ABSTRACTS

CAPSTONE PROJECT PRESENTATIONS

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THE USE OF DISTRIBUTED INFORMATION MANAGEMENT TECHNIQUES FOR THE SELF-HEALING, SELF-MANAGEMENT OF INDUSTRIAL GRADE NETWORKS, AND THE APPLICATION FOR AN ARC RESEARCH GRANT IN THE SAME AREA (12 cp)
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Supervisor : Robin Braun
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Major: ICT Engineering (Telecommunications)

For industrial-grade computer networks, high performance and reliability requirements place an additional element of mission criticality on the data that is being transmitted than conventional office networks. SNMP (Simple Network Management Protocol) has commonly been used to monitor and control the activities of devices within an industrial network, however the central server(s) used to store MIB (Management Information Base) variables along with its associated linkage are all easily susceptible to failure, leaving the network entirely unmanaged. Redundant backup servers can be utilised in the event of a failure, however purchasing and maintaining these servers can be prohibitively costly.

To determine a solution to this problem, Prof. Robin Braun and myself had examined the characteristics of SNMP-managed networks and how potential incidents within these networks can cause performance bottlenecks that are unacceptable in industrial settings. Alternatives to centralised forms of network management were then discussed to eliminate the single point of failure associated with SNMP, including networks that currently utilise self-managing, self-healing techniques and the concepts of AI-controlled software “agents” with pre-programmed management rules.

As a result of this research, it has been suggested that an implementation of DAIM (Distributed Active Information Model) may be used for this purpose. DAIM is a management scheme proposed by Dr. Robin Braun and Dr. Frank Chiang which utilises intelligent software agents for the purpose of monitoring its surroundings and setting MIB variables as necessary. This would effectively remove the performance and reliability issues associated with having a centralised server overseeing all management of the network’s operations.

The report contains the details of the proposed network solution in addition to rules that have been created to govern the behaviour of the agents, directions for future simulations that may be conducted, and the 10-page ARC linkage grant application that will be used in the 2011 submission period to apply for additional research funding.
MEASURING OPERATIONS WITHIN CIVIL ENGINEERING (6cp)
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Supervisor : Peter Pastars
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Major: Civil Engineering

Operations Measurement within civil engineering is not understood to be a substantially developed area, due to the complex operations that exist within civil engineering companies including design, construction and manufacturing. This project researches methods and key performance indicators that can potentially be used within the civil engineering industry to measure operations, focusing on quality of service, productivity, security, responsiveness, reliability and flexibility.

Investigation within civil design consultancy firm Hyder Consulting revealed the depth of which operations measurement is established, and the key operations which are the main point of focus. Hyder Consulting are a large multinational company with well established measurement methods in place. Comparison shows the significant difference between hypothetical and actual measurement methods as well as the operations which are measured. Hyder Consulting focuses on measuring quality of service and productivity above all other operations as these are considered to me directly related to revenue. The measurement processes implemented by Hyder Consulting are well established and effectively provide detailed insight into quality of service and productivity at various levels within the company.

Comparison between literature review and investigation within Hyder Consulting reveals that measurement is based on the importance of the operation. Hyder Consulting have well established measurement techniques for quality and productivity while responsiveness, security, reliability and flexibility are not measured. Due to the complexity of the civil engineering industry it is understandable that all operations are not measured. This project has demonstrated through literature review that the operations not measured by Hyder Consulting are applicable to the civil engineering industry. While these operations are not currently measured within Hyder Consulting there is potential for development into said areas. This project has resulted in an understanding of what operations are considered important to managers within civil design, as well as producing key performance indicators that can be used as a starting place to further investigate a variety of operations in civil design, manufacturing and construction.
A NOISE REDUCTION ALGORITHM DESIGNED FOR SAMPLES USED BY
DIGITAL MUSICAL INSTRUMENTS (12CP)
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Major: Electrical Engineering

Sample-based musical instruments work by layering individual recorded sounds to form music. As computational power has increased and the costs of memory have decreased, these instruments have become much more common and realistic. A current sample-based digital pipe organ may contain samples for every pipe on every stop at several different touches and may be capable of playing back several thousand samples at any instant. This figure is rising as the demand for realism grows.

Prior to being placed on a sample-based instrument, the recorded samples must first be prepared. This process is very dependent on the instrument being sampled, but almost always includes some form of noise reduction. Consider a sample-based instrument playing a thousand samples at a given instant, the background noise in each sample will be added resulting in a one thousand times increase in noise.

This project presents a novel noise reduction scheme designed for audio streams containing sampled instrument data. Pipe organ samples have been chosen as the primary test case for this algorithm as most organs produce a significant amount of background noise just by being switched on.

A method of profiling noise is devised using recorded audible noise at several locations. A statistical model is then developed to formulate a basic reduction function – this differs from the standard methods of power subtraction and spectral subtraction. Common techniques including frequency domain spectral smoothing are discussed and improved to suit sampled audio. The effects of a psychoacoustic model are also investigated to reduce changes to the original audio spectrum.

The system is suitable where signal fidelity must remain very good, but large attenuations (between 20 and 40 decibels) of background noise are required. The scheme has also been found to work very well on other audio streams such as speech.
Delays in construction projects have become commonplace in the industry and are often as a result of projects in distress. Poor time management causes projects to be delayed beyond the specified contract date. Once a project is delayed, not only overruns in time are incurred but both the owner and contractor incur additional unbudgeted financial costs. In the aftermath of the global financial crisis, it has become quite difficult for the construction industry to obtain funding for their projects, thus making it even more crucial for projects to be completed on time and under-budget.

Delays often result in claims for extension of times, pursuit of damages and lengthy, expensive legal battles. The main aim of this thesis is to explore the various aspects of delay, namely causes and types of delays, methods of delay analysis and how delays can be avoided or mitigated in the construction industry. Research was carried out through an extensive literature review of journal articles, recent theses, books and interviews with experienced industry professionals. This thesis reports the findings of this research.

One of the main causes of delays was found to be as a result of poor collaboration and communication between the various important project stakeholders and change orders by the owners. Apportioning the responsibility of the delay is difficult therefore there is no favoured method of delay analysis. However research indicates that the simpler, less expensive but less accurate methods of delay analysis are often favoured. There are a number of tools and methods which when applied properly can help mitigate delays but it was found that the main tool to mitigate delays is a well written contract. A well prepared project plan, together with a sound project schedule is also essential ingredients in order to help minimise delays and their impacts.
SCREW CONNECTIONS FOR THE INTERFACE OF TIMBER-CONCRETE COMPOSITE (6CP)
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Supervisor: Christophe Gerber
Assessor: Anne Gardner
Major: Civil

Timber-Concrete Composites (TCC) structures involve connecting components of concrete and timber together compositely, allowing the mechanical strengths to be used efficiently. The concrete member resists compressive stresses whilst the timber member primarily resists tensile stresses due to flexure. The composite action between both members is commonly provided by mechanical connectors, whose ability to resist shear and impede slip determine the degree of composite action.

Previous research has shown that TCC structural elements behave differently relative to the type of connection that exists between the two materials. With the variation of the behaviour of joints used in TCC, a design approach has not yet been developed in accordance with AS1720.1 or AS3600 with the only accurate determination of joint behaviour is by conducting scientific research and experiments.

This experimental Capstone project attempts to study the effect of the distance between two different types of screwed connections, with the screws having an inclination of $45^\circ$ with respect to the timber member. Five different test specimens were created using two types of screws, with spacing’s at 140mm and 210mm. Another specimen was created with two screws at 10mm offsets from each other with a spacing of 140mm between the centres of the two screws. Thus altogether there were twenty-five specimens that were constructed and tested.

Each of the twenty-five specimens will be tested in accordance with the European Standard EN 26891:1991 (Timber structures). The specimens have not been tested to date due to implications within the UTS engineering labs, though the results and analysis will be presented in the report and during the capstone presentation.

