Faculty of Engineering
and Information Technology

ABSTRACTS

CAPSTONE PROJECT PRESENTATIONS

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Broadway Campus
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ADAPTION OF HARDWARE ABSTRACTION LAYER (HAL) FOR THE OSGI
DEVICE ACCESS SPECIFICATION (12cp)
Christopher Armstrong – S08-004

Supervisor : Anthony Kadi
Co-supervisors: Diarmuid Kavanagh, Dr Sara Lal and Peter Rositter
Assessor : Steve Murray
Major: Software Engineering

Device management is a consistently problematic aspect of software design. Some software systems require that devices be self-configuring and self-managing, but more often than not, the software platform under use cannot support this. Device drivers frequently need to be selected by the user and installed manually. Making matters more difficult, users need instruction in how to use the provided software in order to manipulate such devices.

The SmartData research project (a partnership between Forge Research and UTS Science) had a need for automatic device management within a controlled computing platform. A customized computer running the SmartData software would be placed in a research participant’s home, and a number of external data collection devices would be attached to it. These devices are required to be configured automatically, and the data retrieved from them, without intervention from the user.

We set out to utilise existing technologies to satisfy these requirements. Hardware Abstraction Layer (or HAL) provides the rich device information and events required to detect and distinguish between devices. The OSGi specification defines an application platform that permits devices to exist as dynamic services, which can come and go at any time and automatically execute the relevant application software. The integration of these components would create a platform for dynamic device discovery and automatic driver connection, upon which we could build applications that automatically retrieve the medically relevant data and send it back to researchers in the lab.

This Capstone demonstrates an implementation of this concept in the form of OSGi drivers, and gives an example of a purpose-built driver for a data collection device as a demonstration of the utility of the integrated software platform.
MEETING THE UNITED NATIONS’ MILLENNIUM DEVELOPMENT GOAL ON SANITATION: RECENT PROGRESS AND FURTHER ACTIONS REQUIRED (6cp)
Simon Armstrong - A09-004

Supervisor: Prasanthi Hagare
Assessor: Huu Hao Ngo
Major: Civil Engineering

In 2000, the member countries of the United Nations agreed to the Millennium Declaration. The Declaration outlined eight goals to reduce poverty around the world. These goals are known as the Millennium Development Goals (MDG). The MDG are further broken down into targets and indicators. Target ten is to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation. This capstone project relates to the sanitation aspect of this target.

The overall objective of this project is to showcase the progress that has been made towards this target. Figures for the world as a whole and the separate regions are presented. Using published data, future trends are predicted to assess to what extent the target will be met by the 2015 date. Based on current trends, the world, and a number of regions, will fail to reach the target. The actions required to change this situation so the world reaches the target are presented.

The reasons why the topic of sanitation has been included in the MDG are explained. Increasing access to sanitation facilities brings improved health, positive social repercussions, environmental benefits and boosts economic activity.

The major causes hindering progress towards the target are also examined. The poverty cycle itself is a significant problem, along with a lack of education, social and cultural inhibitors, lack of funding and political support and a general demand / supply failure.

The variety of sanitation systems and associated technical aspects are explained before presenting three country case studies, Nepal, Ethiopia and Australia. These case studies describe in more depth, the sanitation situation along with some of the specific problems and innovative solutions that are being experienced in different parts of the world.
GROUND IMPROVEMENT BY DEEP SOIL MIXING METHOD (6cp)
Leong Ting Lawrence Chan – A09-014

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

Deep soil mixing method is an important method for soft ground improvement. There are variety of ground improvement method being used in the world for sites with different soil properties and conditions. Deep soil mixing method is particularly useful on construction over marine clay with possible high differential settlement. In comparison to the other ground improvement method to fulfill the technical requirements, deep soil mixing method is more cost effective.

The main objective of this paper is to present and discuss the definition and testing methods of soft soil, design and construction methods of deep soil mixing method, comparison of major cement-soil mixing column design methods, and computer simulating application. For further and detailed explanation, cement mixed soil designs and site investigations in the other countries with different site condition are discussed.

Deep soil mixing method is specially designed and used for improving the strength of soft soil unable for construction loads. Theoretically, deep soil mixing method is a soil modification method involved of pile installation and chemical mixing. The deep soil mixing construction and design methods are categorised as dry mixing and wet mixing methods which are used for wet muddy clay and dry loose sand, respectively. The construction method is discussed for dry and wet soil mixing with different machinery requirements. The design methods involve of the calculation of bearing capacity and settlement, design of column patterns and special consideration for other construction purpose, i.e., excavations and embankment construction.

Several case studies will be discussed in the paper related to the column construction, soft soil investigation and consideration, column pattern design and settlement calculations. The cases study of soft clay improvement in Bangkok will conclude soil testing, construction technique, post-construction monitoring and efficiency comparison of deep soil mixing method which provides practical understanding of this ground improvement method.
COMPOSITE MUDBRICK TESTING (6cp)
Jin Soo Cho - A09-151

Supervisor: Hadi Khabbaz
Assessor: Bijan Samali
Major: Civil/Environmental Engineering

It is estimated half the developing world reside in earth buildings. Unfortunately, many of these buildings are located on earthquake prone areas, causing human tragedy when disaster strikes. Often, these communities do not have viable access to safe methods of building houses or modern construction materials.

This project aims to shed some scientific light on this existing building method by providing an analysis of the strengthening effects of straw in mud-bricks, an easily obtainable building material. The findings of this project provide persuasive scientific evidence on the strengthening effects of straws in mud-bricks, which has scarcely been conducted before. The results of this research another step in the direction towards discovering the ‘optimal’ mud-brick formula.

Due to the lack of data available on Australian mud-brick properties, this research incorporates experiments to illustrate the benefits of mixing mud with straw, which will serve as a benchmark for further research into this field. To achieve this, two sets of experiments are being conducted.

To examine the soil properties of the mud-bricks, a number of Unconfined Compressive Strength (UCS) tests are conducted on a selected Australian soil sample. The USC tests are conducted to compare the shear strength of the composite mud-bricks against mud-bricks without any straw additives. Following the UCS tests, a bending moment test will be conducted on various mud-brick samples. This test will quantify the bending moment strength of regular and composite mud-bricks.

Using easy to obtain materials, the composite mud-brick is designed with accessibility in mind. In order to effectively upgrade existing building methods in areas where accessibility is an issue, the findings of this research would be useful.
AN EXPERIMENTAL INVESTIGATION OF PRESSURE LOSS IN CANVAS FIRE HOSES (6cp)
Aaron Doull - A09 - 026

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

The NSW Rural Fire Service (RFS) uses canvas lay flat fire hose to deliver water at an incident. In order for the hose nozzle to operate at maximum efficiency a specific nozzle pressure is required in order to generate this effective flow and spray.

The NSW RFS uses a “rule of thumb” figure for the estimated pressure loss over 1 length (approx 30m) of canvas hose. The pressure drop for any situation is approximated to 100kPa per length of hose. This number is based on figures published by the hose manufacturer. When the manufacturer tests these values all the testing is done as per the Australian Standard AS-2792. AS-2792 requires the hose to be under specific conditions which do not reproduce what is happening in a real life firefighting situation.

In this experimental investigation, a test rig was setup to measure pressure loss over a length of canvas fire hose under different circumstances in order to reproduce how the hose will be lay in an actual scenario and the actual nozzles with the ideal flow rates used. The results of the experimental investigation have shown that the pressure drop can be as much as 230kPa through a 25mm hose with severe bends. It has also shown for large diameter hose (65mm) the loss is almost insignificant (9kPa) regardless of the hose configuration.

The outcome of the report will be as expected, that the pressure drop is greater with the more bends in the hose. The impacts of these results will be discussed further in the final report. There is also a potential for future research to be done with the hoses setup under different conditions again such as running double lines or with kinks in the hose.
MECHANICAL DESIGN ASPECTS OF THE SOMERSBY WATER TREATMENT PLANT STAGE 1 TRAVELLING BRIDGE REPLACEMENT DESIGN (6cp)
Ben Eccles - A09-029

Supervisor : John Dartnall
Assessor : Guang Hong
Major: Mechanical Engineering

The Stage 1 travelling scraper bridges are a key component of the sludge collection and removal system within the sedimentation tanks at Somersby Water Treatment Plant (SWTP). The bridges are in excess of thirty five years old, and, due to their age, require the refurbishment or renewal of all on-board equipment. In addition, evidence of structural failure in the bridge truss structure resulted in the bridges being deemed irreparable by Gosford City Council (GCC) in which they require replacement.

The overall project, being undertaken by URS Australia on behalf of GCC, consists of the development of a replacement design for the two Stage 1 travelling bridges. This Capstone project, however, details the mechanical design associated with this project, beginning with initial scope definition through to final detail design.

The current and proposed travelling bridges consist of three main mechanical systems; the long travel system, the scraper blade hoist and the power supply cable reeling system. The current systems are complex, contain redundant or out-dated technology, and do not wholly satisfy current Australian Standards’ requirements. Operation and equipment maintenance is made difficult as a result, whereby, the equipment does not necessarily operate in a safe or reliable manner. As key design criteria, GCC stipulated that these issues must be addressed.

The outcome of the project is to develop a mechanical design that integrates with the overall design of the two travelling bridges whilst satisfying the key requirements stipulated by GCC. A set of drawings will be produced to illustrate the design which will be complemented by mechanical specifications. These documents will be suitable for construction of the new travelling bridges.
REINFORCED SOIL RETAINING WALLS IN AUSTRALIA (6cp)
Farhang EffatManeshNik – A09-160

Supervisor: Hadi Khabbaz
Assessor: Shami Nejadi
Major: Construction Engineering

Reinforcement soil retaining walls methodology had been introduced not long ago; however, it is being developed based on previously well developed concepts. To some extent, those concepts and their histories are reflected in this study to be more familiar with the history of the reinforced soil.

The mechanism and behaviour of most common types of reinforced soils are studied under both the initial loading and the limit equilibrium state of the soil mass. A critical literature review of the existing philosophies on the reinforced soil systems, the concept and the applications are also carried out. Various types of retaining walls are studied, but only the most popular ones in Australia have been more emphasised on.

Some case studies from all over the world have been investigated and their limits are identified. However the Australian case studies are investigated more thoroughly. Moreover the computation concept of the initial load-settlement relation, bearing capacity or safety factor, distribution of axial, shear or bending forces in the reinforcement, as well as velocity vectors and stress distribution in reinforced soil structures is also presented.

Substantial improvement in the response of the retaining wall structures due to the soil reinforcement is demonstrated through the model test results and then it is being supported by the numerical simulation results obtained by employing a numerical code.

