engineered and designed for waste disposal by burial. It is considered as one of the oldest form of waste treatment method. It can also be defined as a highly engineered facility that provides disposal capability for solid waste. Modern landfills are sited, designed and constructed like a vault to prevent the release of contaminants into the surrounding environment.

This report contains information on different types of issues related to landfills like landfill gases and leachate. Landfill closure and its remediation is also highlighted along with examle of some of the landfill sites in sydney.

Stabilization of landfill is defined as the pre-processing of landfill for diminishing the potential for LFG, odour and leachate impacts. Stabilized landfill is designed, operated and regulated similar to a conventional landfill. Stabilized landfill accepts source separated waste to reduce bio-degradable organic content.

The report contains information on several different methods of stabilization. Some of them are chemical stabilization (using fly ash and cement or slag/cement combination), mechanical stabilization (dynamic compaction and dynamic replacement), use of geosynthetics and by prefabricated vertical drains.

Various experiments have been done to figure out which chemical is best suited for stabilization. All the tests along with their results are discussed in this report.

Finally, the report is concluded by various recommendations of each method based on their feasibility and reliability.
EXPERIMENTAL INVESTIGATION OF EMISSION REDUCTION FOR AUTO IGNITION (AI) IN A TWO STROKE ENGINE (12cp)

Luke Parker - A09-085

Supervisor: Guang Hong
Assessor: Terry Brown
Major: Mechanical Engineering

The introduction and adoption of emission regulations by the European Union and other countries has seen a dramatic increase in the research and development of emission reduction techniques for combustion engines over the past number of years. One particular area that has seen a major resurgence in interest is the application of Auto Ignition (AI) in both two and four stroke engines, with significant emphasis on increasing the operating range, improving fuel consumption and reducing emissions.

With successful research projects being completed at the University of Technology Sydney within the area of AI in two stroke engines, it was decided that the effect of the inlet throttle valve on the performance of AI in a two stroke engine should be investigated with an emphasis on reducing emissions.

Experimental investigations into the effect of the inlet throttle valve on AI were then undertaken, however the outcome of the investigation is unclear, as insufficient data was collected due to continual head gasket failures. A number of different methods were undertaken in an attempt to rectify the situation, including cleaning the mating surfaces of the head and engine, replacing the head, using two gaskets and ensuring the head bolts were tighten effectively.

It is recommended that further investigation be undertaken into the use of AI in an older two stroke engine, the use of different gaskets and gasket material, the importance of head bolt torque specifications and the type of head bolts used. It is also recommended that the investigation into the effect of the inlet throttle valve be repeated with a larger range of reliable data, as the information that can be collected from these recommendations will provide valuable information on the operation of AI and reduction of emissions in two stroke engines.
STEEL STACK DESIGN GUIDELINES AND OPTIMISATION FOR INDUSTRIAL STEAM GENERATORS (12cp)
Kishan Patel - S09-102

Supervisor : Garry Marks
External Supervisor : David Tanner
Assessor : John Dartnall
Major: Mechanical

Exhaust Stacks are a familiar sight in any industrial landscape as they form a vital part of any industrial boiler plant; they are used to vent hot flue gases produced from combusting various fuels used in an industrial boiler or Gas turbine.

This Capstone project is being undertaken in conjunction with Austrian Energy & Environment Australia (AE&E Australia). AE&E Australia is one of the world’s leading suppliers of thermal energy generation and environmental protection technology systems.

Flue ducts and exhaust stacks are a part of nearly every project designed at AE&E Australia and take considerable engineering hours to design and for specifications to be produced. As there is no single expert at AE&E Australia in exhaust stack design, AE&E Australia require a design and material selection guideline which will aid the engineer in selecting the appropriate design and material required for the stack for a specific project.

This project looks generally at all stack types but also specifically at steel stack designs which are relevant to industrial boilers and steam generation. Within this specific area new and existing designs are analysed and the considerations required for the design and selection for stacks for various industrial boilers. This report considers a number of aspects from the Structural, Process and Mechanical design disciplines.

This report and “engineering standard” will contribute to the knowledgebase and resources available at AE&E Australia, it will also contribute to increasing the efficiency in the design process, by alleviating the time needed to gather information from multiple sources and use this information in the design process. The guideline will also standardise designs and remove any issues from using untested designs and help to create efficient and increasingly environmentally friendly boiler plants.
A SUSTAINABLE MATERIALS STRATEGY FOR ENGINEERING CONSULTING: A LIFE CYCLE ASSESSMENT APPROACH (6cp)
Samantha Peart - S09-105

Supervisor: Bronwyn Holland
Assessor: to be confirmed
Major: Civil & Environmental Engineering

A sustainable materials strategy has not been a priority in the overall sustainability strategy for building design to date. This is due to the lack of means within the industry to quantify their environmental impacts in comparison to resource consumption (such as energy, water, and related emissions) and occupant comfort. This project reviews the tools and strategies currently used in the engineering consulting industry to assess the environmental impact and suitability of building materials. It investigates the importance of employing a strong materials strategy in a holistic sustainable design process and demonstrating the environmental impacts of materials in the context of a whole building or development.

This process has been undertaken through industry experience in aiding the development of a Life Cycle Assessment tool designed specifically for buildings. LCADesign is a Life Cycle Assessment software package with the ability to read the information within a Building Information Model (BIM), and calculate the environmental impact of the entire life cycle of a building. Based on the quantities and types of materials, LCADesign can provide sophisticated insights into the environmental impacts of the building, where they are occurring, and how they are occurring. This allows the project team to identify problem areas and take measures to refine them.