The main focus of this Capstone project is to analyse the performance of each of the two different screws and to determine the effect of the screw spacing’s have on TCC. Based on these two variables an analysis will be performed in relation to the strength and stiffness of the TCC specimens with recommendations on which connection is the most cost-effective.
MULTIVARIABLE CONTROLLER OPTIMISATION FOR AN AUTOMATED TREADMILL SYSTEM (12cp)
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Supervisor : Steven Su
Assessor : Shoudong Huang
Major: Electrical Engineering

The control of an exerciser’s heart rate has been used extensively to achieve optimum effects for the purpose of fitness and cardiac rehabilitation. Automated treadmill systems have been designed with basic feedback control to achieve these exercise goals. This project involves the development, implementation and optimization of a Model-Predictive-Control (MPC) scheme to achieve increased performance in such an automated treadmill system. The automated treadmill system has previously been set up where the heart rate signal is acquired using an Alive Bluetooth heart rate monitor interfaced by a LabVIEW™ graphical user interface.

The purpose of controlling a user’s heart rate is to enhance exercise in particular zones whilst ensuring the heart rate does not reach unsafe levels. The use of these zones can primarily facilitate: the rehabilitation of cardiac disease, various levels of calorie burning, aerobic fitness training, and anaerobic fitness training.

MPC has predominantly been used in industrial type applications and not yet for the control of heart rate. It has the advantage of real-time control with measured sampling times. A distinct benefit of MPC over other control techniques is its ability to adapt to a preset model of a system allowing it to incorporate pre-defined objectives in its design and predict disturbances in the system.

The design and simulation of the MPC scheme will be conducted using MATLAB and Simulink software before being implemented in LabVIEW™. The implementation will be primarily targeted at testing the performance of the MPC scheme for the heart rate control application. Expansion on this research would include the control of a user’s pace rate as well as heart rate and the tuning of pre-defined MPC objectives to enhance exercise and rehabilitation results.
ROBUST MANIPULABILITY-CENTRIC OBJECT DETECTION IN TIME-OF-FLIGHT CAMERA POINT CLOUDS (12CP)
Sonja Caraian - A10-015

Supervisor: Nathan Kirchner
Assessor: Alen Alempijevic
Major: Mechanical and Mechatronic Engineering

Robotic perception is an area of growing importance due to the increasing desire for robots to be both pervasive and useful in society, which requires them to be capable of physically interacting with, and hence perceiving, dynamic human environments. Time-of-flight cameras are a popular tool used to generate 3D models of the world for use in locating table tops and detecting objects due to their depth information, high frame rates, measurement range and accuracy and compact size.

This project presents a method for robustly identifying the manipulability of objects in a scene based on the capabilities of the manipulator. The method uses a directed histogram search of a time-of-flight camera generated 3D point cloud that exploits the logical connection between objects and the respective supporting surface to facilitate scene segmentation.

Once segmented, the points above the supporting surface are searched, again with a directed histogram, and potentially manipulatable objects identified. Finally, the manipulatable objects in the scene are identified as those from the potential objects set that are within the manipulator's capabilities.

It is shown empirically that the method robustly detects the supporting surface with ±15mm accuracy from one ToF camera observation, and successfully discriminates between multiple graspable and non-graspable objects in cluttered and complex scenes.
MODELLING INTERCULTURAL VISUALISATION (6cp)
Jian Xin Chen – A10-017

Supervisor : David Davis
Assessor : Zenon Chaczko
Major: Information Communication Technology Engineering

Many anthropologists and researchers have developed sets of cultural dimensions utilised to
model patterns of social behaviour, interaction and mental process that exists in different
cultures in the world. This study is interested in the perceptions of experts from the fields of
System Visualisation on the selection of important cultural dimensions that may influence user-
interface design. This study is based on the research Baumgartner has done using Hofstede’s
cultural dimensions and applying them to the field of intercultural system visualisation where
the culture domain differs occupationally rather than regionally.

This paper goes forth and groups the cultural dimensions discussed in Baumgartner’s paper
based on the lifecycle of system visualisation, namely planning, analysis, design,
implementation and maintenance by paying attention to the cultural dimensions that should
guide developers’ design decisions during each stage of the lifecycle.
Additionally, this paper verifies the application of the grouped cultural dimensions in the
development of the SCADA user-interface design utilised in a university environment where
users are students, teachers and engineers. Finally, an extensive checklist is constructed with the
purpose of evaluating of the “culturability” of the user-interface of systems.

Through this research, one understood the importance of customisation in intercultural system
visualisation and more precisely, the difficulty to cater for all cultures. One realised that most
ideas explored in this study are founded upon assumptions, therefore more empirical studies and
tests are required for further proof of theory.
TOWARDS AUTOMATED WINDOW CLEANING: MECHATRONICS DESIGN  
(12CP)  
Kushal CHHAPIA  A10-020  

Supervisor : Quang Ha  
Assessor : Steven Su  
Major: Mechanical and Mechatronics

Cleaning high-rise building windows without jeopardizing the lives of the cleaners involved remains quite a challenge. A solution to this problem can be formulated by having an automated machine to perform the task for us. This capstone project is on Automated Window Cleaner, with two focuses on mechanical and mechatronic design to address important issues in window cleaning for high-rise buildings. This project has been undertaken by two students working respectively on the mechanical and the mechatronic aspects. Design constraints and the mechatronics aspects of the project will be discussed in the thesis. A number of techniques that can be implemented have been discussed against those available in the research literature and on the market. A final design has demonstrated to be both practical and implementable. All the various challenges involved in making the Automated Window Cleaner are discussed and possible solutions are presented, judging on practicality and ease of implementation.

The mechatronics aspect of the project deals with a design of a mechatronic system that shall best perform the task. Various constraints of the design have been indentified and worked upon for a feasible solution. After having a suitable mechatronics system, different sensors shall be tested individually and later they will be integrated in the entire system. The project shall also discuss the logic used to detect the presence of a window followed by the cleaning procedure. Also included in the project are the various circuits used in the sensors and the ability of the Automated Window Cleaner to move along its track. For the final presentation, both the mechanical and the mechatronic system shall be integrated together to have a final piece of the equipment used to demonstrate the satisfaction of the initially-set expectations.
AN EXPERIMENTAL INVESTIGATION OF RIVERBANK PROTECTION (6CP)
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Supervisor: Hadi Khabbaz
Assessor: Alizera Keshavarzi
Major: Civil Engineering

Scouring is the combination of various forms of erosion in river systems. It has been attributed as the factor causing failure in many structures constructed in or near a river system. Scouring occurring at the riverbank erodes sediment used as support by a variety structures; the removal of this material removes support to a structure causing failure. Methods for protecting both the riverbank and the structure have been developed.

This investigation focuses on protecting the riverbank directly by significantly slowing the natural scouring process. Many types of systems have been developed to resist and minimize riverbank scour. They include structural, biological and in-flow methods; this investigation focuses on the last of these, in-flow devices.

The investigation involves a series of three curved bed sills that have been placed below the sand in a flume to determine the effect they had on the scouring of uniform sand. The experiment was repeated at three flow rates to determine their effect at different river flow conditions. It was anticipated that the sills would produce a scouring pattern, which could lead to further investigation of the sills in the application of riverbank protection.

After an equilibrium point was reached between live-bed and clear-water conditions the experiment was stopped and the resulting scour depth was measured at just under 500 locations. The measurements were made with an Acoustic Doppler Velocimeter device; the device measures the depth to a precision of 0.1 millimetres. On the opposite side of the flume to the sills a uniform scouring depth was the same across all experiments. Also in each of the experiments a distinct build up of sediment was recorded after the last sill. This build up of sediment suggests some validity to the design of the sills.