The proposed methodology offers promising features and a wide range of applicability for the analysis and design of complex reinforced soil retaining wall structures. The results presented throughout this study project provide enough confidence to the practicing engineers to adopt this methodology in their practice.
INVESTIGATION OF LANDFILL IN NSW (6cp)
Farshid Effatmaneshnik - A09-168

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

The rise in interest in construction of structures on top of aged landfills is due to growing demand for developable space in urban areas. Landfills can be redeveloped for a variety of uses such as commercial, industrial, or infrastructure and soft uses such as athletic fields, golf courses and amphitheatres. The two major challenges engineers face regrading landfill redevelopment are foundation design and landfill gas movement control. The large total and differential settlement often associated with landfills is an important part of these challenges. Both deep and shallow foundation systems must be provided with protective measures against landfill gas migration.

The Australian landfill can be categories as wet and dry cells. Construction over wet cells is even a bigger challenge. High quality full-scale field data as being recorded in projects being undertaking by different universities can be used to authorize and advance our capacity to foresee settlements and work out left behind landfill volumes.

This research focuses on the geotechnical aspects of the construction on closed landfill sites. It includes a comprehensive literature review of the current state of the practice of construction on closed landfill sites, typically municipal solid wastes. It also addresses such topics as site improvement that is typically done before construction can begin. In addition it addresses design issues that need to account for the compressibility and low bearing capacity of the waste material underlying the construction.

Furthermore this research analyses case studies of three landfills in the world (Tehran, Auckland and Vienna) and specifically one landfill in NSW (East Gosford). Then different methods of compaction and reuse are investigated and the best possible method is put forward.
AN INVESTIGATION INTO IMPROVING AIRCRAFT FUEL EFFICIENCY (6cp)
Aaron Egan  -  A09-030

Supervisor : Guang Hong
Assessor : John Dartnall
Major:  Mechanical Engineering

This project aims to investigate whether it is feasible for a sub-fleet of four Boeing 737-800 aircraft to operate with the Auxiliary Power Unit (APU) physically removed from the rear of the aircraft, and the potential for fuel efficiency savings from the decreased weight of the aircraft. A Supplementary Type Certificate modification would be required from the manufacturer but would be reversible.

The aircrafts movements would be restricted to flights between the city pairs of Melbourne – Sydney and Brisbane – Sydney. These are two of the most highly trafficked routes in the world, although the journey could be considered regional due to the short distance and travel time involved. Establishment of preconditioned air systems and fixed electrical ground power units at major airports throughout Australia can allow aircraft to function without the use of the APU during a transit stop.

A basic model for the future cost of fuel is developed from several years historical data on the price of oil, jet fuel and the foreign exchange rate. This results in formulas that aid in the prediction of the future cost of jet fuel as the result of several possible scenarios of future oil price and corresponding exchange rate variations.

The removal of the APU, would improve an aircrafts fuel efficiency which results in financial savings, plus the reduced fuel cost required per flight and decreased maintenance costs, less the cost of running the external power sources, returns a benefit year on year. If the four 737 aircraft were to be integrated into a snapshot of the current network, they would displace the larger 767 and reduce the total amount of available seats on the route by a significant portion.

From a commercial perspective, it would be economically unfeasible to remove the APU from the 737-800 at this time.
THE DESIGN AND PLANNING OF A 132KV – 11KV SUBSTATION (12CP)
Hassan Faruck – S08-119

Supervisor: Jianguo Zhu
Assessor: Germane Athanasius
Major: Electrical Engineering

The purpose of this capstone is the design and planning of a 132kV to 11kV substation in the Parramatta CBD. Parramatta is Sydney second largest CDB and the demand for electricity in Parramatta is expected to grow by 18 per cent over the next three years. To tackle the problem the utility provider for Parramatta Integral Energy is going to build three 90MVA zone substations. This capstone will primarily focus on the design and planning of a 90 MVA substation.

This capstone will primarily going to be based on what components are to be used in the substation and a number of options will be considered for each component and a final decision will be made based on the substation specification. Reasons will be given as to why a particular component is chosen in this design over the other components. Subject matter experts from industry were consulted and their advice and professional opinion was integrated into the design. Different substation designs was consid ered and a choice was made based on their practical feasibility, degree of difficulty needed for implementation, availability of standard equipment and cost. Fault current calculations, capacitor bank calculations and earthing grid calculations were carried out to ensure the design meets or exceeds the specifications.

The final design was that the substation was an industrially viable design that can be implemented in an urban environment with an implementation option of being multistory or single storey.
TRANSIT ORIENTED DEVELOPMENT, PLANNING AND URBAN SPRAWL IN SYDNEY
(6cp)
Megan Gee - A09-033

Supervisor: Ken Halstead
Assessor: Alan Brady
Major: Civil and Environmental Engineering

Sydney and its inhabitants are facing a number of transport- and planning-related challenges in the near future: peak oil, the current global financial crisis, population growth, and the need for sustainability including possible climate change. Intrinsically linked to each of these issues is the way Sydneysiders move around their city, and their physical footprint.

The politics of these issues are inescapable. Planning decisions have all too often been made on the basis of popular will, and as a result the importance of the individual has exceeded that of the community: the city has developed a car-centric suburban culture. Sprawl ensues as greenfield urban fringe sites are released for development, generally supplied only by a road network and possibly a single train line.

If peak oil occurs in the near future, Sydney residents could be particularly vulnerable to petrol price fluctuations given their reliance on private vehicles. This is particularly relevant in the context of the current economic crisis, where increased variable costs such as fuel can put significant pressure on households located on the urban fringe.

This project investigates if suburbia and urban sprawl are sustainable in consideration of Sydney’s future challenges, and tests the feasibility of an alternative: Transit Oriented Development (TOD). TOD is a type of urban development that enables increased density and place-making around public transport, increasing the viability of transit and improving the liveability of the area.

To assess the feasibility of TOD and urban consolidation in place of urban sprawl, a potential light rail network in southern Sydney, from Surry Hills to Sydney Airport will be examined, in the context of providing transit to existing mixed use developments.
WEB MESSENGER APPLICATION (12cp)
Peyush Goel – S08-020

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

Instant Messaging (IM) is a web based technology which establishes real-time text-based communication between two or more participants over the internet or some form of internal network or intranet. The synchronicity of the communication by the users separates it from e-mail based services. Web Messenger is the most widely used application nowadays and is extremely popular among the youth, who uses these at their workplaces/educational institutions as well as at their homes.

This project will focus on designing an efficient and user friendly web based instant messaging application that will allow users to communicate more efficiently over the World Wide Web with new user friendly features to make their online experience a joyous one. It focuses on the needs of the youths wanting to communicate with their peers as well as the people working within enterprises where people need to communicate with their workmates without being able to communicate with the rest of the world, maintaining the integrity of the work place. Features like language translator, file sharing, viewing message archive, playing external video etc are incorporated to enhance user’s experience. Further features like finger print interpretation are also planned for the future builds, though these won’t be part of the current system.

For this project, Extreme Programming (XP), an agile software development methodology which follows the concepts of Evolutionary Process Models, has been chosen as the most appropriate software engineering methodology. The nature of the project demanded constantly changing and upgrading of requirements due to various technical as well as non technical factors including improper planning, designing or implementation, network related issues, time, budget and technology constraints etc. The main benefit of using XP is that it reduces the cost of change. It introduces basic values, principles and practices, thus making the system development project more flexible with respect to changes.

The final release will provide the world with a youth’s vision of a messaging application, offering simple but advanced features to enhance the end user’s web experience.
VERIFY AND IMPROVE EXISTING CFD MODELS OF SYNTHETIC JETS IN A 
BOUNDARY LAYER. (12cp)
Michael Robert Griffiths - S08-021

Supervisor: Guang Hong
Assessor: Phuoc Huynh
Major: Mechanical Engineering

This project aims to further develop existing CFD models for investigating effects of Synthetic 
Jet Actuators in the control of boundary layer separation, caused by an adverse pressure 
gr gradient. The numerical models developed are verified by experimental results aquired from the 
wind tunnel aerodynamics lab in 2002. The model was developed using CFD-ACE a 
commercial multiphysics software platform and Large Eddy Simulation (L.E.S) adopted as a 
suitable turbulence model in which to model the flow.

Good agreement between previous experimental data and the numerical models so far 
developed can be found. This thesis aims to verify that the numerical models are independent of 
the mesh structure from which the results are taken and take advantage of new flexibility within 
the CFD software that allows for a more accurate, numerical construction of the problem.

Verifying a mesh structure requires a grid convergence study to be conducted on the mesh 
previously developed and ensuring that the results can be emulated or improved on different 
grids. Performing such a study requires knowledge of acceptable CFD standards that exists in 
relevant engineering journals and a subsequent literature review was required. New flexibility 
within the CFD software also allows the use circular geometry to be constructed, were it was 
too costly to perform previously. Allowing for the formation of a circular jet as utilised in the 
physical experiment.

This thesis contains the results of the grid convergence test, the comparison of a numerical 
circular synthetic jet as opposed to a square jet, and a comprehensive overview of the 
experiment and numerical findings to date to find areas of further improvement.
ENVIRONMENTALLY SUSTAINABLE DESIGN: USE AND SUITABILITY OF THERMALLY BROKEN FRAMES IN BUILDING FACADES (6cp)
Darren Hansen - A09-039

Supervisor: Rezaul Karim
Assessor:
Major: Civil Engineering

The thermal efficiency of a building has become of increasing importance in recent years – operating in hotter climates due to global warming, the increasing cost of electricity, efforts to reduce reliance on fossil fuels, occupant comfort, and compliance with new “sustainability” regulations in the BCA and the potential for the tightening of regulations in the future.

In curtain walls, window frames represent a small percentage of the overall window area, however depending on the design and materials used in constructing the frames, their potential to conduct thermal energy is a larger relative percentage. The use of aluminium window frames is widespread in commercial and institutional buildings, due to aluminium’s properties including its ability to be extruded into complex shapes at low cost, long lifespan, light weight, resistance to corrosion and ability to be painted. However its relatively high thermal conductivity has led to the development of thermally-broken frames in the Northern Hemisphere to reduce condensation and thermal transfer during freezing conditions. The research into applicability and energy-saving properties of these breaks has generally been limited to cold-weather climates, where they are widely used.

Based on a literature review, interviews with façade engineering professionals, and using current ISO standards-based modeling methods of heat transfer through window frames, this capstone project investigates the potential use of thermally broken aluminium window frames within a curtain wall in a hot (non-freezing) climate, with a focus on the Australian climate. Possible alternatives to thermal breaks to achieve a similar reduction in thermal transfer are also considered in terms of relative cost and performance.
EVALUATION OF EFFECT OF OVER-CONSOLIDATION RATIO ON THE OF CONSOLIDATION RATE OF CLAYS (6cp)
Zhao Hui Hao - A09-040

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

The rate of consolidation settlement of soil is an essential parameter in geotechnical design and engineering. It can be attained by determination the value of the coefficient of consolidation (Cv). The value of Cv for a particular load increment in the one-dimension theory of consolidation using Oedometer test can be obtained through standard methods of data analysis.