This is considered an important factor in fostering engagement from the project team and the client with a sustainable materials strategy. This project assesses how LCADesign and other qualitative measures can be combined in a holistic manner to overcome the current obstacles in conveying the importance of materials in building design and construction to all stakeholders of the construction industry.

This report will also chart the process of collaboration over this problem and the iterative refinement of the software tool with the development team over 18 months. This is to demonstrate the unique learning opportunity it represented for me and also to give insights into collaborative design of software for sustainable construction practice.
WIRELESS SIGNAL PROCESSING AND AUTOMATIC CONTROL OF A REHABILITATION SYSTEM(12cp)
John Phuah - A09-134

Supervisor : Steven Su
Assessor : Hung Nguyen
Major: Electrical Engineering

The purpose of the project is to develop an automated control system for the treadmill exercise machine that monitors cardiovascular-respiratory responses via multi-sensor measurements and perform control methods to control the heart rate of the user. This can be achieved by the automatic adjusting of the speed of the treadmill according to the reference heart rate.

The treadmill exercise machine is a commonly used indoor exercise device that has the ability to cause angina pectoris. The extra exertion on the heart of an uncontrolled treadmill can cause the abrupt cessation of normal blood causing the heart to contract during systole. The increase in obesity and poor health choices of people has encouraged the wide spread adaptation of the treadmill for rehabilitation and exercise routines.

It is for this reason that the disquisition of the treadmill be necessary as many people turn to these solutions for their health fitness needs. Treadmills today are highly sophisticated and provide a myriad of functions including, heart rate monitoring, calorie burning, slope and speed control; however treadmills do not provide the user the ability to set a desired heart rate and if uncontrolled in both speed and slope can have the potential to cause irregularity of the heart rate leading to cardiac arrest.

This project covers a summary of the discoveries made throughout this project including a literature review of the available methodologies for the signal processor, automated control, problems encountered throughout the project, lessons learned, results and final thoughts.
THE DEVELOPMENT OF A TEST METHOD AND STANDARD FOR IMPACT
ATTENUATING SOIL – RUGBY OVAL SAFETY (6cp)
Martin Plokstys – S09 – 111

Supervisor: David Eager
Assessor: Christopher Chapman
Major: Civil and Environmental Engineering

Throughout Australia, safety standards and regulations with regard to sport are becoming imperative to ensure that risk is reduced in both likelihood and occurrence. Rugby union is becoming a sport many children want to play, but parents hesitate due to the high risk of injury. As every sport has leapt to new heights in both skill level and professionalism, it is only likely that players, parents or managers of players will start to look for compensation if the athlete in question is injured whilst training or competing. In recent times it has not been uncommon for players to pursue litigation when injuries have occurred and it is important that all sporting bodies are made aware of the legal ramifications. Therefore it is essential that all avenues are taken into account when analysing risk in the sporting arena.

An underlying fact is that the playing surface of rugby ovals does not have a standardised test to ensure that fields contain the appropriate soil properties which will ensure a reduced risk of injury to players. Therefore the scope of this project is to analyse and compare various rugby ovals throughout the Sydney district. The goal is to test a handful of rugby fields against the Australian and New Zealand Standard AS/NZS 4422:1996 playground surfacing – specifications, requirements and test method. Although this test method is for playground purposes the properties which are calculated from the tests can be adopted for rugby ovals to attain the attenuating properties of each oval tested. For this Thesis project the focus will be aimed at the extrinsic variables, where only the ground hardness will be analysed.

This project successfully explored the various results of each field tested, where the main outcome was to determine the standard qualities that each field should entail. The results obtained from researching a variety of fields will be presented through a comparative analysis, so that an accurate gauge of each field’s risk of injury can be obtained. The experimental analysis and computer analysis will determine Head Injury Criteria (HIC) which is the determining factor for this project.

This project is vital for the progression of rugby as it will provide a basis and starting point of how the hardness of any oval can severely injure players, and hopefully this project will encourage superior safe practices with regard to field preparation and in turn reduce the risk of injuries on the sporting oval.
DISTRIBUTED BACKUP SYSTEM – A CLOUD COMPUTING STORAGE AND REDUNDANCY SYSTEM (12cp)
Deon Poncini - A09-124

Supervisor : Lian Loke
Assessor : David Lowe
Major: Software Engineering

With the advent of digital still and video cameras, ubiquitous home office software and the general proliferation of home computers, laptops and netbooks an increasing amount of personal data is being stored that has no backup. 82% of home PC users do not do regular backups, with 66% of home users having irretrievably lost pictures and files on their PC, 42% of these within the last year alone. Home backup solutions however can be costly in terms of redundant hardware, involve time consuming activities like creating manual backups or require specialist IT knowledge to set up.

This project proposes the creation of an automated distributed backup system that does not require additional hardware expenditure, and is mostly invisible to the end user. The Distributed Backup System proposes to allow users to back up their sensitive data on remote peer computers via the Internet, using the spare capacity on their hard drive to store foreign data. Data security and reliability is achieved through the use of data encryption, data redundancy and the use of error correction codes.

To develop the system an iterative software development life cycle model was chosen, with the solution implemented using C++ for the Linux platform. Theoretical usage models were constructed to indicate how many users would be required to ensure specific redundancy levels could be achieved. Results indicate that approximately 200 users would be required for typical system usage to operate with full redundancy.