The consistency of the results across all flow rates tested demonstrates that the results of the investigation are valid for a range of river flow conditions. These findings provide civil engineers with a quick and cost effective method of protecting riverbanks. It is recommended that further investigation is conducted for each real world application.
MINING SUBSIDENCE AND THE EFFECTS ON STRUCTURES, IN PARTICULAR BRIDGES. (6CP)
Joel Deacon: S10-024

Supervisor : Professor Keith Crews
Assessor : Hadi Khabbaz
Major: Civil Engineering

Australia is the largest coal exporting country in the world, with New South Wales alone exporting up to around $13 billion in 2009. Mining and coal mining are major and vital industries to the Australian economy. Unfortunately though the act of removing resources from the earth comes with the price of differential ground movement. This ground movement is called mining subsidence, which effects the built and natural landscape.

Mining subsidence is a three dimensional ground movement that is due to the collapsing of underground strata material from mining. In this investigation the effect of coal mining subsidence on structures and in particular bridges will be discussed. The phenomenon effects structures because subsidence includes vertical and horizontal displacement, ground curvature and ground strains. These characteristics need to be considered and understood for bridge design, construction, maintenance and the overall bridge life cycle.

This investigation gives background to the mining and specifically NSW coal industry. Included is also an explanation of mining subsidence theory and a background to subsidence prediction models. From understanding these subsidence prediction methodologies an excel model is presented to visual show the difference in the methodologies and the predicted results. This investigation will summarise researched data on the mining subsidence characteristics followed by possible bridge design precautions and measures to be used against mining subsidence effects. This section also includes real life case studies of designs used in mining subsidence areas.

To validate this research the RTA Hunter Valley expressway project has been assessed as a real life case study to evaluate the possible mining subsidence prediction models and the possible bridge designs. This case study is presented with an AutoCAD model to compare theory with construction, which will verify how a bridge could be designed effectively and economically for mining subsidence.

*It should be noted that RTA information from the Hunter Valley Expressway is confidential only to be disclosed to the supervisor and assessor of this project. With limited information to be shown for the project presentation.*
REDESIGN AND IMPLEMENTATION OF FRONT SUSPENSION OF 1966-1988 FORD FALCON (12CP)
Phillip Diasinos - A10-027

Supervisor : Terry Brown
Assessor : Garry Marks

Major: Mechanical Engineering

The following capstone project focuses on improving the functionality of classic Ford Falcons without the need to modify their original structure. The value of this project lies in its potential to enable car enthusiasts to further enjoy their older vehicles by improving comfort, handling and most importantly, the safety of the occupants and fellow motorists.

This paper investigates the most effective solution to satisfy this problem to cater to the needs of this target market by undertaking the development of a front suspension replacement kit. The goal of this kit is for consumers to gain access to an affordable and user-friendly alternative to existing products on the market which are expensive and involve irreversible alteration to the vehicle sub-frame.

The kit aims to offer the user adjustability to tune their suspension to suit street or track applications and ensure maximum tyre patch contact with the road/track surface.

This report outlines the analysis of the shortcomings of the existing suspension, the exploration of alternative solutions and the rationale behind the avenue taken in formulating a suitable design. It includes the development of the design, the stages of modelling, manufacturing and testing of the final product on the test vehicle. Benefits of the new suspension package are highlighted through a series of static and road tests highlighting improvements.

Future direction for the project is to rigorously test the system and gain approval to guarantee the system is safe to be used in the appropriate vehicles both on street and track conditions.
FAULT MONITORING OF J2EE APPLICATIONS IN A HIGH AVAILABILITY, DISTRIBUTED ENVIRONMENT (12 cp)
James Dibley - A10-028

Supervisor : Lian Loke
Assessor : Zenon Chaczko
Major: Information and Communication Technology (Software)

Foreign Exchange trading systems require extremely high availability and performance to ensure effective risk management. There is an exposure to a number of risks for financial institutions operating these trading systems. System failure can result in user dissatisfaction, unhedged foreign exchange positions, reputational damage or regulatory action.

The sponsoring financial institution operates an internal trading system running on a number of J2EE servers across the world supported by a centralised operations team. Minimisation of, and effective reaction to, system failures is required. Existing fault monitoring systems are reactive and becoming insufficient to deal with the growing system scope.

The proposal is to replace the existing fault monitoring systems with a new framework based on existing monitoring paradigms. This includes the Probe-Gauge-Consumer and Event Correlation monitoring models. The new monitoring system must offer accurate, high performance and extensible monitoring in order to enhance ongoing system support.

The monitoring system was iteratively developed using the Agile methodology, ensuring close communication between various stakeholders and end-users. This communication allowed features identified in system monitoring literature to be selected, adapted and prioritised.

The final deliverable is a generalised Java based framework supporting extensible data collection and flexible event evaluation and correlation. Both existing logging frameworks and specific application instrumentation provide data for evaluation. Key applications include specific instrumentation as a proof of concept for collection, evaluation and correlation framework.

This deliverable allows operations staff to have an at-a-glance view of all events in the system. Operations staff also benefit for automated alarm generation in previously unmonitored areas of the system. This includes when there are indicative rates, excessive memory usage or when strings matching defined regular expressions.

Further work planned includes integration with existing alarm escalation and distribution systems, more specific data gathering and analysis methods.
EVALUATION OF CORRELATION FACTORS BETWEEN CONCRETE AND MICRO-CONCRETE TRIAL MIXES (6cp)
Natalie Dumbrell - S10-029

Supervisor: Kirk Vessalas
Assessor: Robert McLaughlan
Major: Civil Engineering

Increased use of concrete in construction has lead to increased pressures on meeting specification requirements and testing quotas required for quality assurance purposes. In Australia, concrete is tested in accordance with Australian Standards, using a pan mixer with a capacity of 100L. This results in high labour costs for testing laboratories, since two or more people are required to handle such large volumes of concrete.

One way of reducing labour costs is to perform mixing in a small Hobart mixer (10L), which can be manouvered by a single individual. To accommodate this smaller batch size, smaller size moulds must also be utilised, for example 100mm cube moulds. To prepare these specimens, a new, micro-sized concrete mix must be developed, removing the 20mm aggregate from the concrete to avoid difficulties with compaction and void filling.

This project specifically assesses different mix design methodologies for preparing micro-concrete mixes using a maximum aggregate size of 10mm, in a Hobart mixer.

Three mix design methods of reducing to 10mm aggregate concrete were tested against a control mix design, provided by the projects sponsor, Sika Australia Pty Ltd. These are: the Abdelrazig method based on sieve analyses; the Ken Day method based on relative specific surface area; and the standard mix design method of the American Concrete Institute (ACI). The success of each mix design was assessed against the target requirements of a fixed water/cement (w/c) ratio of 0.65 and a slump of 100mm. The compressive strength of the 100mm cubes produced were compared after 7 and 28 days standard ageing, to establish a correlation factor between the control 20mm aggregate concrete and each of the three micro-concretes. From this study, it has been found that both the Abdelrazig method and the ACI method, are successful in providing a workable mix design.
INFLUENCE OF SALT CONTENT ON PLASTICITY OF KAOLINITE (6cp)
Marlon Efesem - S10-030

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

Salts have been known to affect the properties and structure of soils. In the natural form, organic and non-organic soils contain salts of various concentration levels. Soils can be further classified into fine or course grained soils. Fine-grained soil such as clay has the capacity to retain large amount of moisture while maintain its physical shape. There are many factors that can be used to explain this occurrence. One indicator is to apply the Atterberg Limits to explain mechanical properties in terms of liquid limit, plastic limit, and plasticity index.