There are two well developed methods that can be used to calculate Cv. Taylor (1942) proposed root of time method utilising the early time (primary consolidation) response. Casagrande and Fadum (1940) proposed other method called the logarithm of time method considering both primary and secondary consolidation responses.

Both methods need finding the best fitting curve on each load increment to calculate Cv. It is desirable to predict the value of Cv by an equation capturing effective stress and stress history of soil to apply to geotechnical designs.

In this project, the results of three sets of consolidation tests on Kaolinite clay samples conducted in UTS geotechnical laboratory are presented and discussed. A correlation between \( \frac{(Cv)_{OCR}}{(Cv)_{NC}} \) and Over Consolidation Ratio (OCR) is obtained. It is observed above relationship is asymptotic towards higher OCR values. It should be noted the conducted tests cover soil with OCR between 1 and 10.

The predicting engineer may use the correlation in their design when they need to estimate consolidation rate of over consolidated soil similar to the above Kaolinite clays.
WEMHÖNER SINGLE DAYLIGHT SHORT CYCLE PRESS LINE SYSTEM (12cp)
Adam Harlow - A09-041

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

In Australia, manufacturing trends are heading towards a situation where the more technically complex or precision machinery and systems are purchased in from overseas, and installed in Australian manufacturing plants. Associated machinery and auxiliary systems can be manufactured here to accompany, improve or modify the system to better accommodate the requirements of the Australian manufacturing process.

This capstone thesis presents a practical case study of the above type of system implementation for a melamine board manufacturing facility on the N.S.W. Central Coast. The system studied is a Single Daylight, Short Cycle Melamine Press Line System, manufactured in Germany by Wemhöner Surface Technologies. The press comes accompanied with the necessary transport and lay-up systems.

Systems manufactured in Australia to accompany this press line system include a hot oil heater, closed cooling aggregate, an accident and injury prevention system, a board stack strapping device, vacuum board transport devices and other associated transport devices such as conveyors.

This report details the planning, design, manufacture, installation and commissioning of all machinery and systems required for production of melamine laminated boards at the Borg Manufacturing melamine board manufacturing facility at Somersby in N.S.W. This includes the installation and commissioning of the machinery from Wemhöner, with the assistance of Wemhöner technicians, and the installation, commissioning and integration of the Australian machinery and systems.
TANGARA WHEELS FATIGUE LIFE ASSESSMENT (6cp)
Antony Henry - A09-170

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

The Client for this project is RailCorp. This project is a collaborative venture between RailCorp, Interfleet Technology and the University of Technology, Sydney (UTS).

The tread of railway wheels underlies high load and wear and its integrity is essential for the safety of the whole train. This project looks at predictive fatigue analysis of the Tangara wheels, thereby providing RailCorp with information regarding the timeframes required for the replacement of wheels. The intent of this project is to provide useful data to RailCorp that could be used to influence current inspection regimes, timing estimates for wheel rectification actions and an underlying confidence in the usable life of the wheels.

The project initially identifies the underlying factors that contribute to the cracking phenomenon through a desktop review of historical incidence reports, visual inspection of cracked wheels, assessment of annual usage patterns and a supplier compliance audit. The project then moves on to a series of stress analyses and fatigue life calculations. Stress analysis consists of the creation of a finite element model and linear static finite element analyses utilizing axisymmetric boundary conditions and stress combinations. Fatigue life calculations provide a series of calculated lives at varying tread thicknesses, variable passenger loading and potential usage rates.

The outcomes of this project furnishes RailCorp with an underlying understanding as to the causes for the observed cracking, recommendations as to serviceable life and ongoing inspection regimes, timing estimates for wheel rectification actions due to sub-surface cracking and confidence in the usable life of the wheels and recommendations regarding the current bogie overhaul period.
COMPARISON OF GROUND WATER QUALITY REGULATIONS IN AUSTRALIAN STATES AND TERRITORIES (6cp)

Kelvin Holey - A09-044

Supervisor : Prasanthi Hagare
Assessor : Huu Hao Ngo
Major: Civil and Environmental Engineering

The changing Australian climate, long dry spells, reduction in annual rainfall, and water pollution is placing increasing demand on water availability and water supply. Groundwater in particular, is having more relevance than in previous decades, especially for remote and non-coastal areas. As demand increases, so does the requirement for an increase in contaminants testing in water supplies, this in turn requires an increase in the frequency and detection levels of water quality through testing.

This project investigates groundwater quality information in Australia. In particular, this report focuses on State and Territory governments and the information available to groundwater users with regard to groundwater contaminants and the suitable level of contamination for consumption and whether consumption is for irrigation, livestock or potable water usage.

This study examines State and Territory information and compares set groundwater quality indicators to each state, national, and international guidelines and it comments on the effectiveness and rigor with respect to health and environmental issues.

Further more, this report outlines safe groundwater quality contamination levels, such as acceptable levels of heavy metals. This outline is aimed at being relevant to the whole of mainland Australia, irrespective of location. In addition, the report aims to highlight priority contaminants when testing groundwater, with the view that every type of contaminant cannot be tested due to the costs involved. Finally, an example of ‘best practice’ testing compared against minimum testing and no testing is expected to assist in evaluating to the overall suitability of the application of national quality testing standards.

To conclude, this paper aims to demonstrate the purpose of this study and the benefits and drawbacks of having minimum national groundwater quality legislation that is applicable to each individual state or territory.
COMPOSITE MUD-BRICK HOUSING: FIBROUS REINFORCEMENT OF MUD BRICKS AND ITS STRENGTH CHARACTERISTICS (6cp)
Damian Hong - A09-046

Supervisor: Hadi Khabbaz
Assessor: Bijan Samali
Major: Civil Engineering

The production of modern building materials generates large amounts of waste and contributes to the carbon emissions in the atmosphere. In addition industrialized building materials are not available to certain communities from developing regions of the world that are in dire need of safe sustainable housing. These communities often lack the skills, materials and funding necessary to design and construct houses. For these primary concerns, an initial study of sustainable earth building and earthquake resistance of cob housing has been carried out at UTS. This project in particular, is the study of the selected soil sample and the mixture ratios of fibrous reinforced materials (straw) to determine the effectiveness in strength characteristics. An array of tests on selected soil specimens was undertaken to determine soil material properties which also resulted in the production of several samples of soil cylinders for an unconfined compressive strength (UCS) tests. This research project has been supported by an Australian earth building industry having previous experience in rural communities in the Philippines.

The results of these tests are to be compared against a similar project undertaken at the University of Auckland, New Zealand where samples of earth with fibrous reinforcement was tested for its strength. There is limited knowledge in this particular field of study which also confronts the challenges faced in this project to determine its effectiveness both here in Australia and other parts around the world. This area of research is only considered a minute part of the larger research yet to be further investigated. However, it is assumed that similar results are to be achieved as a foundation for further study in the field of composite earth building and its applications in developing nations.
OPTIMISATION OF CENTRIFUGAL FAN INLET BOXES USING COMPUTATIONAL FLUID DYNAMICS (6cp)
Tristan Hosgood - A09-171

Efficiencies and energy consumption are becoming increasingly important in the industrialised world today due to major trends like global warming, green technology, and depleting resources. My project is concerned with increasing the efficiencies of centrifugal fans with inlet box arrangements by optimising the design of the inlet box section through the minimisation of losses. The primary aim for the project is to improve on the existing design by increasing the total efficiency of the inlet box section.

I have used computational fluid dynamics (CFD) analysis techniques to run simulations on various designs of the centrifugal fan inlet box. While working with Howden Australia (a major air and gas handling equipment manufacturer) I was involved in performance testing centrifugal fans in numerous arrangements, including open inlet and boxed inlet. During this testing I noticed that significant losses were experienced when the boxed inlet arrangement was tested, efficiency losses in the order of 5 – 7% were found when compared with the standard open inlet setup. It is envisaged that by using CFD analysis software that these losses will be pinpointed as turbulence or disturbances of the flow in the model. It is the goal of this project to minimise these losses created in the inlet box by modifying the existing inlet box design to remove the losses and return the impeller inlet conditions to a more even distribution.

The success of my project could have a significant impact on industry in Australia and possibly the world. In the engineering community this project has the potential to make significant contributions to the efficiencies of plant in facilities such as power plants, steel smelters, gas refineries, mines, HVAC, etc. In order for the results to be accepted in industry it is important that my CFD model can accurately represent the physical world, every effort has been made to maximise the accuracy of the models by using simple models and conservative estimates. Ideally it would be beneficial to build and test my final design however due to time and budget constraints I will leave this outside of the scope of this capstone project.
USING NEURAL NETWORKS IN HAND MOTION SYSTEMS AND MULTI-SENSOR BASED COMPUTER CONTROL. (12cp)
Gibson Hu – S08-166

Supervisor: Hung Nguyen
Assessor: Seven Su
Major: Mechanical and Mechatronics Engineering

This project investigates the efficiency and reliability of neural networks for use in hand motion control systems. In addition it also investigates how multiple sensors can be used to aid in computer based control.

Hand motion control is an interesting research topic that can generate many issues, mainly because the anatomy of the human hand can be variably different on each individual. A simple close loop control system is usually not enough. This project poses the possibility of using non-linear statistical data modeling, such as neural networks, to perform such a task. Optimisation of the network is one of the biggest challenges and will be tackled through network design, code efficiency and learning parameters. The back propagation rule is proposed as the learning rule for this network, but also more complex structures, such as genetic algorithms, have also been investigated.

All experiments are carried out on the, Immersion Corp Cyber-Glove, which lets the user operate in a regular Microsoft Windows interface. This type of control allows for flexibility in design, such as interfacing with serial outputs or applying new/existing software. In relation to hand gestures, both static and dynamic models have been trialed for movement recognition. The control algorithms are all run in real time, including network learning and command execution.

Computer control often requires several types of input commands; this is why this research also offers an integration of multiple control schemes. In addition to the glove other sensors include; voice recognition (through the Microsoft Speech SDK) and movement tracking (using LDR).

All of these features, stated above, are incorporated within the final system algorithm. Very little customization, to the software, is necessary because of its intelligent control elements. Consistency and efficiency are tested through several university students. These are then compared with existing data gained from current hand motion control models.
AN APPROACH TO PERFORM EDGE GRIT-BLASTING USING AN AUTONOMOUS ROBOTIC SYSTEM IN COMPLEX BRIDGE ENVIRONMENTS (12cp)
Hien Quang Huynh - S08-026

Supervisor: Dikai Liu
Assessor: Zenon Chaczko
Major: Computer Systems Engineering

Bridge maintenance by means of grit-blasting is currently being performed manually by workers. This is a dangerous task as workers are exposed to harmful airborne particles (such as lead-based paint or asbestos) and must carry heavy equipment which can generate forces of 100N and above during grit-blasting. In order to minimise the risks and alleviate the workers of heavy burdens the Centre for Autonomous Systems (CAS) is developing an autonomous robotic system for bridge maintenance. During bridge maintenance the blast stream must be kept away from the edges of the surface since the rebound of high velocity grit particles can cause severe damages to robot and other devices.