The system that has been built serves as a prototype proof of concept model, with 10% of remaining functionality to be implemented in a future release. The system can handle an unlimited number of peers through a distributed network approach. The system successfully backs up data to peers and retrieves this data after hard drive failure on the primary host.
Since man has walked this planet, war has been inevitable. Warfighting has almost exclusively been centralised around the platform. The platform could be a ship, base or a congregation of soldiers. Technology in the commercial world has advanced rapidly whereas the military world has typically remained stagnant in its information distribution architecture. Commercial companies have thrived from information networks and early research has indicated that militaries could also benefit from adapting the same to increase the speed of communication.

The ultimate goal of implementing an information architecture for military use is to promote Network Centric Warfare (NCW). NCW is the concept of warfighting using a high speed information architecture to share resources among its operators. These resources are correlated and synthesised from sensor and effector array networks on a global scale. The outcome is a system where all operators are contributing to the warfighting effort regardless of their position relative to the battlespace.

NCW requires a distributed architecture combat system that is network enabled in order to operate in its operational objectives. The overall outcome of the whitepaper is to determine what existing Thales products are available, what changes need to be made to them, what new products and components need to be purchased to implement a Network Enabled Warfare Combat System (NEWCS) product, hence providing the capability of NCW.

To date, there are no countries that can confidently claim to have shifted from Platform Centric Warfare (PCW), to NCW, as the backbone warfighting combat system is not currently commissioned on any level. NCW is expected to provide a primary combatant warfighting advantage in the wider battlespace for some time to come, outlining the importance of the whitepaper. The whitepaper will provide the initial assessment underlining the feasibility of a Thales implementation for NEWCS to provide the capability of NCW.
The objective of this capstone project is to perform the measurement of the magnetic properties of soft magnetic composite (SMC) materials under one and two dimensional magnetic excitations. The 3D tester developed at University of technology, Sydney (UTS) was used for the measurement. The primary focus of this project would be on obtaining and analyzing B-H curve of the SMC sample for one and two dimensional magnetic excitations.

The circuit used for the magnetic measurement can be considered to be a series RLC circuit. The inductance of the excitation coil and the capacitance of the capacitor are matched to obtain the highest possible current in the circuit thus to obtain the saturation of magnetic flux density (B). The SMC sample is placed between the excitation coil set and the behavior of B and H (magnetic field intensity) is monitored through the set of sensing coils attached to the surface of the sample. Even the sensing coils are calibrated before putting into the circuit.

The obtained data from the sensing coils is processed using Matlab software to obtain the B-H curve and hysteresis loop. For 2D test the feedback control of the magnetic flux density components on X and Y axes is achieved by two specially designed differential amplifiers with low and high pass filters. A PC-based DSP system (AMLAB) is used for the function generation as well as data acquisition.

A lot has been done in the rotational core loss measurement and modeling of electrical sheet metals. However the rotational core losses and the B-H loci of the soft magnetic composite material is neither supplied by the manufacturer nor presented in any literature. The rotational B-H characteristics of SMC play vital role in the study of magnetization mechanisms, performance simulation and assessment in the design of SMC electromagnetic devices.
DESIGN OF A FLOW CONTROLLER FOR THE RESMED AUTOSPIRIT II SLEEP APNEA APAP DEVICE (12cp)
Mark Robens - A09-154

Supervisor : Hung Nguyen
Assessor : Peter Watterson
Major: Electrical Engineering

Sleep apnea is a disease that affects approximately 10 percent of the middle aged population. Sleep apnea is a dangerous disease as it results in the partial collapse of the pharyngeal wall collapses resulting in an inability to breath for a period of time. Pharyngeal wall collapse can often result in lower blood oxygen, disrupting sleep and is also a known cause of death in some patients.

The ResMed S8 Auto Spirit II device operates by detecting when this pharyngeal wall collapse occurs and responds by increasing the pressure of the air into the nasal cavity helping to prevent pharyngeal wall collapse. By monitoring and controlling flow of air in the pharyngeal passage instead of pressure it is believed that blockages can be more effectively managed.

The purpose of this research is to design and implement a flow controller for the ResMed Auto Spirit II device using a Labview interface to the device. The flow generator output is PWM controlled. By applying a step input of a series of PWM’s analysis could be performed using MATLAB to develop a transfer function of the plant.

Using the plant transfer function two controllers were designed successfully to achieve optimal control. A discrete time controller was developed in Labview using Root-Locus and Nyquist design techniques. A digital logic controller was also developed using digital logic to calculate the difference between the reference and actual flows. Using logic it was possible to create a program that incremented or decremented the PWM by varying degrees depending on the size of the error. The success of these approaches is documented in the thesis report.
GIS SYSTEM FOR VERTEL – A GIS DATABASE, GOOGLE EARTH AND USER INTEGRATION (12cp)
Scott Rowlandson  -  A09-094

Supervisor : Kumbesan Sandrasegaran
Assessor : Anthony Kadi
Major: Telecommunications Engineering

Geographical Information Systems are one of the most widely used applications in the world today. They are able to provide a means to represent a great deal of information quickly and accurately in a format that anyone from any background can understand. For this reason it is becoming increasingly important for businesses to utilise the power of GIS technologies in sales, marketing, operations and planning

This capstone project has aimed to produce a scalable and easily usable GIS application that will enable an organisation to collate, view, edit and share geographical information quickly and easily. The primary goal of the project was to create such a system completely through the use of free and open source software in the backend, whilst providing output and presentation compatibility with the widely used Google Earth and Google Map products.