This study attempt to explain the effect of various salt concentrations on the mechanical and physical characteristic of clay. The test is carried out using Kaolinite clay and the type of salt used is sodium chloride (NaCl). NaCl crystal is added to dried clay granule to produce uniform mixture prior to the addition of distilled water of diverse amounts. The test performed follows the method described in Australian Standards to ensure the results obtained are accurate and reliable. According to Australian Standards, the two most widely accepted methods are Casagrande method and the drop cone method. The drop cone penetration method requires less operator involvement and simplistic in nature thus minimising the possible error in results, making it the most appropriate method for this study.

The results show the decay in clay liquid limit with the addition of NaCl. Liquid limit is observed to decrease rapidly but progressively with the addition of up to 30% NaCl. However, the decrease in liquid limit started to decelerate, as clay become less sensitive to NaCl concentration beyond this point.
Shielded metal arc welding (SMAW), also known as ‘stick welding’, is a common welding process used at Caltex Refinery, Kurnell and all over the world. It is the welding process of choice when welding large diameter pipelines (typically > 12 inch diameter) due to its ability to perform in adverse environments. Because it is dealing with hazardous petrochemicals, Caltex requires and expects defect free welds in all piping around the refinery.

Caltex recently experienced problems when trying to weld a large diameter pipeline that had become magnetised; the problem was a phenomenon commonly known as ‘magnetic arc blow’; a process whereby the welding arc is deflected one way or another due to the interaction of the magnetic field in the pipe and that of the welding arc.

The question arose of whether the tensile properties of welds produced under the influence of magnetic fields were affected. Hence, the aim of this project was to experimentally study the effect of magnetic fields on SMAW welding; more specifically to determine whether the tensile properties of welds created under the influence of magnetic fields were altered in any way.

The project identifies common methods in which piping can become magnetised and presents several known demagnetising methods used to eliminate magnetic arc blow in welding. Further, the project briefly experiments with demagnetising techniques used to eliminate magnetic arc blow. Specialist equipment for dealing with magnetic arc blow are also identified and presented as possible solutions to the problem.

Test specimens were magnetised, welded and then mechanically tested to analyse the effect of the magnetic fields. The study found that there was no appreciable difference between the mechanical properties of welds produced in the presence of magnetic fields and the ‘control’ welds produced without the presence of an applied magnetic field.
Throughout the history of the construction industry, engineers have perpetually debated about a particular system or methodology and its superiority over another. Road pavements are one of those systems. Namely, which of the two pavements types is ideal for road surfacing: flexible versus rigid road pavements.

A flexible pavement is defined as any form of road construction which is not completely rigid. In other words, any type of pavement other than concrete. Flexible pavement is one of the most common applications of asphalt mixes. It can be used as a full depth asphalt pavement or as a wearing course on a base made of different construction materials.

A rigid road pavement on the other hand typically comprises of a compacted sub-grade, a select material zone, a lean-mix concrete sub-base and finally a high strength concrete base. These concrete bases are most commonly either Plain unreinforced Concrete Pavements also known as PCP or Continuously Reinforced Concrete Pavements CRCP.

In an attempt to provide an objective assessment of the strengths and weaknesses of each pavement alternative, this thesis aims to bring to light the advantages and disadvantages of these two pavement types from various viewpoints.

In essence, the principle objective of this thesis is to assist decision makers in choosing the most efficient pavement alternative in any particular situation without being influenced by common assumptions. To achieve this objective, the paper includes a thorough investigation of the various important characteristics to be taken into account when designing a pavement, including strength and performance characteristics, constructability, durability and design life.

Finally, this thesis puts forth a life cycle cost analysis for each of the various forms of flexible and rigid pavements. Due to the nature of cost analyses, various reliability issues exist in relation to the data used and the accuracy of the results; these are clearly outlined and discussed as a part of the cost comparison. Despite these concerns, the life cycle cost analysis will form an effective basis for evaluation of the two alternatives by suggesting an order of precision for the results obtained.
EFFECTS OF WATER IMPURITIES ON GEOTECHNICAL PROPERTIES OF CLAY
(8) cp
Shahin Falahati - S10-032

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

Soil compaction can be generally defined as the process of mechanically increasing the density of the soil. In doing so benefits such as; an increase in the load bearing capacity, improved stability, reduction in seepage, swelling, contraction and settlement of the soil can be achieved.

The moisture content of the soil is a key element in regards to achieving proper compaction and therefore the desired geotechnical properties. For any given soil and given required compaction effort, an optimum moisture content exists, which can be calculated in a lab.

The main problem investigated in this project is to investigate how the salinity of water would affect the soil properties. The specific aim of the experimental program is to integrate the effect of salinity on the soil maximum dry density and the optimum water content. This is very important as the Standards recommend using fresh water, however more often than not construction companies across Australia use brackish water or recycled water to compact the soil.

I conducted all experiments and procedures in accordance with AS1289.

Several tests using fresh water have been conducted to establish a benchmark, after which point I tested brine water at 5% salinity, actual sea water at roughly 3.5% salinity and brackish water at 1.5% salinity. The general results that I obtained showed that when using saline water, there was a fluctuation of less than 5% in dry density as opposed to fresh water.

The major conclusion that I reached from these results was that, if the main concern is purely to reach the maximum dry density and therefore higher bearing capacity, then there are no problems associated with using any brackish or river water that is readily available on most sites. Further research should be carried out to examine other soil properties using different soil types.
DESIGN OF A FLOW METER TESTING & CALIBRATION LABORATORY (6cp)
Kenan C Fernandes - S10-035

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

Flow meters are very commonly used to measure the flow of liquids in pipes in various applications and monitor fluid consumption. This data is later used to control dosing applications, custody transfer etc. Hence, we realise the need for these instruments to be able to output accurate results. As a result, all measuring devices need to be frequently calibrated to ensure they are within their specified tolerances.

Currently, Australia has a very limited number of laboratories where flow meters can be effectively tested and calibrated to determine their accuracy. Moreover, almost all flow equipment is imported into Australia and the units are quite rarely tested prior to installation into the customer’s process. This shortage of laboratories results in longer lead times to carry out required tests and high costs associated per test which forces customers to skip an annual calibration of their flow meters.

This capstone project is undertaken for CMC Technologies Pty Ltd, a supplier of industrial instrumentation to all industries. With a dedicated flow measurement division within the company, CMC intends to add value to its existing line of flow measurement products particularly to the electromagnetic and ultrasonic flow meters by being able to provide a calibration service.

The project focuses on the design of a flow rig in a flow meter testing & calibration laboratory for in-line flow meters (electromagnetic) and external flow meters (ultrasonic) for liquids. The design incorporates a design for sustainability by providing flexibility in installation and allowing for future expansion.

Different calibration methods that can be employed to test and calibrate flow meters are also investigated and compared against various factors such as cost of implementation, levels of accuracy achieved, instrumentation required, significant advantages/disadvantages etc. A preliminary financial analysis of the instrumentation required for the operation of the flow-rig has also been carried out to be to provide an estimate of the monetary investment required.

This thesis concludes by looking at the necessary accreditations required to be able to achieve certification as an authorized flow meter calibration laboratory. It is anticipated that the final design along with all instrumentation to be presented to engineering consultants for their professional opinions on the design and approval. Future work includes revising the design as required to be able to receive a design issued for construction by the consultants.
EXPERIMENTAL STUDY OF FRICTION BETWEEN HIGH-DENSITY POLYETHYLENE (HDPE) AND A VARIETY OF WOVEN MATERIALS (12cp)
Rahul Garg - A10-041

Supervisor: David Eager
Assessor: Christopher M Chapman
Major: Mechanical and Mechatronics Engineering

Playground slides have always been an integral part of almost everyone’s childhood and they still are the most common form of outdoor entertainment among the present generation of children. The issues related to the child safety also arise as a result of the various scientific phenomena occurring during the use of the slide. All the slides used in the internal and external playgrounds within Australia must comply with AS 4685.3: 2004 which is an Australian Standard for safety and test methods of playground slides. This Standard is a voluntary Standard and there are a lot of accidents reported yearly related to the playground slides usage.