The objective of this capstone thesis is to design a path and motion planning approach for the removal of paint and rust along the edges of a surface in the complex bridge environment using a 6 DOF manipulator. The determination of edge areas and the orientation of the manipulator corresponding to the individual grit-blasting targets are focused upon in this approach. The proposed approach uses technique such as principle component analysis (PCA), cluster analysis and boundary tracing. Furthermore, this thesis shall allow an operator to visualise the continuous smooth manipulator movements while grit-blasting so as to verify the trajectory of the blast stream.

The proposed approach has been demonstrated successfully by results from both simulation and laboratory experiments. The approach can potentially be applied in other industrial applications where it is crucial to perform precise actions along the edges of a surface such as cleaning and painting.
Each and every society on this earth produces waste that comes in a liquid or solid form. The liquid form is called “wastewater” which discharges from residential, commercial and industrial areas. Wastewater normally contains toxic organic and inorganic compounds which will have irreversible damage on the natural river systems, the aquatic environment and our drinking water supplies. Thus, it is very important that the wastewater is properly treated before being discharged to secure a safe, clean and healthy water environment.

One of the vital wastewater treatment technologies is the use of attached growth systems (biofilm process) which are related to biomass growth on support media. In this report, attached growth systems are discussed in details focusing on supporting media and typical treatment processes of conventional, non-conventional and advanced bioreactors.

The choice of the proper support media for various processes has been the subject of several research articles. Since sponge has been considered as an ideal mobile carrier for active biomass, the specific sponge biofilter was designed and evaluated to treat a primary wastewater treated effluent.

The main objective of this study was to determine the optimal sponge size in terms of removal efficiencies of organic removal (chemical oxygen demand COD and dissolved organic carbon DOC) and nutrient (total nitrogen TN and total phosphorus TP). The laboratory-scale study was conducted with synthetic wastewater using a sponge reactor with diameter of 10cm, height of 30cm and the effective volume of 2L. The results indicated that the 1-cm cube sponge bioreactor under anaerobic condition led to the best performance which removed 34% T-N, 40% T-P, and 55% COD after 27 days of operation.

Further study on other sponge conditions such as sponge type, sponge shape is necessary.
WEB MESSENGER APPLICATION (12cp)
Amish Joshi – S08-031

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

Instant messaging is a simple form of communication through which messages are exchanged between two or more people connected together. Web based messenger is a simple application that requires a user to log in to their designated account in order to communicate with other members that are connected at that time, without having to go through the troubles of downloading the program and then installing it onto the system, before it can be used. This project will be focusing on building an efficient web based messenger application that will allow users to communicate more effectively with the aid of additional user friendly features such as; incorporate audio/visual conversation, document sharing, view message history, select language for message transmission and play external video links in the chat window.

For this project the most suitable software engineering methodology is extreme programming (XP) which is a form of agile software development. The reason for choosing XP is because in this project the requirements are expected to change at a later stage in the project. This could happen due to incorrect implementation of a feature or not able to design a planned feature. The design of the project will be continually improved to keep it right to meet the requirements. The application will be released in small releases that will need to pass all the planned tests before they can be merged to form the system as a whole upon which, further testing will be carried out before its final release.

The result of this project will provide software developers a path to further develop existing web messenger technologies. Also users of web messengers can perform all the functions on the one chat window and not need any other browser window or programs to be running.
MEDICAL HISTORY AND MONITORING SYSTEM (12cp)
Mark Karatovic - S08-123

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

This thesis explores the issues, requirements, and functionality of the standard paper medical records that are in use in and in between medical institutions across the country. In order to speed up the diagnosis of patients, and improve the quality of medical treatment for the community the computerisation of this process is explored.

Current business processes in medical institutions are currently highly proprietary even though they share common needs in what data needs to be stored in patient’s files and how they store their paperwork. The operating environment described has made communication between these entities difficult, and as such each entity needs to compile their own patient records for both internal use and for use by external parties. By computerising and standardising medical paperwork new functionality could be realised by users of the medical system that hasn’t previously been possible. Storage of complete medical records by patient, traceability of medical records to medical professionals, paperless communication between all medical professionals in hospitals, practices, pharmacies, specialists and others are just some of the possibilities. Computerised actors (such as patient sensors) can also make records that other medical professionals may access to track the patients condition.

This will greatly assist doctors and other medical professionals in diagnosing patient conditions based upon their complete medical history, and help eliminate (or reduce) possible human errors in measuring patient data and in written paperwork.
EUNOIA CLOUD: A SOFTWARE TOOL FOR ENABLING HIGHER ORDER INTERACTIVITY, MASS SCALE PEDAGOGY AND PARTICIPATION USING MOBILE DEVICES (12cp)
Paul Kent – S08-124

Supervisor: Richard Raban
Assessor: Zenon Chaczko
Major: Computer Systems Engineering

In a large lecture or seminar environment learning is often a passive process: the presenter speaks while the audience listens. For many young people, who thrive on interactivity, this monological approach to learning is often boring and ineffective. One possible way to enable an active learning environment may be to make use of ubiquitous mobile devices that allow anyone in an audience to interact and participate.

The purpose of this project, which I have titled Eunoia Cloud (meaning Beautiful Thinking Cloud), is to build a prototype of a software application that will allow a presenter to prepare open ended discussible questions and activities that permit the audience to participate in large conferences, seminars or lecture environments. A member of the audience can participate by contributing ideas and providing feedback through their mobile phone web browser. Once such a contribution is made it is displayed immediately on a large screen that is visible to the entire audience, or even remote participants. This can in turn promote further discussion and development of the ideas creating an autocatalytic or contagious effect.

This thesis analyses some of the possible web technologies that can be used to build such an application and includes mobile web browsers worth supporting for future commercial use. A specification that outlines the functionality of this prototype is presented followed by its design and architecture.

The Eunoia Cloud application will be developed using ASP.NET C# on the server side with NHibernate and MS SQL Server 2005 in the backend while making heavy use of JavaScript and AJAX on the client side with the aid of third-party user interface components.

The result of this project is a proof of concept application which will be demonstrated and trialed and which can be further developed into a fully fledged commercial product.
OPTIMIZATION PERFORMANCE OF BUILDING INTEGRATED PHOTOVOLTAIC FOR UTS BUILDING (12cp)
(Daryl) Kin Hoong Khoh - S08-125

Supervisor : Jaffar Madadnia
Assessor : Steven Su
Major: Electrical Engineering

The capstone project had chosen based on United Nations (UN), UTS, IEAust, and the faculty of Engineering & IT commitments to promote sustainable energy in all aspect of human activities. This project was done in collaboration with the subject 49321 Energy Conversion content, my role as a team leader in photovoltaic research group under supervision of Dr. Jaffar Madadnia; the subject coordinator and capstone supervisor. Putting in practice this commitment, my aim is to improve the ecological impact of UTS tower and future planned buildings in Australia.

This sustainability project puts into practice the initiatives committed upon by the Vice-Chancellor in focusing on some of the principles limiting the impact of the University has on the environment. The project involved will be using the active solar energy technique to produce electricity. Further development and improve the photovoltaic module to achieve the best efficient way of using the active solar energy technique.

The project is further investigating, developing and improving on the existing PV cell prototype build by previous semester capstone students. Based on the studies done by Myung Park A08-111, his work was used as a bench mark in this project. Since there are enormous areas to be improved in order to provide a comprehensive sustainable system. This paper will discuss about the proposal, methodology, justification, environmental/social/economic impact, process for building complete with drawing and calculation in different areas.

Final recommendations are made into mesmerizing areas of research which may undertaken by prospective capstone research students interested in pursuing continual research in this field, which may contribute to improve the BIPV system’s performance.
PROTOTYPING A DISTRIBUTED SOIL MOISTURE MONITORING AND IRRIGATION CONTROL SYSTEM (12cp)
Avtar Singh Kohli - S08-036

Supervisor : Steve Murray
Assessor : David Lowe
Major: ICT-Software Engineering

Current solutions to correctly monitor soil moisture include expensive and bulky sensory equipment which are restricted to just one location due to their design. A distributed monitoring solution shall introduce a capability for autonomous systems in some cases, supersede then need for manual surveying. An example application: local councils neighbouring industrial belts would be interested in monitoring liquid toxic waste disposal using buried wireless devices under the soil. Also, an automatic water pump connected to the network could be handy for a farmer to increase soil moisture in his/her absence.

A low cost and low power solution is sought for deployment in the field; an existing solution is Xbee devices which communicate using Zigbee Protocol. Experiments were conducted to investigate essential communication parameters of deploying a wireless device under soil which includes operational range, depth, attenuation sources, electrical characteristics, sampling frequency, antenna orientation, configuration and protocol. Valuable insight into the suitability of the Zigbee protocol based devices [Xbee] was gained by testing these devices for the above parameters, using spectrum analysers, network analysers and antenna scanners.

Xbee devices allow several configuration options, for the project 4 classes of configurations where created: Coordinator, Router, End nodes and Pumps. The hardware setup includes coordinator serially connected to a computer and all other devices wirelessly connected within a valid range of the coordinator. A light sensitive Diode was used to simulate moisture levels which were connected on the end nodes.

An application was developed (using C# on .net framework 3.5) which allows monitoring of Xbee devices (one sample per 5 seconds) and controlling simulated pumps. Features like saving logs to a Database, seeking latest sensor reads and controlling pumps (automatically/manually) were prototyped. A sample web application was created using PHP to exhibit remote network monitoring (http://askohli.net/sensorNet).
FEASIBILITY STUDY OF AN INDIRECT CYCLE ENERGY RECOVERY SYSTEM, IMPLEMENTED IN BUILDING 2 OF THE UNIVERSITY OF TECHNOLOGY, SYDNEY (12cp)
Rudolf Lapan - S08-128

Supervisor : John Dartnall
Assessor : Guang Hong
Major: Mechanical Engineering

This Capstone project investigates a case study of the feasibility of an Indirect Cycle Energy Recovery (ICER) air-conditioning system installed at Building 2 of the University of Technology, Sydney. A report of our findings on the building and an explanation of how an indirect evaporative cooler operates will be covered. The savings on the ICER systems operation and its payback period is analysed.