The centralized implementation of the system has allowed for a central store of all GIS data within the target organization with dynamically generated Google earth network links providing the client to server connections to ensure that all users of the system are able to gain the latest set of data. A web-browser interface has also been developed to promote user interaction and utilization of the systems products whilst providing a means for users to input and modify the geographical information that they require to be presented. While on the backend, update process’s and data organisation within the database has allowed for ease of administration and maintenance.
WATER HAMMER INVESTIGATION – EASTERN NSW SEWAGE PUMPING STATION RISING MAINS (6cp)
Justin Scerri - S09-124

Supervisor : Vigid Vigneswaran
Co-Supervisor : Jey Talayasingham
Assessor : Jaya Kandasamy
Major: Mechanical Engineering

Water hammer, in pressurised pipelines, is the pressure surge experienced within a water supply system resulting from a change in steady state conditions. Water hammer can occur when the fluid within the system changes flow, direction or pressure as a result of pump trip, pump start, pump stop or a valve closure. The transient pressures developed from the change in steady state depend on the system characteristics and design criteria such as fluid velocity, pipeline material, pipe wall thickness, main profile, location of air valves etc.

Water hammer is a phenomenon that can result in the catastrophic failure of multimillion dollar pipelines and consequently injure people and cause damage to nearby properties. Quite often, water hammer is misunderstood and overlooked as an unnecessary expenditure to a project. In reality, the mitigation of infrequent and excessive water hammer occurring within a pipeline should be a vital design criterion in every pipeline system.

This report analyses a typical sewage pumping station and its associated rising mains located on the East Coast of NSW and investigates into the possible water hammer occurrence experienced with various operating scenarios. The mains will be modelled with proven water hammer software and measures to reduce excessive transients will be recommended.

With this analysis completed and recommendations implemented, the risk of catastrophic failure of the rising mains will be considerably reduced whilst the service life of the system will be significantly lengthened.
TRANSITION FLOW FROM A ROUND PIPE INTO A RECTANGULAR CHAMBER WITH SYMMETRICAL EXPANSION (6cp)
Dong Ho Seo - S09-125

Supervisor: Phuoc Huynh
Assessor: Hao Ngo
Major: Mechanical

The hydraulic laboratory currently contains an axial-flow pump test rig. This rig allows students to conduct practical experiments on a typical industrial-sized axial-flow pump and system. For a more involving learning experience and also for research, it is very desirable to include a rectangular chamber (which is currently not available) into the current test rig. Such chamber will make it possible, for example, to visualize flow around submerged objects.

This project aims to design a symmetrical rectangular chamber and include it to the existing test rig. This also requires a symmetrical expansion for the transition from the circular pipe to the rectangular chamber. This project thus helps to determine the correct transition and rectangular chambers. The method is Computational Fluid Dynamics (CFD), using the software CFD-ACE by the ESI group. Models with smooth corners and without are used and compared.

Reynolds- Averaged Navier-Stokes equations along with the common K-epsilon model are used for the equations governing incompressible, isothermal and turbulent flow. Thorough care has been taken for example, grid convergence having been obtained to ensure results are reliable and trustworthy.
COMPARISON STUDY ON THE BUILDING SUSTAINABILITY BETWEEN AUSTRALIA AND SINGAPORE (6cp)
Ninos Shlemon – S09-127

Supervisor: H.H.Ngo
Assessor: to be confirmed
Major: Civil Engineering

Buildings are the primary structures that accommodate the settlement of humans and therefore there exist a close link between both humans and building, to ensure the well being of both humans and the environment subsists, it is essential to create sustainable buildings.

Sustainable buildings are essentially an outcome of design. Containing sustainable features they are predominantly efficient and minimise the use of resources such as energy, water and materials to operate. Inherently linked to our lives, buildings are one of the most important structures that humans have developed.

This thesis has been compiled to entail a detailed comparative analysis of sustainable buildings both in Australia and Singapore. It will initially contain both the requirements and pathways for creating sustainable buildings followed by a detailed analysis of sustainable building development both in Singapore and Australia. It will also include the key principles of building sustainability and how sustainable buildings can lead to an increase in efficiency of the buildings occupants. Economic, social and environmental positive outcomes will also be discussed and how sustainable buildings benefit both people and the environment.

It is written in support of sustainable development, because it involves looking ahead and developing today in such a way that does not come at expense of the quality of the environment for current and future generations. It is a new way of thinking, innovative and is important to sustain earth natural resources. Fairly new to many cities around the world, sustainable building development is going to be part of future generations.
CASE STUDY: HOW THE NSW GOVERNMENT HAS IMPLEMENTED BASIX TO FURTHER SUSTAINABILITY GOALS IN THE CONSTRUCTION OF RESIDENTIAL BUILDINGS (6cp)
Cindy Tan – S09-206

Supervisor: Bronwyn Holland  
Assessor: to be confirmed  
Major: Construction Engineering

Environmental sustainability has been an important agenda in the world for more than two decades. Many countries have worked together to find a balance between development and the need for environmental protection. The Australian government has participated in negotiations over sustainability internationally, and since signing the KYOTO Protocol in 2007, has committed Australia to lower carbon emissions to the atmosphere.

This paper will focus the State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004 under the Environmental Planning & Assessment Act 1979. This policy targets the planning stages of the construction of residential buildings with the objective of reducing a typical residential building’s energy usage by 40%, and water usage by 40%.