The project was undertaken to meet the need of the child safety during slide usage by analyzing the behavior of various woven clothing material when they come in contact with the playground slide material which is High Density Polyethylene (HDPE). As a part of the experiment, six different and most common clothing materials worn by children were identified and experiments were conducted in a series using modern data recording approaches and techniques. All the equipment used during the experiment was provided by the University and the experiments were conducted within the FEIT laboratory facility.

The results and conclusion derived from the experimental reading over a period of 1 year are documented as a final thesis document. These results highlight the relation between the material of the cloth used during sliding down the slide and also the trends in the frictional properties of the cloth. The recommendations regarding the most suitable cloth material to be worn during sliding down and also other most crucial factors affecting the safety of the children are made as a part of meeting the need of the child safety in the playgrounds.
EXPERIMENTAL STUDY OF FRICTION BETWEEN HIGH-DENSITY POLYETHYLENE (HDPE) AND WOVEN CLOTHING MATERIALS. (12cp)

Ganesh GHOTANE - A10-042

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

Play is an essential part of a child’s overall development. Outdoor and Playground equipments encourage children to play in the fresh air. It keeps them active and they can learn different skills of coordination while having fun at the same time. Slides are the most common equipments we usually found in the backyards or in the local playgrounds. However, some parents may limit their child’s playtime activities because they are concerned about injury. Injuries due to playground equipments are usually serious and most of the times need hospitalization.

At present playground equipment manufacturers follow Australian standards for Playground equipments, (AS 4685-2004), (AS 4685.3-2004). This experimental study is intended to find the relation between the woven clothes and the High density Polyethylene (HDPE) typically used to manufacture slides. The outcome of this study will help to provide guidelines to set standards for playground slides. In addition this will help manufactures to take these factors in consideration when designing and developing play ground equipments.

Experiments were conducted in the Dynamics Laboratory in building 2 level 3 at the University of Technology, Sydney. For this study we selected commonly used six types of clothes and different weights ranging from 25kg to 75kg. It helped us to analysis behavior of each weight against different clothes and to derive conclusions based on the same.

All the readings and data were gathered using sophisticated equipments. The main focus was to establish the frictional relation between woven clothes and HDPE slides. The report also highlights the problems and errors encountered during this experiment. Recommendations are made at the end to help the further research in this field.
AN INVESTIGATION INTO THE COMPLEX SYSTEM OF WORK LIFE BALANCE ISSUES IN PROJECT MANAGEMENT WITHIN THE CONSTRUCTION INDUSTRY (6cp)
Nathan Grace - S10-043

Supervisor : Ravindra Bagia
Assessor : Mary Walmsley
Major: Civil

Work-life balance is becoming an increasingly popular subject of interest to today’s working individual. Changes within the workforce, demographics, culture, society and the family construct have been the catalyst for employees aspiring for balance between work and life. Work-life balance is not simply a matter of an equal division of time spent on work and on life, but is a combination of satisfaction gained, psychological involvement and time spent on the elements that make up an individual’s unique work-life construct.

The construction industry is an extremely demanding and competitive work environment with business centered primarily on succeeding in contract based projects. This has driven the industry to operate at low profit margins and tight construction schedules. The project management team has an integral role in the success of construction projects and the continuity of their organisation. These responsibilities have historically induced a strong culture of long hours, unpaid overtime and a six day working week.

This project aims to investigate the issues associated in project management within the construction industry by comparing the results of a literature review with an industry analysis. Over fifty professionals were surveyed, and six were interviewed to gain an understanding of current expectations, perceptions and issues relating to work-life balance in the industry.

This project explores multiple work-life balance issues in project management within the construction industry, focusing particularly on industry culture, work-family conflict and ‘burnout’. The findings are presented as a model highlighting the causes of imbalance and their effects. This project attempts to provide a sound understanding of work-life balance by highlighting issues leading to an imbalance.
APPLICATIONS OF PRESTRESSING TECHNOLOGY TO TIMBER FLOORING SYSTEMS – PART 1 – PREPARATION, DESIGN AND DETAILING OF BEAM SPECIMENS (6cp)
Jesse Hallen  -  S10-046

Supervisor: Keith Crews
Assessor: Christophe Gerber
Major: Civil Engineering

The development of engineered wood products such as laminated veneer lumber (LVL) has widely increased the number of applications of timber in engineered structures. The reduction in variability between members has led to characteristic strengths and stiffness’ greater than those permitted by sawn members from the same species of wood. As a result, timber is finding more applications in the commercial and industrial sectors, and significant research is going into developing composites to promote this. Of particular interest is the application of prestressing technology (from prestressed concrete) to timber flooring systems. This project will focus on the long-term implications of applying prestressing forces to timber, as timber is susceptible to time dependent deformation under constant load, referred to as creep strain. Significant value will come from examining the creep strain both parallel and perpendicular to the grain.

The absence of accurate models that are practical for design purposes is attributable to the fact that testing is often carried out on small specimens or structural sub-assemblies and tests are usually short-term. This project will involve performing long-term tests on full scale beam assemblies.

Due to the long-term nature of testing, it is not possible to complete this project in the time permitted by a 6 credit point Capstone. As a result, this Capstone thesis will put forward the findings of a thorough literature review, the documentation of the beam specimens' design, and a testing methodology to be carried over a period of 12 to 18 months, after which time a graduate project at a Masters level will be produced.
CONSOLIDATION OF SOFT SOIL ROAD FOUNDATIONS WITH WICK DRAINS AND VACUUM PRELOADING (6cp)
Joseph Hanna - S10-048

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

Soft soils present a challenge for the construction of new roads in many coastal areas. These soils are largely comprised of alluvial clay, silt and organic matters that are either over consolidated or normally consolidated. A variety of techniques have been developed to allow the utilisation of soft soils by reducing the encountered settlement to acceptable levels. Among these techniques are wick drain consolidation and vacuum preloading, which are similar in the approach of relieving excess pore water pressure in a short period of time. Each of these techniques is under continual refinement as data are gathered for the most modern procedures and materials, in varying ground conditions.

The problem investigated in this project is the treatment of soils that are susceptible to settlement under loading, with the aim to minimise settlement of embankments and the overlying road pavements following their construction. The topic is widely encountered in highway construction projects where the road alignment passes over soft soils.

The design process is becoming more reliable as further sites with unique conditions and limitations are experienced. The most commonly used design models will be discussed with the aim of maintaining relevance to current practice. The materials and practices presented in modern publications will be discussed, together with those observed through first hand experiences of treatments implemented on the Ballina Bypass.

The approach taken by the author to examine the topic being presented was to initially research existing literature on the issues. This was followed by investigation and analysis phases, which incorporated numerical software modelling of consolidation scenarios. The finalisation phase involved identifying similarities found between the research and investigation phases. The project has been completed with the intention of providing a basis for further studies and development in wick drain and vacuum preloading soft soil treatments.
The modern Australian soldier finds themselves in an increasingly complex and dangerous battlespace. Rapidly evolving combat tactics and improvements in technology in recent years have changed the nature of warfighting in the places where Australian troops are deployed. Where once two armies might have engaged each other directly and aimed to avoid civilian casualties, now more than ever adaptive techniques are needed to respond to the threat of highly mobile and well equipped insurgents who deliberately risk the lives of non-combatants in order to make themselves more difficult to target.

The solutions to these problems are similarly complex. A number of directives have been issued and programs put in place by the Australian Army over the last few years in order to begin to address these concerns. One particular initiative, known as LAND 125, is Australia’s soldier modernisation program. This project focuses on developments and improvements to current soldier combat systems and investigates new technology solutions to address capability requirements.