Address the need to design “green buildings” and how a DICER/ ICER can contribute to the aspects of sustainable design of buildings. Studies have showed time and time again that poor indoor environment quality has led to poor performance of the buildings occupants and worse yet cause poor health. The use of an ICER/DICER in pre-treatment of outside air will boost the indoor environment quality.

It’s important to address these issues as buildings remain in use for many decades. Poor building design and consideration of its greenhouse gas emission/occupants well being will then ultimately increase and its impacts which will last and be felt for a long period of time (Energy Efficiency, BCA Volume 1).
TURBO PRESSURE REGULATOR FEEDBACK CONTROLLER (12cp)
Mike Laverick - S08-129
Supervisor : Peter McLean
Assessor : Steven Su
Major: Electrical Engineering

This project is for the design, implementation, and testing of an Electronic Turbo Pressure Controller (AKA Electronic Boost Controller, EBC) to replace or work in conjunction with the standard regulator system in a motor vehicle. The capstone will explore if this method of control is suitable in a motor sport environment.

The standard method of regulating the turbo pressure in a motor vehicle is by means of cylinder that actuates a turbine bypass valve (Waste gate), by opening this valve the pressure in the outlet can be regulated until an equilibrium is reached. While this method is obviously effective, it is far from optimum. A ‘boost controller’ is necessary if a user wishes to change the steady state boost level from its OEM value.

A successful Electronic Turbo Pressure Controller will need to exceed the boost performance of systems with a manual boost controller fitted. The ECB should overcome the two main performance flaws inherent in using a manual boost controller, these are:

- Boost Response
- Waste gate creep

The project has shown that a correctly tuned Electronic Turbo Pressure Controller will increase boost response, and can eliminate waste gate creep that was previously present. My current research, however, indicates that a feedback controller may be not be suitable for use in motor sports such as drifting. The development of an open loop Electronic Turbo Pressure Controller whereby the open loop map is generated from a closed loop calibration is proving to be a promising alternative.
PROBLEMATIC SOILS AND REDEMPTION TECHNIQUES (6cp)
Thu Minh Le - A09 – 057

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

The urbanisation and the increase of population in metropolitan areas require developing the infrastructures. Engineers have been compelled to construct earth structures, major highways, railways and other types of structures over the problematic deposits.

This capstone project is to identify problematic soils and their possible problems based on literature reviews, and consequently to provide some common ground improvement techniques to improve the soil properties as well as minimise the probability of the risks caused by the soils.

There are various types of problematic soils existing widely over the world. This project concentrates on the most common types of the soils including soft clays, loose sands, expansive soils, collapsible soils and erodible soils. Their engineering behaviour is depending on their composition and structures. Most of problematic soils have relative low shear strength and instability which can damage structures resting on the soil. The possible problems caused by problematic soils include large settlement, structure deformation, ground movement, and liquefaction. The damages not only challenge soil and geotechnical engineers, but also require the high maintenance and repair costs for construction on problematic soils which is in the order of billion dollars.

As a result, this project is also to introduce a number of remediation techniques for each type of the soil. Recently, various soil improvement methods have been developed, and depending on the site characteristics, a suitable technique can be applied to strengthen the soil properties. For example, for soft clays lightweight fill and consolidation can be used to reduce the settlement, and improve slope stability. Furthermore, deep soil mixing can be applied for loose sands to control liquefaction conditions.

Moreover, case studies are also included in this project in order to provide comprehensive illustration for problematic soils, their problems and the improvement methods which were utilised to defeat the problems.
A FIXED AUTOMATION SOLUTION TO THE FIRST GAMBREL TRANSFER IN SHEEP PROCESSING (6cp)
Ross Macpherson - A09-145

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

Many of the manual practices in the meat processing industry are gradually becoming automated. The rate of uptake for automated processes is currently being driven by high labour costs and occupational health and safety issues related to the repetitive nature of process work. The automation of such processes can lead to increases in efficiency, providing significant commercial value for the Australian meat industry.

This project is a continuation of the work undertaken by David Neville for his Capstone project, Automation of First Gambrel Transfer in Meat Processing, which was completed in spring 2008. The project is being conducted by the University of Technology, Sydney (UTS) in conjunction with Meat and Livestock Australia (MLA) and the Australian Meat Processor Corporation, Ltd. (AMPC). Neville’s project outlined a solution for automating the first gambrel transfer for lamb and calf carcasses at the CRF Colac Otway (CRFCO) plant in Victoria, Australia. The outcome of Neville’s project was a final design that is ready for manufacture.

This project details the manufacture, testing and modification of the proposed gambrel in order to validate the design before implementation. The project examines problems with the current design that were uncovered during the testing of a prototype model, and outlines potential design solutions to these problems. Due to issues uncovered during the course of the project that may inhibit the gambrel being implemented at CRFCO, an alternative processing environment is investigated. The project examines the potential for the design to be used at the Castricum Brothers abattoir in Dandenong, Victoria.
AN INVESTIGATION INTO THE CHARACTERISTICS OF 802.11N DRAFT STANDARD (6cp)
Vineetha Menon- A09-139

Supervisor : Kumbesan Sandrasegaran
Assessor : Zenon Chaczko
Major: Telecommunications Engineering

Wireless technologies have become increasingly important as mobility becomes paramount in our society. The IEEE developed the 802.11 set of standards to uniformly define wireless local area network (WLAN) transmission. Towards the end of 2009, a new standard, 802.11n, is set to be released by the IEEE 802.11n Task Group. 802.11n aims to enhance the performance of WLANs through increased data rates, throughput, signal quality, and range rivaling wired Ethernet LAN performance. It is set to replace 802.11g as the primary wireless standard for home and business environments.

Due to the pre-release status of 802.11n standard, limited conclusive testing has been conducted on this draft to assess the improvements and gain a better understanding of the proposed contribution it offers to WLAN technology. Anecdotal evidence exists hinting at degraded performance of 802.11n wireless networks when compared with 802.11g. This Capstone project aims to quantify and validate improvements in 802.11n when compared with the 802.11g standard.

The aim of this project was achieved through an investigation and comparison into specific characteristics of 802.11n draft standard for audio and video streaming over an indoor wireless channel. A set of experiments was planned and conducted using two laptops and two access points in varying conditions to stream audio and video files from a local server. During the streaming download, Wireshark and CommView for WiFi software were used for packet sniffing and analysis. Data rate, average packet size, download times, and malformed packet ratios were computed and collated for each experiment.

The preliminary results show the draft 802.11n standard to be error-prone and unpredictable when compared with the 802.11g standard. Recommendations and conclusions derived from the results of these tests will ultimately help shape further conclusive testing under more ideal conditions.
All deep excavations need support during the construction of buildings and infrastructure and one of the effective systems used for deep excavations is reinforced retaining walls. Reinforced retaining wall systems consist of a retaining wall and an anchor system holding back soil during the excavation. These systems are cost effective and efficient method of shoring excavations and are popular systems of shoring around the world. The correct design of a reinforced retaining wall is vital for the prevention of excavation collapse and consequently the damages associated with adjacent structures and loss of human life.

A common form of a reinforced retaining wall system is the anchored steel sheet pile system which is widely used in Australia. Although this system is very popular and efficient when designed correctly, there are many instances in which anchored walls fail. In the majority of cases, the failures are due to the anchor length not being adequate resulting in an interaction between the anchor and reinforced soil failure zones creating a new failure zone which is not typically considered during design.

The focus of this capstone project is to assess this interaction between the anchor and retained soil for reinforced retaining wall design. The project briefly reviews current literature on design and construction of reinforced retaining walls and the Australian Standard AS4678. Detailed modeling of a case study in Queensland, Australia using the finite element analysis code Plaxis is described and results analysed to assess the anchor and soil interaction. In finite element analysis, anchors with end bearing plates are simulated and measured deformation of the reinforced wall is compared to the numerical predictions. It is shown that the proposed numerical simulation method is a promising tool and can be used by practicing Geotechnical Engineers for anchor reinforced retaining wall design. Finally, recommendations on anchored retaining wall design are provided based on literature review and modeling outcomes.
A SUSTAINABLE ANALYSIS OF THE CITY OF SYDNEY’S TRANSPORT INITIATIVES AS PUT FORWARD IN THE 2030 SUSTAINABLE SYDNEY PLAN (6cp)
Danielle Nesbitt - A09-073

Supervisor: Ken Halstead
Assessor: Alan Brady
Major: Civil Engineering

This paper reviews and analyses an array of upcoming transport initiatives put forward by the City of Sydney using a 3 way sustainability base line. The paper identifies the sustainable model to be used, provides a background into why it is necessary to explore these options in this manner and analyses the transport options, as well as looks at the starting point for future solutions.

This paper is highly relevant especially in the engineering world as it highlights the importance of project sustainability for future generations. In the current global environment, it is vital for engineers, as deliverers of future development to understand the concept of sustainability, value its importance and acknowledge its presence in the development cycle.

The sustainable model given in this paper relies on congruence between economic, environment and social goals to achieve a sustainable development. By aligning these 3 outcomes, engineers will be able to achieve the ideals of sustainability thereby: ensuring to meet the needs of the present without compromising the ability of future generations to meet their own needs.

As a result it can be determined it is necessary to consider 3 way sustainability in the very early planning stages of any transport decision-making process. By giving consideration early, potentially detrimental projects can be rejected early. In looking forward, there are long ways to go to achieve sustainable transport solutions; however by looking to our global neighbours, perhaps the answer isn’t that far-off.
Problematic soils could be defined as loose sand, soft clays, expansive soils and collapsible soils. High compressibility, low bearing capacity, creeps and high shrinks potential affect construction time and costs of projects. These issues can be overcome by using the right method to treat the ground conditions. Ground treatment methods should consider effect of soil type particularly grain size distribution to indentify the appropriate method for soils conditions.

Grouting techniques can be used to solve problems in dam and tunnel construction. There are various categories of grouting techniques such as permeation grouting, compaction grouting, chemical grouting and fracture grouting. The use of these grouting can improve the bearing capacity, reduce settlement, reduce permeability and improve strength of soil. In addition, grout curtain below dams and filling the void between the lining and rock face in tunnel works are other applications. Most popular grouting construction techniques are Tube Manchette method and upstaging and downstaging injection of the grout into the rock or soil. Each grouting method also has its own specifications to treat soil and rock. The grouting design usually includes the rate of injection, degree of groutability, flow through soil voids and holes injection spacing. Some case studies are discussed in this project related to permeation, compaction, chemical and fracture grouting in Australia and overseas.