Policies are developed in consultation with stakeholders to address problems and challenges to long term sustainability. There are many factors policy makers have to consider in preparing a policy, such as its objectives and desired outcome, the target audience, the culture and environment of its application, and the ethical and philosophical approach behind the policy.

The successful implementation of policy depends on many factors, including an investment in educating industry and the community in its justification and benefits. This paper is a case study of BASIX as a policy that the NSW Government has developed to improve the sustainability of new residential buildings. It examines its origins, how BASIX fits in with the NSW Government’s goals for sustainable development and asks whether it has met its objectives as a policy.
REPAIR AND STRENGTHENING OF TIMBER BEAMS WITH CFRP (6cp)
Tracey Tat - S09-136

Supervisor : Bijan Samali
Assessor : Keith Crews
Major : Civil Engineering

Existing timber structures may require repair or strengthening due to a number of factors including general age-related deterioration, damage caused by overloading, design deficiencies due to changes in design codes and increases in loading due to functional changes. Fibre reinforced polymer (FRP) composites feature properties ideal for repair and strengthening purposes such as high strength to weight ratio, corrosion resistance and ease of handling and forming into different shapes.

Past research has focused on the use of FRP on timber primarily for strengthening purposes to yield enhanced mechanical properties. Less emphasis has been placed on the use of FRP to repair damaged timber members. This project investigates the behaviour of timber beams either repaired or strengthened with carbon FRP (CFRP) in terms of strength, stiffness and modes of failure.

An experimental program comprising of static and dynamic testing was executed on three rectangular beams. Two control beams without CFRP were initially loaded to failure and then repaired using a combination of CFRP sheets and wrap. The repaired beams were then tested to failure to investigate the extent of recovery in strength and stiffness. The third beam was a strengthened specimen and was reinforced with CFRP sheets prior to loading to failure. The test results indicated that the use of CFRP in the timber beams was overall effective. It allowed the repaired specimens to support further increments in loading, while the strengthened specimen showed an improvement in ultimate capacity and stiffness.

The experimental results from the static testing are compared with theoretical calculations based on the transformed section method. The experimental results from the dynamic testing are used to validate the theoretical model employed.
iUTS – AN IPHONE APPLICATION FOR UNIVERSITY OF TECHNOLOGY, SYDNEY (12cp)
An Trinh - S09-140

Supervisor : Yusuf Pisan
Assessor : Chris Wong
Major: Software Engineering

This thesis presents the processes and issues encountered during the development of an iPhone application for the University of Technology, Sydney (UTS).

In today’s world, smart phones and portable media devices have evolved and become sophisticated, integrating mobile computing into our everyday lives. This is evident through the integration of the iPhone and iPod touch. Both devices mostly owe their success to the App Store which provides a central marketplace for developers to easily distribute and update their applications and for customers to download a wide range of applications, “There’s an app for just about anything”.

As a result access to information and services is readily being converted into applications, for example, Facebook, Google, Yellow Pages, etc. Universities in America have adapted this trend, creating applications for the iPhone/iPod touch devices to access university information and services. To accommodate the need of an equivalent iPhone application for UTS, the iUTS project was developed.

Existing applications from other overseas university institutions are analyzed and compared. The limitations of UTS information and services are discussed. The decision behind the information sites and services selected is justified using student/staff personas and the 7 ± 2 rule. The iterative design of the interface is explored in conjunction with Apple’s design guidelines, the Stanford iPhone application development lectures, and other sources. The Facebook 3.0 iPhone application provided the inspiration for a functional layout which this version of iUTS utilizes.

This thesis concludes with possible future deployment procedures, handing the code over to UTS and working in collaboration to gain permissions, and publish this application into the App Store. Maintainability and future development areas of scalability and extensibility are also discussed.
TRANSITION FLOW FROM A ROUND PIPE INTO A RECTANGULAR CHAMBER WITH EXPANSION INVOLVING A FLAT BOTTOM (6cp)

Vincent Tse - S09-143

Supervisor : Phouc Huynh
Assessor : Hao Ngo
Major: Mechanical Engineering

The hydraulic laboratory in the UTS building holds a closed-loop axial-flow-pump test rig. This rig is designed for students to conduct practical experiments on a typical industrial-sized axial-flow pump and system. Many different characteristics can be determined and measured by students. These include flow rate, head and efficiency.

This project aims to implement a rectangular chamber to the existing test rig. This rectangular chamber would help with further teaching and research purposes; those which are not possible at the moment. For example, it is envisaged to allow for visualisation of flow around submerged objects with this new chamber.

From a circular pipe, the rectangular chamber will be implemented with the use of a transition chamber having a flat bottom and an inclined top surface. Investigation of the transitional flow from a circular pipe to the rectangular chamber will be performed using a Computational Fluid Dynamics (CFD) method. The CFD software uses a well known k-ε model together with the Reynolds-Averaged Navier-Stokes equations to compute the turbulent flow. The software is CFD-ACE by the ESI Group.

Comparison of 3-D flow patterns using models with smooth transition and without will be performed to help determine a good design. Thorough care has been taken (for example, good grid convergence having been obtained) to ensure results are reliable and trustworthy.
The ease of interpretation and unimpeded flow of information by and between colleagues is vital for effective collaboration, within any organisation, to occur. Without an effective mechanism for capturing and sharing information time is wasted through enacting tedious manual processes, information is misinterpreted as it is fragmented across multiple channels, and decisions are made based on incomplete or inaccurate information. Such issues are further compounded when those within the organisation do not all reside in a central office but are instead spread across the country.