There is a growing recognition within the defence community, both in Australia and abroad, that the flexible business models, approaches and developments offered by commercial enterprises, particularly in the area of portable mobile device technology, can contribute to the current capability needs of soldiers as they carry out their day to day tasks, whether they are in warfighting environments or otherwise.

This Capstone Project undertakes to enter this topic area at two levels. Firstly it investigates the applicability of current commercial mobile technology to the field of soldier systems through a process of background research and first hand requirements elicitation. Secondly it uses the software development cycle in the implementation of a concept demonstrator to reveal how this idea could work in typical military operational scenarios in order to provide a focal point to open up discussion on further development.
SMART LANDSCAPING QUOTATION SYSTEM (12cp)  
Matthew R. Higham - A10-051  

Supervisor : Zenon Chaczko  
Assessor : Robin Braun  
Major:  Software Engineering  

Running a small landscaping business has not changed much over the past 50 years. Most of the operators still use pen-and-paper for their designs, a notepad for their ideas, and constant visitation with a potential customer to get their designs right. With the increased general knowledge of computers in the community, it is becoming more and more viable for businesses to move towards digitising their workplace and customer interactions.

The purpose of the Smart Landscaping Quotation System (SLQS) is to provide a professional landscaper the tools they require in order to quickly design, cost and quote a job for a potential customer. The landscaper would only need to visit the customer once, and then email proposed designs for feedback. This thesis outlines how this outcome was achieved, as a result of thorough consultation with a practicing landscaper.

The practical implications are that a landscaper will have all the tools required to make an informed decision about the costs of a project available to them in one convenient package. The amount of time spent creating a landscaping design and building a corresponding quote will be significantly reduced, while at the same time encouraging more customer interaction through the visual representation of the landscaper’s plan. The end result is:

- A plan which the landscaper and his workers can follow
- A customer that is happy with a design that they have seen, given feedback, and approved
- A business owner that can cut down administration costs due to the efficient processes that the system promotes.
In recent years, robotic devices have begun to emerge as an additional tool to be used in situations where humans would otherwise be exposed to a hazardous or dangerous environment. One such environment is bridge maintenance, where periodic inspection for rust of welds and joins must occur. In a case such as the Sydney Harbour Bridge, this is a complex environment where the difficulty of maneuvering is high. A robot is required to perform such inspection, to reduce the risks to workers. The UTS RVC was developed as a prototype robotic platform to evaluate a particular solution for climbing this complex structure. This robot demonstrated feasibility but would require significant development to be field deployable. As such, the prototype has been re-engineered for use as a learning and research development platform.

Evaluation of designs for efficiency, practicality and control are extensively called upon when developing robotics hardware and software. This capstone focused on taking the prototype system which was incomplete and unreliable, into a fully functioning, reliable test platform. This platform allows for low-cost testing of newly designed components, or experimentation with walking robot control. By incorporating in-built control algorithms this platform allows new configurations to be controlled with a minimal amount of re-programming and analysed for real-world suitability. The motion of the platform via walking and turning gaits is controlled by an intuitive motion sensitive controller while simultaneously allowing for control of peripheral devices such as a camera or laser scanner mounted to an onboard inspection arm.

While this platform allows for testing of new designs, it has also been programmed in such a way as to allow for the development of new control algorithms to be integrated into the existing architecture. This gives the availability of using this platform in the testing of both physical designs as well as allowing for the incorporation of new, advanced control techniques.

Furthermore, the electrical schematics and hardware level control code have been documented appropriately to ensure future users can integrate with the system. The result is a fully functioning quadruped robot for use in future robotics research at the Centre for Autonomous Systems.
INVESTIGATION OF ADVANCED MANUFACTURING AND ITS APPLICATION AT A MEDICAL DEVICE MANUFACTURER (12cp)
Morgan James – A10-060

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

The competitiveness of manufacturing in Australia is the source of much economic dissertation, with a seemingly overwhelming belief that factories in first world economies such as Australia must move to the developing world to maintain competitiveness and profitability from low cost labour. However, there are many successful manufacturing companies in first world economies, including the Australian medical device manufacturer ResMed. These companies have maintained their competitiveness by driving innovation and improving their efficiency, effectively meeting more customer needs with less material and effort.

Ideas and systems to continuously improve efficiency are extremely valuable for a society that is seeking to improve its standards of living in an environment of declining resource availability. An extensive literature review identifies the systems and ideas that enable manufacturing companies to continuously improve efficiency. The review begins with a brief overview of the historical development of modern manufacturing ideas before launching into a detailed study of the concepts that form the foundation of contemporary manufacturing systems including the works of Shewart, Juran and Demming. The study of these philosophies is supported by examples of current systems and practice from industry leaders such as Toyota, Lincoln Electric and Motorola.

The literature review forms the foundation of the evaluation criteria established to analyse how business systems at ResMed Ltd. support ongoing improvement of its operations to ensure the future success of the business. The evaluation is split into 8 overlapping fields including business strategy, employee recruitment and development, waste reduction, consistent production flow, technology selection, relationships with suppliers and distributors, problem solving structures and communication structures. The evaluation report documents the systems from the perspective of a Patient Interface Manufacturing Engineer and includes the development of each business system, the current form of deployment and any evidence of its ongoing effectiveness.

The outcomes of the evaluation have been used to develop and justify several improvement projects of differing scale throughout the Patient Interface Department. These project briefs and the documented progress towards implementation form the final section of the report. The projects are targeted at systemic deficiencies observed during the evaluation and should help ongoing improvements to efficiency and innovation required to ensure the future success of the Patient Interface Manufacturing Operations.
INVESTIGATION ON INFLUENCE OF SALT CONTENT ON PLASTICITY OF BENTONITE CLAY (6cp)
Sonja Jaric - S10-062

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

Soil is an important civil engineering material, whose properties influence the strength, stability and serviceability of civil engineering structures. There are many factors which influence the properties of soil and it is important to be aware of these factors and how they affect our construction materials. Liquid Limit is one parameter which can be used to approximate important soil properties, including compressibility and shear strength, and thereby assist in determining the suitability of a particular material for its proposed use.

This Capstone investigates the effect of Sodium Chloride (NaCl) on the properties of clay. This is carried out by determination of the Liquid Limit of Bentonite Clay with NaCl contents ranging from 0-10% using the Cone Penetrometer apparatus in accordance with Australian Standard testing procedures.

Further motivation for this research results from several instances where inconsistencies between data obtained from in situ testing and laboratory testing have arisen. The inconsistencies may have occurred due to salt content, therefore the results of this investigation may also be useful in addressing this issue and developing possible recommendations to Australian Standards for the improvement of formal testing procedures to account for this influence.

This Capstone briefly reviews current literature on the relationship between NaCl and Liquid Limit, outlines the experimental procedure conducted, discusses the results in order to deduce a relationship between NaCl and Liquid Limit, and finally makes a recommendation based on the literature reviewed and experimental results attained.

Prior studies undertaken at UTS are confirmed by the results which show that the Liquid Limit of Bentonite Clay decreases significantly with the increase of NaCl content. This research will contribute to these studies by allowing conclusions to be drawn, possible recommendations to formal testing authorities such as Australian Standards to be made, as well as supporting further research in this area.
VARIANCE IN RESIDENTIAL HOUSING CONSTRUCTION – NATION BUILDING ECONOMIC STIMULUS PACKAGE (6cp)
Lucas Jordan - S10-064

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

The construction industry has changed little over the past few decades compared to industries within the manufacturing sector with regard to design, supply and assembly. Increased efficiency in the manufacturing industry is evidenced by “lean production management”, businesses striving to maximise value and minimise waste. Unfortunately, the construction industry experiences little in the way of “lean production management”. Consequently, the cost of construction is volatile, depending largely on the market through popular mechanisms such as the tendering process.