Grouting techniques are important in infrastructure construction such as tunnels, dams, roads and bridges. With the demand for higher capacity, and improved transport and infrastructure systems in large cities, where land is scarce, tunnels are becoming more essential. Therefore, the current development in grouting which provides geotechnical contractors with comparative information is critically reviewed. Geotechnical practitioners can untilise this summary in the design and construction of various projects.
INSTRUMENTATION OF THE DATA ACQUISITION SYSTEM IMPLEMENTED ON DUAL INDIRECT CYCLE ENERGY RECOVERY SYSTEM AT THE UNIVERSITY OF TECHNOLOGY, SYDNEY (12cp)
Tien Hong Nhan - S08-058

Supervisor: John Dartnall
Assessor: Guang Hong
Major: Mechanical and Mechatronic Engineering

The experience of selecting and fitting instruments, organizing data acquisition and commissioning an evaporative air-cooling system (also with heat recovery) is detailed in this thesis.

The “evaporative air-cooling System” described is termed a DICER, being an acronym for Dual Indirect Cycle Energy Recovery. Summer air-cooling by evaporation of water and winter air heating by the use of energy recovery from exhaust air are available with the DICER. A polymer plate heat exchanger is the core of the air-handling unit and water is used as a refrigerant. Because of the low power consumption of evaporative air-coolers corresponds to a “high” Coefficient of Performance.

Major emphasis is placed upon the installation and testing of the data acquisition system (DAQ). This system allows various measurements to be recorded and displayed on the UTS server and thus acting as a remote lab for air conditioning subjects. From this remote lab, students are able to conduct experiments on the DICER system.
INVESTIGATION INTO THE LIFE CYCLE OF A BULK MATERIALS HANDLING PULLEY WITH RESPECT TO THE PERCEIVED INCREASE IN THE AMOUNT OF FAILURES (6cp)
Malcolm Peattie - A09-087

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

In recent years the conveying systems within Australia have become larger, faster with more capacity as companies maximise their production rates to meet the demand. These significant increases in production rates have been driven by the demand for Australian natural resources. A pulley failure can bring an entire mining operation to a complete stop.

There is an emerging view within the clients and the professional engineers that there is an increase in the number of pulley failures that have occurred in the recent years compared to years past. Pulleys are a major component of conveying system and as materials handling system designers we are responsible for the pulley specification. The specification is used by the pulley suppliers to complete design for pulley manufacture.

The project is to investigate examples of catastrophic failures of bulk materials handling pulleys and to consider why they are occurring. There are numerous elements within the pulley which includes design, manufacture and the effects of operations and maintenance that can all cause a pulley failure. If any one of these elements fails to meet the required duty of the conveying system the pulley could be prone to failure.

The results show that the majority of the failures investigated have been as the result of design and manufacturing errors.

Results of the investigation and report have the potential to identify design improvements within the life cycle. The potential design improvements will be incorporated into future pulley design specifications produced by my employer.
GRAPHICAL USER INTERFACE DESIGN FOR AN AUTONOMOUS ROBOTIC STEEL BRIDGE MAINTANANCE SYSTEM (12cp)
Anusha Premachandra - S08-067

Supervisor : Dikai Liu
Assessor : Sarath Kodagoda
Major: Telecommunications Engineering

The success, usability and effectiveness of graphical user interface design (GUI) depend on the interaction with intended system users and their involvement throughout the planning, design and development process. With many graphical user interfaces considering usability late in the development process, we are often left with systems based on the developer's mistaken assessment of 'correct usage'. This leads to inconsistency and instability of the interface, where tasks are met with difficulty and expectations and performance fall short.

What is proposed is the design of a graphical user interface for an autonomous robotic bridge maintenance system that employs the philosophy of User-Centered Design in the human robot interaction (HRI). The operation of bridge maintenance through grit blasting is at present a manual task performed by humans. It is a hazardous exercise from harmful partial inhalation, lethal high pressure grit blast streams and human errors that come from the highly laborious process, endangering the lives of maintenance operators and damage to bridge surfaces. The autonomous robotic system aims to solve the health and safety issues of steel bridge maintenance by removing maintenance personal from the physical task of grit blasting. Their technical skills, understanding and experience are instead used in the HRI.

The GUI design process is segmented into Needs Analysis, Use Case Scenarios, Paper Prototype design and Usage Testing. Each phase involves an iterative process of user feedback prototyping and testing, shaping the interface at each increment. This is the foundation of user centered design and is the basis for which the GUI design methodology is founded.

The user-centered design approach has proven successful in establishing a fully realisable and robust GUI for the central task of Blast Target Classification. The progressive developments of task specific Exploration and Motion Validation, Blast Plan Verification and Path determination are also detailed, with plans on further work to develop the designs into usable and accepted prototypes.
CALCULATION OF LONG-TERM DEFLECTIONS IN CONCRETE SLABS USING FINITE ELEMENT METHODS (6cp)
Adam Price - A09-090

Supervisor : Shami Nejadi
Assessor : Anne Gardener
Major: Civil Engineering

The deflection of concrete slabs involves numerous factors including the geometric properties, concrete properties and load history. Long-term deflections are the result of a decrease in stiffness over time due to concrete shrinkage and creep effects. The accurate calculation of long-term deflections in concrete slabs is very important as it is often the governing design criteria to determine the slab thickness to meet the required serviceability limit state. Serviceability limit state places a limit on the maximum deflection and cracking allowed in the slab. If the structure does not meet the serviceability state it may be deemed not fit for intended purpose.

Finite element programs are useful to analyse the behaviour of concrete slabs most notably two way slab systems. However, they lack the current functionality to accurately model long term deflections due to the complexity of factors involved. Currently there is no industry accepted method to calculate long-term deflections in concrete slabs using finite element software. AS 3600 Concrete Structures makes no mention and provides no guidelines for the analysis of concrete slab deflections using finite element software. Without industry guidelines there is an increased risk of structures failing to meet the required serviceability limit state using finite element methods.

The scope of this study is to demonstrate the load factors, effective curvature ratio and cracked element analysis methods to estimate total long-term deflections of concrete slabs in the finite element program RAM Concept. The refined calculation program RAPT has been used to compare the finite element methods with. The long-term deflection results have been compared to experimental results of concrete slabs that have been subjected to sustained service loads. (Gilbert & Guo, 2002, p. 110) (Gilbert, 2008b, p. 15) The advantages and disadvantages of each method have been discussed.
THE EFFECTS OF BEARING AREA ON FIBRE REINFORCED POLYMER CONCRETE (6cp)
Rhesa Reinaldy - A09-093

Supervisor: Ravi Sri Ravindrarajah
Assessor: Shami Nejadi
Major: Civil Engineering

This project is continuation of Craig Scheffers’ project from previous semester which is looking at the bearing strength of concrete in fibre reinforced polymer confinement. Fibre reinforced polymer jacket can be use to strengthen concrete core. The fibre reinforced polymer jacket can increase the strength way above the strength of the concrete alone by increasing energy absorption. Fibre reinforced polymer can be a great solution as it is lightweight, high strength and the ability to resist harsh environment.

Bearing Strength of concrete is important design factor that can be use in designing footing for foundation. According to previous research the bearing strength of the concrete dependent on the bearing ratio which is the area of the concrete surface to the bearing area. The increase of bearing strength is linearly dependent towards the increase of bearing ratio.

This project will focus on finding the influence of bearing shapes and bearing areas towards the bearing strength of the concrete in both unconfined concrete and concrete with carbon fibre reinforced polymer jacket. Circular bearing plate is going to be used for the testing of the bearing strength with three different bearing areas and will be compared with previous results. The difference in bearing strength will be compared and crack and failure pattern will be observed. Literature review will also be done to see some other effects that will be affecting the bearing strength of the concrete in real applications such as looking at the effects of the sustained load on the bearing strength. The increase in bearing strength that carbon fibre reinforced polymer jacket provided can be interest and benefits towards real life applications.
AN INDUSTRIAL EMBEDDED FUZZY LOGIC CONTROLLER – DESIGN AND IMPLEMENTATION (12cp)
Christopher Ross - S08-071

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

Fuzzy logic is a branch of control theory that uses simple logic based rules to determine an effective course of action. As opposed to traditional theories that require complex mathematical models, fuzzy logic can be used to control a complex system without detailed knowledge of the system’s dynamics.

The industrial automation sector has many complex processes, often demanding fast and accurate control of variables such as speed, positioning, pressure and temperature. Despite the benefits of fuzzy logic, adoption by this industry has been limited due to cost, complexity and hardware availability.

The main objective of this capstone is to develop a low cost and easy to use microcontroller system capable of using fuzzy logic to control a standard industrial process. It requires the ability to interface with current industrial hardware and be suitable for the harsh industrial environment. The key outcome of this project is to have a functional prototype and implement fuzzy logic control of an unstable system.

The project plan was shaped around the product development lifecycle, involving identifying requirements, selecting a system architecture, detailed design, and prototyping. Software was developed to implement a fuzzy logic controller running within an embedded real-time operating system, using a Windows application as a graphical user interface.

The prototype was built around a 32-bit Freescale ColdFire microcontroller, selected for price, performance and connectivity options. It is able to communicate with other industrial devices and computers through Ethernet, RS-232 and EIA-485 interfaces. Fuzzy logic control functions are performed by monitoring and controlling high-resolution analog voltage channels.

A revolving pendulum machine created a challenging test environment, consisting of a free-swinging pendulum attached to a linearly driven cart. The prototype was successfully able to balance the pendulum in an inverted position for an extended period of time, demonstrating the controller’s ability to control a complex and unstable system.
FORMULA SAE – PADDLE SHIFT GEARBOX SYSTEM (12cp)
Anson Sequeira - S08-141

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

Formula SAE (FSAE) is an international design competition run by the Society of Automotive Engineers which requires university students to conceive, design, fabricate and compete with small, formula-style, open-wheeled race cars.

The FSAE competition consists of several performance based tests such as acceleration, endurance, autocross and skidpad events. One way to reduce lap times is by implementing a mechanism/system that enables the driver to shift quickly between gears, thereby reducing power interruption to the driving wheels between shifts. A paddle shift operated gearbox would enable the driver and team to have quick and more precise gear shifts thus producing quicker lap times.

This project investigates gear changing mechanisms from FSAE entries, leading motorsport series and reference literature on pneumatics, gearbox, clutch and electromechanical control systems. Previous UTS FSAE entries featured gearbox systems with servo motors and electronic solenoids which were heavy designs and had the tendency to jam between shifts.

A proposal was submitted and approved to design and build a lightweight pneumatic operated paddle shift system. Components were to be supplied by team sponsors.

Due to delays in procurement of several components on the 2009/10 entry, limited testing was simulated on an older UTS FSAE car. The outcome of this project entails a detail design analysis, technical drawings and schematics of the paddle shift system for implementation on the 2009/10 UTS FSAE entry.
DESIGN FABRICATION AND MEASUREMENT OF SMALL ANTENNA SYSTEMS FOR MIMO AND DIVERSITY APPLICATIONS (12cp)
Kenneth Smart - S08-143

Supervisor: Tim Aubrey
Assessor: Ananda Mohan Sanagavarapu
Major: Innovation Engineering

Improving the performance of wireless communication systems such as those employed in MIMO or wireless censor networks is often approached from the point of view of information/network theory where the solution to performance issues usually involves a better coding scheme. The objective of this Capstone project will be to look at the measurement of antenna performance, an integral and important element in a communication system.