This project set out to analyse a business that faced the issues outlined above, implement a system that would address these issues, and migrate their legacy business management system to this new system. In order to achieve this aim the system had to be scoped, designed, developed, implemented and tested; the methodologies used are outlined in the main report. The overall objective was to create a multi-user business system, that replicated functions found in the existing system, yet that would provide a consistent user experience in terms of functionality, interface and information access; for both in-office and remote staff.

This process led to the creation of a rich Internet application (RIA) front-end, developed using a technology called Google Web Toolkit or GWT, and linked to a back-end that uses technologies such Spring to simplify enterprise Java and Hibernate to facilitate transparent persistence. By making the application browser based it becomes inherently cross platform, it is able to be accessed from any computer that has a browser and an internet connection, and updates are delivered without end user intervention. In addition to this it creates the opportunity for the system to be deployed using the Software as a Service (SaaS) model.

The resultant system can be classified as a hybrid between a Professional Services Automation (PSA) system and a Customer Relationship Management (CRM) system. It has characteristics of a PSA system in that it allows the scheduling of consultants involved in micro-projects, the tracking and management of deliverables, and recording of consultant payment. It has aspects of a CRM in that it manages client information, billing, payment processing, quoting, complaints and dispatch of deliverables.

The overall objective of this project has been outlined above, yet, through meeting this objective an unexpected conclusion has been reached; the web browser is ‘the’ platform for collaborative multi-user applications.
THE ROLE AND OPTIMISATION OF TRANSMISSION POWER CONTROL IN
BODY AREA NETWORKS (12cp)
Andrew Varis - A09-184

Supervisor : Bruce Moulton
Assessor : Zenon Chaczko
Major:  Computer System Engineering

Wireless Sensor Networks (WSNs) must operate on a number of constraints, the most significant and unique of which being a limited power source, usually in the form of a battery. Body Area Networks (BANs) are a specific application of WSNs where nodes are placed about the human body for the purposes of long term monitoring of vital biometric parameters. The most noteworthy application of BANs lies in their ability to monitor the health conditions of the elderly or sufferers of chronic diseases with a minimum of inconvenience to the wearer. It is desired that these devices operate for as long as possible on their limited power source.

There is strong evidence to suggest that significant power savings can be found through optimising the control of the wireless transceiver of the nodes. While there exists many protocols which optimise the power use of the transceiver in a WSN, these protocols often lose their effectiveness when applied to the much smaller and often vastly different network structures of BANs.

A system was developed to compare the various power usage and signal quality associated with fixed, Received Signal Strength Indicator (RSSI) feedback and frequency-modulated RSSI feedback control methods in a realistic medical application BAN. The system implements the periodic polling of multiple on-board sensors and the propagation of this data to a powered sink node, so as to mimic real world conditions as closely as possible.

Results suggest that the close monitoring and manipulation of the wireless transceiver in regards to transmission power and transmission frequency in appropriate scenarios can significantly decrease the power usage of a wireless node. The implication of this is that the node will have a much longer lifetime in the field and will therefore provide more support to those in need of long term care.
SOIL REINFORCEMENT – COMPARISON BETWEEN EXISTING METHODS FOR REINFORCED SOIL IN NSW (6cp)
Bojan Vujica - S09-149

Supervisor : Hadi Khabbaz
Assessor : Behzad Fatahi
Major: Civil and Environmental Engineering

The concept of soil reinforcement or mechanically stabilised earth was established in 1967 by a French scientist by the name of Henri Vidal. It is over 30 years old but the rapidity at which the related products are being developed and used is nothing short of astonishing. As the technology has developed over recent years, it has evolved from discrete steel strips used as reinforcements to incorporate metallic grid reinforcements, and, quite recently, geosynthetic reinforcement. Many applications of geosynthetics have proven their value in civil engineering projects, nevertheless, the fundamental technology remains the same. Mechanically stabilised earth in essence is the act of increasing and improving soil strength to enable it to withstand or carry a greater load. Steel and polymeric materials provide tensile resistance and stability to soils that have low to no tensile strength.

This capstone project will provide a comparison between existing methods for soil reinforcement. The project will concentrate on reinforcement by metallic strips and geogrids. The purpose of this thesis is to integrate existing knowledge and industry data to enable the successful comparison of existing conditions in New South Wales based on various factors affecting performance such as cost, reliability and stability. The thesis also provides an evaluation of the data collected in New South Wales, a recommendation, as well as guidelines to soil reinforcement design and construction. This thesis can be accessed as a reference document for the engineering community, more specifically geotechnical engineers, by creating awareness and knowledge of the usefulness and potential advantages and disadvantages of existing methods for soil reinforcement.
ANALYSIS OF A HYDRAULICALLY INTERCONNECTED SUSPENSION SYSTEM INCLUDING VEHICLE PARAMETER ESTIMATION METHODS (12cp)
Benjamin West - A09-177

Supervisor: Nong Zhang
Assessor: Chris Chapman
Major: Mechanical Engineering

A large portion of automotive vehicle accidents involve vehicle roll-over which damages the vehicle and harms the vehicle’s occupants. The majority of these accidents involve large passenger vehicles known as Four-Wheel-Drives (4WD) and Sport-Utility Vehicles (SUV) because they possess a higher mass centre, which increases the risk of vehicle roll-over occurring. UTS has patented a derivative of Hydraulically Interconnected Active Suspension (HIAS) titled Demand Dependant Active Suspension (DDAS) as a means of repelling vehicle roll-over.