This Capstone Project is a study of the variance in cost of residential housing construction with comparisons across such fields as size of contractor, location of job, time of contract award, length of contract and number of concurrent projects. This study has been undertaken in the context of the current economic stimulus conditions with the shear number of residential housing projects in construction as part of the Nation Building Economic Stimulus Package, a Government initiative to provide over 6500 affordable dwellings across New South Wales. The current stimulus climate provides a unique opportunity to study residential construction on a large scale. Prior to the Federal Government’s Stimulus Package, the Department of Housing New South Wales commissioned 300 dwellings per year on average compared with 6500 dwellings in two years under current stimulus conditions. This Capstone Project focuses on analysing a large sample set of projects across New South Wales to establish trends. Such findings may be extracted to produce a set of indices which could set useful comparative values. For instance, such data would be useful when evaluating tenders (client perspective) or as a baseline for producing a competitive bid (contractor perspective).
Neuro-muscular disorders such as arthrogryposis multiplex congenita, muscular dystrophy, cerebral palsy and stroke can severely limit limb flexibility and strength. This makes it increasingly difficult for one to perform even the simplest of everyday tasks such as feeding themselves, lifting a cup or combing their hair. Even with continued therapeutic care, muscles will continue to deteriorate.

Recently, there has been significant research into the development of active exoskeletons (human wearable robots), which provide an external force onto the limb, to compensate for muscular degradation. Such machines pose a potential danger to the wearer, in the event of system failure, where excessive force is applied to the limb.

The development of an external passive exoskeleton will assist people with neuro-muscular disorders while reducing the danger present in active systems. A passive exoskeleton utilizes the internal energy of the system such as weight, thus limiting the force provided to the limb, reducing the potential dangers to the user.

This project presents detailed research and analysis of the kinematics of the WREX upper limb exoskeleton (an existing commercial product). Such information is not currently detailed in academic literature and an understanding is required to facilitate future innovation. The WREX exoskeleton is a 4DOF system that assists the user but presents a limitation of pronation and supination of the forearm. Further, the use of linear springs in the gravity compensation process of the exoskeleton creates a non-linear feel to the system.

An analysis of the torques applied to each joint of the WREX has been simulated through computer modelling, as well as construction of a physical prototype. This simulation allowed further study of elastomers and springs to optimise the system, by reducing the non-linear feel.

The result of this capstone is a better understanding of how the WREX system works, the limitations of this implementation and potential solutions to these problems.
DISTORTIONAL STRESS OF COLD FORMED PERFORATED MEMBERS USING FINITE ELEMENT ANALYSIS (6CP)
Ryan King - S10-080

Supervisor: Ali Saleh
Assessor: Hamid Valipour
Major: Civil Engineering

This thesis examines the behaviour of steel industrial packing frame columns under direct axial loadings. Tests and simulations have been performed to explore the modes of failure under this loading type along with the failure stresses reached. From this investigation primarily using Finite Element Analysis (FEA), recommendations for a more efficient design system can be made.

The project is focused specifically on a typical Dexion perforated steel upright for analysis. The scope of this project only allows for the investigation of axial loadings, however it is hoped that similar investigations could be made into other loading types to achieve an all encompassing solution in the future. The project has been performed in association with a Dexion company representative to ensure that the analysis remains both relevant and useful.

The Finite Element Analysis program Ansys has been used to create computer models of the Dexion uprights. Lab testing of specimens provided initial material data and were also used to confirm the results produced by the Ansys models. As the system models plastic distortional failure modes it was imperative that both geometric and material non-linearities were used. A considerable investigation into Ansys and the use of pilot models has been performed to further ensure the validity of the procedure.

A column curve for the upright has been produced to relate ultimate stress capacities to column slenderness ratios from the models produced. Also, a comparison is made between the theoretical column curve produced and predictions of strength capacities from using the AS4600 building code highlighting any discrepancies. This all should allow for a more efficient and flexible design of the bracing and packing shelf attachment points considering the typical distortional failure modes likely to occur. Significant findings and recommendations are also made at this stage.
DEVELOPMENT OF A .NET-BASED SYSTEM FOR UTILISING REAL-TIME LOCATION-AWARE DATA COLLECTED FROM ROAD-BASED PUBLIC TRANSPORT IN ORDER TO PROVIDE SERVICE IMPROVEMENTS. (12cp)
Samuel Kirkpatrick - A10-065

Supervisor: David Lowe
Assessor: Xiaoying Kong
Major: ICT (Computer Systems) Engineering

The deployment of Global Positioning Systems (GPS) in public transport has in recent times become commonplace; additionally a greater number of vehicles are being fitted with 3G data communications for driver communication. These are typically proprietary systems, designed for a single purpose which tend to operate independently of one another.

The goal of this project is to demonstrate that significant improvements can be made to road-based public transport with the development of a distributed real-time information system based on integrating GPS and 3G technologies. This project will also demonstrate the suitability of the .Net framework and C# as a high-level framework and language for the development of a distributed soft real-time system.

The projects .Net demonstration system entitled ‘TransTrac’ showcases features such as: an open on-board Application Programming Interface (API) to allow future 3rd party real-time sensors and Apps to be seamlessly added to vehicles, a passenger information system that displays maps of the local area along with specific landmarks and features, and a location, time and route based advertising system that is able to display targeted image and video advertisements to passengers based on the location of the vehicle. In addition to the showcased features the system provides a stable real-time vehicle tracking and messaging system. It centrally records the movement of all vehicles for later analysis and raises alarms for drivers and operators if vehicles deviate from scheduled waypoints and stops by a configurable level.

The ‘TransTrac’ system that has been built is a prototype proof-of-concept system that has succeeded in providing a wealth of knowledge about the possible benefits to public transport and the suitability of .Net. Future work would include looking at types of sensors and Apps that could be integrated into the system and development of an effective rule-based system for selecting and distributing location-based advertisements in real-time.
INVESTIGATION OF KINETIC ENERGY RECOVERY SYSTEMS AND ITS APPLICATIONS (6CP)
Vincent Lee - S10-091

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

Everyday, more and more cars are being manufactured and driven on the road. The World oil reserves are depleting and the level of pollution in the atmosphere generated by burning fossil fuels is increasing significantly. It is only a few decades away that our oil reserves will be totally depleted.

Kinetic Energy Recovery Systems have attracted more interest in the past few years because they are systems that recover and store the kinetic energy of the vehicle while braking and using this energy to accelerate the vehicle or power the electrical system on the vehicle. Basically, this system captures and utilises energy that would have been wasted as heat in normal friction based braking. This process enables vehicles to use less fossil fuels, hence less pollution will be created and prolonging our oil reserves.

The objective of this project is to investigate and analyse information regarding Kinetic Energy Recovery Systems and its applications. The project will involve investigating the different types of Kinetic Energy Recovery Systems available today, which system is suited to certain applications, the advantages and disadvantages of each system, development and benefits of utilising such a system. It will also include an investigation into the challenges that affect their applications and development and how these complications can be solved.

The report will assist people to understand how Kinetic Energy Recovery Systems work and make them aware of the potential benefits. It will also make manufactures aware of the potential solutions to the challenges that hinder the use and installation of Kinetic Energy Recovery Systems in their vehicles.
As a part of their research into human robot interaction in an indoor environment, the ARC Centre of Excellence for Autonomous Systems at UTS has developed the RobotAssist platform, a wheeled anthropomorphic robot designed to perform human-like tasks. As an ongoing research project, the robot receives continuous modifications to improve its construction and functionalities.

The purpose of this project is to increase the coverage of the sensors and the workspace of the manipulator(s) to allow the robot to perform tasks that were previously beyond its capability.

After some research and discussions with members of the project, it was decided that adding a two degrees of freedom (pan and tilt) to the robot's upper body (consisting of the arm(s) and the sensor suite), through the installation of a waist, will effectively achieve that goal, within the constraints of time, resources, and hardware available to the project.