Traditionally, the measurement of antenna performance often required significant capital outlay on anechoic test chambers and associated test equipment. A novel device manufactured by Canadian company Emscan that can perform some of these measurements in a bench-top environment may offer a solution. A study was undertaken into the performance of the Emscan near-field scanner. Comparisons with measurements taken in anechoic chamber and theoretical models using CST microwave studio are used in the evaluation of the scanner as well as measurements of repeatability and accuracy.

A trapezoidal log periodic antenna was manufactured for use in wireless communication systems employing multiple antenna elements. Small antenna systems employing multiple antenna elements are affected by mutual coupling as well as near-field scatterers especially if these antennas are embedded in a device. This can adversely affect polarization purity, being able to quickly and accurately measure these effects will aid in the design and verification of antenna systems. Using the output from the Emscan an attempt is made to evaluate the modal excitation of the antenna.
Homogeneous Charge Compression Ignition (HCCI) is an advanced combustion mode that has attracted a lot of research because of its potential for high efficiency and low levels of emissions. There is currently PhD student research being conducted at UTS by experimentally investigating a method of HCCI called Auto Ignition (AI). The AI is achieved through internal Exhaust Gas Recirculation (ERG) and has been applied to a small two-stroke engine. To aid this experimental investigation a numerical model has been developed using a commercial CFD code.

The aim of this project was to further develop the numerical model for the investigation into AI combustion by verifying and applying the model. The model used in this project is bound by the physical geometry of the two-stroke engine and includes the intake, exhaust, crankcase, and cylinder. The simulation was setup to find numerical solutions for the fluid flow, heat transfer, and mass composition within the defined volumes of the model. The numerical simulation was run using the Re-Normalised Group (RNG) k–epsilon turbulence model and the finite volume method of discretisation.

The development of the model included the examination and improvement of the Courant–Friedrichs–Lewy (CFL) condition by refining the time step increment and increasing the quality of the grid structure. Other aspects of development included updating the intake geometry and developing methodologies for defining initial conditions where experimental data is not available. With these improvements made to the model, simulations were run using a control condition of 70% exhaust restriction at 3000 rpm. This condition was run with variations of the throttle percentage to examine the effects on the scavenging process and the pre combustion distribution of the fuel mixture and temperature that is integral to the investigation of the AI process.
With the rapid increase in development for digital audio broadcasting in Australia, it has become necessary to design circuitry that can receive, process and transmit incoming digital audio signals with minimal delay, loss of quality and cost.

The AES-3id is the standardised digital audio signal that is used in professional audio equipment. An application of this technology is to receive a digital audio signal in its AES-3id format with any given sampling rate and convert this sampling rate to 48kHz. This particular sampling rate is chosen as the industry standard because the human ear is only able to distinguish between frequencies up to 20kHz and Nyquist’s Theorem states that a signal must be sampled at twice the rate to prevent the effects of aliasing. 48kHz is slightly over double and is chosen because of its convenience to other signals used which are either sampled at a multiple or divisor of this rate.

My objective was to implement this concept using Altera’s 256 ball-grid arrayed field programmable gate array logic device (FBGA). The board is built for professional use and houses necessary components including a power supply which supplies polygon plane voltages, digital audio interface receiver and transmitter, external RAM, FRAM, JTAG and ASP interfaces. Everything was designed using surface mount technology (SMT) except for the power supply.

This relied upon the schematic and PCB design using Protel 98. It is a 6 layer board that has been built and tested electrically with the potential for software development which would provide the functionality it needs to convert the sampling rate to 48kHz.

The theoretical analysis covers the mathematical design of the digital audio resampler using polyphase filtering techniques used in multirate systems. The report details the complete professional design process and dwells upon the future enhancement of software implementation.
UNDERFLOOR AIR DISTRIBUTION – (6cp)
Nagib Tadros - A09-101

Supervisor: John Dartnall
Assessor: Jafar Madadnia
Major: Mechanical Engineering

Modern day office environments have high expectations with regard to occupant comfort, low energy consumption and improved indoor environment air quality. In particular, due to higher equipment loads (i.e. Computers, printers, etc), air conditioning heating or cooling loads are high. In addition, legislative requirements as well as financial pressures are pushing for lower energy consumption. However, employees and employers require better air quality from air conditioning systems as well as individual control of thermal comfort. Studies strongly suggest that this improves employee productivity and health.

Unfortunately current conventional HVAC systems cannot meet the expectations of the modern day office with respect to low energy consumption, thermal comfort and indoor air quality. In recent years, the use of raised access flooring systems for office environments has become much more frequent. Power and data cables housed in the floor cavity can easily be accessed and modified to accommodate change in the occupancy and use of the space. This cavity can also be used as a supply air plenum, which allows introduction of conditioned air through the floor. Unfortunately, most load calculation procedures and programs in use today are based upon conventional systems and do not afford the designer the tools necessary to properly assess the performance and economics of underfloor air distribution systems.

This document discusses opportunities for improving space ventilation, reducing energy and reducing installation and operating costs that are inherent to underfloor air distribution systems. In addition, procedural differences in the determination of equipment requirements and operational efficiencies are identified and adjustments are suggested that allow application of load data obtained by existing methods to underfloor systems.
The television industry has implemented digital broadcasting to improve the picture quality of television. Viewers can experience real live events on their television that has the ability to receive High Definition Television (HDTV). As the resolution of HDTV is expanding, the industry demands that video compression and decompression devices be improved in order to effectively transmit HDTV. The industry requires the devices to be compatible with the existing infrastructure of television studios that use a bandwidth of 270 Mbits/s for serial data transmission.

There is a hypothesis that JPEG 2000 has the ability to improve HDTV compression and decompression over the current MPEG that is widely used in television studios. JPEG 2000 uses a lossless compression technique as comparing to a lossy compression technique of MPEG. In addition JPEG 2000 can also ease the difficulty of television editing. It compresses each frame of motion pictures separately from others of the same sequence.

The purpose of this project is to investigate the ability of JPEG 2000 compression and decompression. This is conducted by designing a print circuit board (PCB) and the embedded software for JPEG 2000 compression/decompression devices. The PCB is a sub board that is composed of an off-the-shelf silicon chip, called ADV212 that performs JPEG 2000 and other electronic components. As well the PCB has a High Speed Mezzanine Card (HSMC) connector to be attached to an Arria GX development kit that contains a Field Programmable Gate Array (FPGA). The PCB is designed with software called Protel 98.

The PCB has successfully been manufactured and assembled with a pick-and-place machine. In order to setup this device’s hardware configuration, firmware is required and embedded in the FPGA. The FPGA has the ability to communicate with other electronic devices on the PCB via Serial Peripheral Interface (SPI). The FPGA is programmed in AHDL (Altera Hardware Description Language) by software called Quartus II. As a result of having firmware in the FPGA, the ADV212s can compress HDTV format to a 270 Mbits/s serial data with JPEG200 technology and vice versa for decompression.
FEASIBILITY OF A DUAL INDIRECT CYCLE ENERGY RECOVERY SYSTEM IN A COMMERCIAL BUILDING COMPLEX – TOP RYDE SHOPPING CENTRE
Quang Thanh Tran – S08-148

Supervisor: John Dartnall
Assessor: Guang Hong
Major: Mechanical Engineering

Energy efficiency has been a key issue of society and a significant topic for energy engineers and scientists. Especially, in a modern society where human’s demands on air conditioning use has lead to climate change and greenhouse gas effect. The use of a dual indirect energy recovery system (DICER) in pre-treatment of outside can reduce power consumption of the building in terms of mechanical services.

This capstone assesses the Top Ryde Shopping Centre. The shopping centre has all features such as cinema, mall, food court, commercial offices, residential apartment and other various purposes of use where the DICER shows significant savings on running cost and energy efficiency as well as the quantity of outside air required by Australian Standard 1668 for the cinema and alike. The Woolworth’s plantroom will be the focus of the feasibility of a Dicer being installed in the shopping centre. The success of the Dicer reducing energy and cost savings can then be replicated to other plantrooms of the shopping centre.

An introduction of Australian Standard 2913 – 2000 “Evaporative Air Conditioning equipments” sets out the minimum requirements for evaporative cooling equipments. This is used as the base of calculation of fundamental parameters of the DICER system such as evaporative efficiency, airflow, sound level and electricity consumption.

Cost benefit analysis is estimated. The results have shown significant savings on energy and cost whilst complying with the Building Code of Australia and especially Section J “Energy Efficiency” which is a new section which has been added in recent years.
The Maze Rover Enhancements project was based upon Dr Peter McLean’s Maze Rover robot, an educational tool used to assist UTS students to learn about embedded systems design and programming, signal processing and control systems. The Enhancements refers to the implementation of two key changes: the inclusion of a networking interface (Ethernet and/or 802.11b/g Wireless LAN) and the use of a Field Programmable Gate Array (FPGA) as the primary logic device. The ultimate design goal was a system that students could access via the internet from home, program it, and drive it around the classroom using video streamed from an attached camera to navigate. Although the necessary firmware and software was not able to be implemented with the time and resources available, the hardware designed is perfectly capable of meeting this goal.

An FPGA was selected to fill the role of host controller for many reasons, the most important of which come down to:

1. They’re supremely flexible and scalable.
2. They’re the future of embedded systems – in time, they will replace microcontrollers. Engineering students should become familiar with them now.

802.11b/g wireless networking was selected because it is a global standard for reliable high bandwidth wireless data transport; Ethernet is the parallel hardwired networking standard.

Three printed circuit boards were designed to capture these requirements. The motherboard is an almost-direct replacement for the Maze Rover motherboard; it is the same size and has mounting holes in the same positions, the only major difference is that the majority of the logic operates at 3.3V. As a consequence, a single IC had to be changed on the Maze Rover motor interface board for full compatibility with the MRE motherboard. Two daughterboards were designed with networking capabilities, one with 10/100 Ethernet and the other with an 802.11b/g module from Lantronix. The daughterboards are mutually exclusive; only one can be used at any given time. Both boards provide identical interfaces from the perspective of the FPGA – an Ethernet Media Independent Interface (MII) for networking and two UART’s (with hardware handshaking).