DDAS consists of four double direction hydraulic actuators, hydraulically interconnected and controlled by a compact manifold with a pressure controlled fluid supply unit. The hydraulic configuration of DDAS determines the moment generated in reply to the vehicular motions of roll, pitch and bounce. UTS has developed several revisions of a test rig to research DDAS technology.

The second revision of the DDAS test rig that was developed consisted of four interconnected hydraulic actuators, which could be paired in either front and rear or left and right configuration. This design allowed the vehicular motions of roll, pitch and bounce to be controlled. Due to the severity of vehicle roll-over accidents and the contribution of the vehicle's roll motion alone to such instances, a third revision was created to reflect this. This thesis reports on the design and testing of this revision.

The fourth revision of this project consists of implementing DDAS into the existing suspension of an SUV. Before fitment can commence an assessment of the vehicle’s current unmodified dynamic nature is required so that the benefits of fitting DDAS can be studied. This is achieved by identifying parameters such as moment of inertia, center of mass, as well as natural frequencies of roll, pitch and bounce. Appropriate methods for testing, analysis and validation of these parameters are presented to conclude the content of this thesis.
DEVELOPMENT OF A SOFTWARE UPDATE SYSTEM (12cp)
Marie White - A09-181

Supervisor: Steven Murray
Assessor: Zenon Chaczko
Major: Software Engineering

The advancement in Internet technologies and availability of increased bandwidth has exposed the Internet to a global audience. The Internet has transformed from a static content repository to a rich and interactive environment delivered through a variety of media. These changes present both threats and opportunities. An audience of billions is within reach of both companies and malicious software. The strategic delivery of content over the Internet allows us to maximize potential and mitigate threats.

This capstone has been undertaken in the context of the business needs of Emotum Pty Ltd, an organization specializing in software for the telecommunications industry. Emotum was faced with a request from clients for a more effective content delivery system that distributes a variety of software, firmware and updates. This capstone investigates content delivery mechanisms currently available and implements a proprietary system to distribute software updates with the aim of increasing user uptake.

The investigation led to a focused analysis of software update systems within the umbrella of the content delivery space. Two main approaches to update systems are in practice: silent and user-interactive. The appropriate approach is dependent on the application and user demographics. It was determined that a silent software update mechanism was suitable for the current business scenario.

A silent software update system was implemented as a proof of concept. The system leverages the Windows Operating System environment to deliver software updates in a manner to maximize user uptake.
BRAKE SYSTEM DESIGN FOR A FORMULA SEA RACE CAR (6cp)
Matthew Wyres - S09-158

Supervisor : Terry Brown
Assessor : Peter Tawadros
Major: Mechanical

This project is entitled “Brake System Design for a Formula SAE Race Car”, and is written by Matthew Wyres in spring semester 2009. This project involves the design and manufacture of a brake system for the UTS formula SAE race car to be entered into the 2010 Formula SAE Australasia competition, also the modification of that design to be used on the 2009 car. The design includes the selection of suitable ‘off-the-shelf’ components as well as the design of a set of brake calipers.

The beginnings of this project were in the analysis of an existing design used on the UTS 2007 car, which was intended to be re-used on the 2009 car. However due to the poor performance of this design in the 2007 competition, the task was given to me to refine the design to achieve a system with sufficient stopping power. Analysis of this design revealed its unsuitability to our unusually heavy car, and facilitated a complete redesign. The design process was iterative in every stage, first with the iterative calculations required to determine the best combination of component sizes for the specific application, followed by the iterative Finite-Element-Analysis process used to arrive at the best possible stiffness to weight ratio for the caliper design.

The outcomes of this project will be a brake system that will perform well on both the 2009 and 2010 entries into the Formula SAE competition, allowing the team to pass the competition’s brake test, and perform well in the competition’s other events. This project will also produce a brake caliper design that can be used by the team in future competitions, and also a thesis that will serve as an instruction manual to any students given the task of brake system design for the UTS Formula SAE team in the future.
A ROTATION SYSTEM FOR THE CHARACTERIZATION OF SPIN-POLARIZATION IN HOLE ONE DIMENSIONAL QUANTUM WIRES (6cp)
LaReine A. Yeoh - A09-161

Supervisor: Keith Willey (UTS), Alexander R. Hamilton (UNSW)
Assessor: Tim Aubrey
Major: Computer Systems Engineering

There is growing interest in the development of spintronic (spin-electronic) devices which rely on the property of electron spin, rather than charge to represent and carry information. This new paradigm of electronics has many potential advantages over conventional semiconductor devices, such as increased data processing speed and nonvolatility. For this new technology to be realized, many challenges still need to be overcome, including the manipulation and control of individual spins, using electric rather than magnetic fields via the spin-orbit interaction at a quantum level.

The effects of electric fields and the spin-orbit interaction can be studied through measurements of the anisotropic Zeeman spin-splitting in nanoscale, low dimensional heterostructures. These are typically conducted within isolated environments at low temperatures, and high magnetic fields, making it challenging to vary the angle between sample and magnetic field. A system that allows for the in-situ rotation of a device, provides a more elegant solution to the problem of stopping the experiment and manually changing the sample orientation. In situ rotation is essential since the nanoscale devices themselves are delicate, with repeated thermal cycling quickly degrading the electrical properties of the sample.