Apart from getting the boards delivered, the biggest challenges encountered were the embedded RTOS provided by the FPGA design software vendor (extremely buggy, and ultimately discarded), and getting the FPGA mounted onto the board - 676 pin BGA packages are not friendly for hand soldering! Paradoxically, the biggest win was the FPGA design software; Altium Designer is a truly amazing package, integrating design tools for circuit schematic, PCB layout, FPGA logic and the firmware to run on the processor(s) implemented in the FPGA fabric. While the software does have its flaws (primarily the inadequately tested RTOS), they are outweighed by the vision behind the integration between the tools.
FOUNDATION TREATMENT AND EMBANKMENT CONSTRUCTION ON SOFT SOIL, WITH A FOCUS ON THE BRIDGE APPROACHES OF THE COOPERNOOK TO HERONS CREEK PACIFIC HIGHWAY UPGRADE (6cp)
Scott Tyrrell - A09-107

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

Soft soils present significant problems when building major structures, rail embankments and road foundations. Excessive, uneven, and prolonged settlement as well as lateral displacement are issues that must be considered and dealt with. To combat these problems, a number of specific methods can be used to control or reduce their effects; these are known as Foundation Treatment.

The purpose of this report is to investigate and critically analyse the foundation treatment and embankment construction methods implemented on the Coopernook to Herons Creek Pacific Highway Upgrade on the New South Wales Mid North Coast, with the main focus being on the embankments built on soft soil flood plains, which form the approaches to two major bridges.

A detailed literature review has been carried out to provide an in-depth overview of the many foundation treatment and embankment construction methods available today. Design Reports and Monitoring Reports from the Coopernook to Herons Creek Pacific Highway Upgrade have been analysed, and a case study produced, which critically analyses the construction methods implemented as part of the highway upgrade. This case study also includes documented site visits performed by the author. Finally, a review of the construction methods implemented on site has been prepared and the success, or failure, of these methods documented and possible alternate methods identified.

This report provides a detailed investigation into foundation treatment and embankment construction methods currently being implemented on a major civil infrastructure project in Australia. As geotechnical aspects of projects have a relatively high degree of uncertainty, this report will act to shed light on the reliability of some current industry practices and assumptions. Specifically, the assumptions and decisions made during the site investigation and design phase on the Coopernook to Herons Creek Pacific Highway Upgrade can be critically reviewed and justified, or otherwise.
Ground improvement has become increasingly popular as a cost effective alternative to constructing soil foundations. Various ground improvement techniques are available to accommodate site conditions and ground properties. Dynamic Compaction is a ground improvement technique, which improves the ground by controlled high energy tamping and its effects vary with the energy input and soil properties, most effective for loose granular soils.

This project aims to provide a conjunction of ideas in dynamic compaction based on authors’ experiences and industrial records. The information that is available on dynamic compaction comes mainly from ground compaction methods, which is suitable for the understanding of practical measures but it does not state the reasoning behind the procedures.

The objective of this paper is to describe the design and construction stages of dynamic compaction, and a comparison of these stages is provided with the case studies documented. Dynamic compaction design parameters must be considered to obtain an effective densification of the soil. The parameters include soil classification, degree of saturation, permeability and length of drainage path. By producing a clear design program, reduction on energy dissipation, and increment on soil dissipation, will be achieved at the construction stage.

During the construction stage of dynamic compaction, site investigation is found to be an important preliminary process. Throughout the literature review, it was found that the most challenging matter, during construction is the quantification of the energy applied on to the soil. Suggestions of solutions are documented to acquire the required densification.

A comparison of the processes used in various case studies obtained from Austress Menard Pty Ltd is discussed in the paper. The processes described in the literature documents are discussed with conclusions drawn on the effectiveness of the compaction process and the current processes used.
WIRELESS TECHNOLOGY FOR A NON-INVASIVE BIOMEDICAL DEVICE (12cp)
Jerome Villalon Jr - S08-150

Supervisor: Hung Nguyen
Assessor: Zenon Chaczko
Major: ICT (Computer Systems) Engineering

In the biomedical world of monitoring, there is a strong need to implement wireless systems not only to ensure the correct propagation of data from one source to its destination but to guarantee a peace of mind to the end users. The study was initiated to improve the data transmission accuracy and integrity of the unidirectional wireless system for a non-invasive hypoglycaemia overnight alarm system - AiMedics’ HypoMon. Beyond the convenience, the wireless aspect of the system seeks to prevent the disruption of the person’s normal sleeping habits allowing them to have a night’s rest without disturbance caused by 2 hourly finger prick BG testing.

A unique problem to the HypoMon system is its overnight use. Subjection of the transmitter radio to orientations that break the line-of-sight simultaneously increases the Specific Absorption Rate (SAR) and results in an impediment of data received. A high Radio Frequency (RF), 2.4 GHz, was selected deeming the frequency’s susceptibility to obstacles compensated by prompt re-transmissions. This incorporation of a bi-directional transmission system seeks also to improve the transmission Bit-Error Rate (BER).

This study adopted a systems approach including; an analysis into the user requirements, feasibility study of current wireless technologies, design & implementation of a prototype and quantitative system testing. The prototype design & implementation includes; a digital patient simulator to generate patient data and event-driven applications & embedded firmware to handle the transmitter & receiver sub-system functionality, all which conformed to a simple peer-to-peer communications protocol.

Quantitative testing has successfully validated the implementation of a 2.4 GHz bi-directional wireless system for the current HypoMon system, with improvement of transmission BER and dealing with SAR issues. It is recommended that the HypoMon and similar systems to utilise the 2.4 GHz wireless technology and associated protocol be implemented in their future designs.
Aircraft and bicycle designers have, for many years, proposed designs that they have been unable to build due to the non-existence of suitable construction materials. Carbon Fiber (CF) has not only aided designers, but also engineers in these industries, by allowing them to produce items that exceed expectations in terms of strength and weight, whilst also meeting aesthetical design requirements. New aircraft from both Airbus and Boeing have incorporated CF composites in their designs producing a new generation of commercial aircraft. While the Airbus A380 has incorporated fiberglass into its fuselage skin, the proposed A350 uses CF composites for a majority of the fuselage and wing construction.

The extensive use of CF presents questions as to what it can be used for at the end of the product lifecycle. In the past disused CF has been disposed of in landfill or incinerated. Due to the toxins released through incineration, this method can have adverse effects on the environment. Other disposal methods in practice include a form of recycling where CF is milled or chopped for use in molding applications.

At present there are multiple companies and organisations conducting detailed research into the further development of CF recycling. Two of these companies include the United States (U.S) based Adherent Technologies and United Kingdom (U.K) based Milled Carbon. Both these companies are members of the Aircraft Fleet Recycling Association (AFRA) and are researching methods of reclaiming CF for reuse as opposed to milling or chopping. This will ensure the full value of advanced CF composites used in aviation are not simply wasted in landfill or storage once aircraft are retired from service.

Adherent Technologies recycling process is a low temperature, catalytic conversion process used to separate the polymer matrix and the fiber. Other materials in the composite like fillers and metals are also removed during this recycling process. Experimentation by Adherent Technologies has shown, using Scanning Electron Microscopy (SEM) images, that once the fiber has been separated there is visually no residual resin remaining. Mechanical testing has shown reductions in tensile strength of 8-9%.

While CF recycling can produce fiber that has similar mechanical properties to virgin fiber, using reclaimed CF for structural aviation applications would require the use of more material to achieve the same strength. This would result in heavier aircraft and decreases in fuel efficiency. However reclaimed CF can be used in non-structural applications as a replacement for aluminum, fiberglass and steel. This will provide economic and environmental benefits because of the lower purchase costs and the reduced levels of energy required in its production.
SYDNEY RAIL CAPACITY STUDY (6cp)
Fabian Watson - A09-114

Supervisor : Ken Halstead  
Assessor : Alan Brady  
Major: Civil Engineering

The CBD Metro is the latest addition to a string of NSW Government transport proposals, its announcement coinciding with the dumping of a number of other transport proposals. It appears that in the eyes of the Government, metro is the future for Sydney, invalidating any future extensions to light rail and heavy rail. But its priority and design has been questioned by many transport experts, citing the complexity, capacity constraints and reliability issues of the existing CityRail network.

This Capstone project, titled 'Sydney Rail Capacity Study', investigates the capacity and infrastructure needs of the existing CityRail network, in order to identify infrastructure priorities and provide comment about various recent rail proposals. The document commences with a brief discussion on capacity of different transport modes, to put the metro mode in perspective with other modes. The track and rolling stock of the existing CityRail network is explored in detail, to uncover capacity constraints. Particular attention is paid to the inner city area, which contains the most significant capacity constraints. It is concluded that feasibility studies of future rail projects must include aims to remove capacity bottlenecks and simplify operations of the CityRail network where appropriate.

A number of recent metro and CityRail projects are discussed and compared in terms of their ability to improve CBD capacity and simplify the CityRail network. With CityRail patronage rising and many lines approaching capacity, a prioritised list of possible infrastructure proposals is developed. It is concluded that the current CBD metro project is ineffective in providing capacity where it is most urgently required, and ineffective in aiding improvement to the CityRail network. It is also concluded that the previously proposed Metropolitan Rail Expansion Programme is more effective in improving rail capacity and should receive the highest priority.
EVALUATING THE VIABILITY OF UTILISING PYROLYSIS AS A MEANS TO CONVERT BIOMASS INTO CHAR TO SEQUESTER GREENHOUSE GAS EMISSIONS IN AUSTRALIA (6cp)
Panida Wongpaibool - A09-163

Supervisor: David Eager
Assessor: Ken Halstead
Major: Civil Engineering

The release of greenhouse gas emissions into the atmosphere has proven to be problematic on a global scale. Specifically in Australia, climate change has resulted in changing weather patterns and adverse affects on the natural ecosystem. To reduce the possibility of further damage, various methods and applications for reducing and sequestering greenhouse gas emissions have been devised. In 2007, Australia ratified the Kyoto Protocol and consequently a Carbon Pollution Reduction Scheme is to be phased in by the year 2011. This commitment to reduce carbon pollution may entail the adoption of different methods to reduce greenhouse gas emissions.

This project focuses on utilising pyrolysis technology as a means to reduce greenhouse gas emissions, specifically methane (CH₄) and nitrous oxide (N₂O). Pyrolysis is the process of converting organic matter into charcoal, gases and oils. In this context pyrolysis is proposed to be used to convert waste biomass into biochar, an inert form of carbon to be sequestered. Organic wastes, both municipal and agricultural have commonly been a large source of greenhouse gas emissions. Converting these wastes into biochar will enable them to be stored in soils which will potentially provide a long term carbon sink.

Research of carbon rich Amazonian soils has shown that increasing carbon content in soils has the potential to improve soil quality, leading to increased agricultural yields. This project will discuss if this is possible for Australia and how Australia stands to benefit from increasing agricultural yields and sequestering carbon.

In addition, this project will explore possible proposals for commercial scale conversion of biomass to biochar and the implications for Australia if this method of waste management were to be successfully adopted.