My project involved the design, development and testing of an automated sample rotation stage for use in a dilution refrigerator, at temperatures below 0.1K and magnetic fields over 10T. Two configurations allow the sample to be rotated either parallel or perpendicular to the magnetic field, based upon a commercial piezoelectric rotator. The system was characterized and calibrated using a two-dimensional electron gas and its performance evaluated against the requirement specifications.

After completion the device was used successfully to measure a one dimensional hole quantum wire and the angle-dependent Zeeman spin-splitting observed as a function of magnetic field and rotation angle. Future research will use this rotation system to investigate spin-orbit effects in different semiconductor nanostructures.
UPGRADING CP RANGE CENTRIFUGAL PUMP BEARING BRACKET (12cp)  
Cameron Young - A09-123

Supervisor: Phuoc Huynh  
Assessor: Quang Ha  
Major: Mechanical Engineering

Through my employment at Sykes group, I noticed that there was more efficient methods of design and this project was originally undertaken to verify the validity of these methods. This research compares the more traditional means of designing shafts and bearing brackets with computer FEA based design with actual physical testing. This research has implications in the wider industry because a number of other companies use FEA technology to design and test machinery.

In order to complete this research I started by reviewing previous projects relating to shaft and bearing design completed at Sykes and by reviewing the current design method. Then using Solidworks and Solidworks Simulation to design a new shaft and bearing bracket. This design was prototyped and tested on a new test rig.

This project verified the design approach undertaken and created guidelines for its use and helped produce a working prototype of the new bearing bracket. The project also led to the design, testing and refinement of the shaft fatigue testing rig which will be used to verify all new shaft and bearing arrangements.

The project was successful at providing a new method of designing/refining shaft and bearing arrangements and led to the acceptance of this style of design in the company. It will lead to greater acceptance of this design method in the field of manufacturing, mainly through word of mouth and business association. The project has also led to the design of a new style of bearing bracket with performance, manufacturing and servicing benefits over the current design which could be used in production if it meets final costing criteria. In addition Sykes also has a physical shaft testing rig, to test static deflection and fatigue which will verify older designs as well as new designs.
RESEARCH ON DESIGN, TESTING AND BUILDING AN EFFICIENT BUILDING INTEGRATED PHOTOVOLTAICS (BIPV) SYSTEM FOR UTS BUILDINGS (6cp)
Tan Zhao - S09-161

Supervisor: Jafar Madadnia
Assessor: Garry Marks
Major: Mechanical Engineering

The incorporation of photovoltaic modules in the structure of a building is becoming popular. Advances in PV-technology allow today to use PV-modules in addition to an electricity production for several other purposes on a building. As the majority of these systems are designed alongside the building envelope it means money and time are saved in the design process that would be spent later on incorporated this technology into an already built structure.

Research is being undertaken at the University of Technology Sydney, into using solar energy to design, build and testing an efficient Building Integrated Photovoltaics (BIPV) system for UTS buildings. In accordance to its continuous commitment to sustainability, the UTS and five other Australian Technical Network Universities signed an agreement to promote energy efficient projects by UTS students, academics and support staff to reduce carbon emissions; reducing the effects contributing towards climate changes. The project involves design and testing of compact BIPV-panels for UTS buildings. The BIPV panels with the channel-spacing of 6mm, 12mm, 18mm, 24mm, 30mm designed by previous Capstone students were selected as the Benchmark models for the present capstone project (Daryl 2009).

The shortcoming of the benchmark is suggested that at S=13.5 convection cooling is the maximum. However, the primary thermal-modelling showed an optimum value of S=13.5mm for the maximum head loss. The problem statement of this project is the electric conversion efficiency of Photovoltaic (PV) is less than 10% and further decreases with increase in its surface temperature.

The general solutions for this problem is a) convection cooling of the PV’s surfaces, b) to use the extracted heat in air conditioning, and c) to employ PV in a multitask application in the building structure including façade/building boundaries, external walls, double glazed windows. A mobile proximity probe was designed and built using two thermocouples to measure both PV’s surface temperature and air temperature at a very close proximity to the PV surface. Convection heat transfer parameters were determined using the mobile probe. In addition, a number of fixed thermocouples and anemometers were also employed. Heat transfer parameters were determined both in transient and steady state conditions.
A FUNDAMENTAL HORSE RACE HANDICAPPING SYSTEM FOR AUSTRALIAN RACETRACKS (12cp)
Jeremy Zhou - A09-118

Supervisor: David Davis
Assessor: Zenon Chaczko
Major: Software Engineering

Thoroughbred racetrack betting can be seen as a sequence of small markets. They are similar in many ways to the stock market. For this reason it has attracted many academics to study its nature to gain insights into its information efficiency, bettor’s psychology and potential investment opportunities. Numerous authors have convincingly demonstrated that a racetrack wagering system can be constructed to give positive financial return in the USA and Hong Kong, but none are concerned with the Australian racing market.

This project describes the analysis and development of a statistical race handicapping model and an algorithmic wagering system within the Australian context. The multinomial logit model is used to analyse past racing data and empirically assesses the winning probability of racing candidates. Racing conditions local to Australia such as variance across the large number of racetracks and a different style of racing are taken into account.

A defect minimal prototype of the algorithmic wagering system has been developed as a proof of concept. It uses the output of the handicap model and wagers on racing candidates whose winning probability exceeds that determined by odds by a certain amount. Since the wagering system finds inefficiencies in the betting market and make bets on candidates with positive expected value, it is expected to generate a positive financial return over long term.

A betting simulation has been conducted on all races in Australia between 2008 and 2009. A total of 1480 bets were placed and generated a 191% rate of return.