Numerous alternative designs were proposed, and evaluated based on criteria including dimensions, strength, ease to manufacture, and compatibility with existing hardware. A prototype was built out of poly(methyl methacrylate) and underwent testing to verify its suitability.

Throughout the design process, Solidworks was used to produce the 3D models and analyse the mechanical characteristics of the components and assemblies. CAS’ laser cutter was used to produce the prototype. And the final product will be produced by UTS' engineering workshop.
URBAN WATER CONSERVATION PROGRAMS: A COMPARATIVE STUDY BETWEEN AUSTRALIA AND CHINA (6cp)
Katrie Lowe - S10-182

Supervisor: Saravanamuth Vigneswaran
Assessor: Jaya Kandasamy and/or H.H.Ngo
Major: Civil and Environmental

Water conservation programs that encourage households to reduce their water usage are a proven demand management approach practiced in many countries. Whilst the common end goal may be to conserve water, the context and method of implementation of programs can vary.

Much of the existing literature on water conservations strategies focus on outlining template program structures for the development of successful water conservation programs. However, very little public documentation exists as to the degree of success and challenges faced for the many variants of water conservation programs that have been implemented worldwide.

Through the comparative study of domestic conservation programs implemented in Sydney and Beijing, this thesis documents the different design considerations and challenges faced by two variants of water conservation programs. Analysis of programs from these two cities reveal that whilst differences in methods of implementation, social structures, and emphasis on different program elements such as price signals do have a significant influence on program outcomes, there does exist common factors that are crucial to improving the performance of programs despite variations in program context. The key findings of this study have the potential to further assist in improving the design of water conservation programs globally.

This thesis draws on information collected from the main water utilities of both cities. Sydney Water, as the main water utility for Sydney, was consulted in the locating of relevant documents, with two interviews also conducted to assist in developing a more candid understanding of the city’s water conservation programs. Also included are findings from a visit to the Beijing Water Conservation Exhibition Centre. Documents used in researching Beijing’s water conservation programs have been read in the original Chinese text. Additional to the above mentioned findings, this thesis is also a unique insight into the content of these documents for the English reader.
FEASIBILITY STUDY OF ALTERNATIVE TECHNOLOGIES FOR TOILET FLUSHING APPLICATION IN SYDNEY METROPOLITAN AREA. (6cp)
Alan Mak - A10-099

Supervisor: Huu Hao Ngo
Assessor: Wenshan Guo
Major: Civil Engineering

Sydney’s recent water crisis from 2007-2009 is a critical problem. Historically, draught has been a major problem for Sydney and with the population being expected to grow to six million by 2036, there is pressure to secure sufficient water supply.

In a typical household, a person uses about 50,000 L of fresh water per year, where 41245 L (82.5%) has the potential to become grey water (through showering, cleaning and kitchen applications) and 8030 L (16.1%) becomes black water (through toilet flushing applications). This means that only 725 L (1.5%) of water is used for consumption purposes. While it is logical to use fresh water for cleaning and kitchen purpose which involves human hygiene, it is unreasonably inefficient to use drinking quality water to flush our toilets.

The main aim of this project is to contribute to the efforts of finding suitable solutions to this problem. Through scientific literature, a variety of outstanding technologies available at the time of writing, this report has been analysed for their feasibility within the context of the Sydney metropolitan area.

Currently the NSW government acknowledged Sydney’s need for expanding water supply and hence proposed the latest 2010 Metropolitan Water Plan as its comprehensive strategy. Acknowledging this plan, the report focused on obtaining additional methods of supplying water for toilet flushing applications.

The report displays a selection of innovative technologies which includes: use of direct sea water (currently being used in Hong Kong and other countries), rain water tanks, decentralized grey water recycling and the most recently introduced semi-centralised wastewater treatment systems.

The conclusion from this report has identified a number of feasible options for promoting efficient water use in the context of Sydney metropolitan area. Readers should be able to appreciate the role of alternative technologies to provide for sustainable and efficient water usage.
Building maps is one of the fundamental tasks of autonomous mobile robots. It is only by having a detailed knowledge of its surroundings that a robot is able to perform useful location based tasks. Building a map while travelling in an unknown environment is known as SLAM (Simultaneous Localisation and Mapping) and is a complicated problem in mobile robotics due to the interdependence of mapping and localisation. Quick and accurate solutions to the SLAM problem are an essential area for development and research at the moment as there is great potential for autonomous systems in our society.

This project was undertaken in conjunction with the UTS CAS (Centre of Excellence for Autonomous Systems) team who participated in the 2010 robocup@home competition in Singapore. This event was based around a series of household challenges with the aim of developing service and assistive technology with high relevance for future personal domestic applications.

The project work up to the competition involved developing a SLAM algorithm that could be used offline to map a household environment from logged 2D laser data. The algorithm predicted the robot path and corresponding map using ICP (Iterative Closest Point) scan alignment and regularly updated these predictions using feature detection and least squares optimisation as opportunities arose.

The project work after the competition focused on improving the SLAM method for the following year. This included investigating the potential of GMapping, a SLAM algorithm that combines a particle filter in which each particle carries a distinct representation of the map, with an occupancy grid and various adaptive techniques. After adapting the GMapping code specifically for the CAS robot platform the technique was found to be quite robust and offers great potential for the competition next July.
EXPERIMENTAL STUDY OF RIVER BANK STABILITY (6CP)
Alex Mosse-Robinson - S10-104

Supervisor: Hadi Khabbaz,
Assessor: Alireza Keshavarzi
Major: Civil Engineering

River bank stability is an ongoing engineering issue and there are many methods and techniques used in protecting banks from collapsing. When there is a potential for excessive erosion, resulting in large scale bank failure and the undermining of nearby buildings, bridges piers and abutments etc. structural solutions may be required. Bed sills are one such solution. Their presence limits the general erosion process, however also causes a local scouring phenomenon which in itself can become hazardous if not properly considered during design.

An experimental study on local scouring downstream of curved bed sills in a uniform sand bed was carried out in the hydraulic flume at the University of Technology, Sydney. The main objective of this study was to determine the dimensions of the resulting scour holes during the equilibrium stage. It was hoped that the interaction between the water flow and the bed sills would allow for a build-up of sand, which ultimately would aid in the stability of the river bank.

Three experiments were conducted using various flow rates (i.e. 27, 37 and 40 l/s) with a spacing of 400mm between the bed sills. These results are compared to similar experiments using matching flow rates, however with different spacing’s (300, 500 and 600mm). This experiment is unique as it is exploring the new concept of using curved bed sills rather than the previous standard of straight or angular. The different flow rate’s velocities were measured using an Acoustic Doppler Velocimeter (ADV) every half an hour during the experiment, and a relationship between these measurements and the final scour hole dimensions is explored. This experimental data and research may ultimately be used in adapting curved bed sills as a cheap and easy to install means of river bank stabilisation.
Deep Soil Mixing (DSM) is a ground improvement technique generally applied to soft clays in an effort to improve their bearing capacity under construction loading. The process involves injecting cement or lime in a dry or slurry form into in-situ soil using a rotating mixing shaft. Soft clay is deemed a problematic foundation soil due to its sensitivity to temperature, water content changes and low bearing capacity. The DSM process aims to reduce the settlement of the soil by increasing the stiffness of the material, in an effort to satisfy design criteria and improve performance of structures built on these soils.

This experimental Capstone project studies the influence of surcharge on soil-cement columns applied during their curing. It is proposed that a preload provides confinement and pre-compression during curing, which in turn increases bearing capacity. The stress vs. strain relationships are analysed to illustrate how the mechanical properties are influenced under a surcharge applied instantly after mixing.

Q38 Kaolinite was the clay selected for analysis. A moisture content 1.5 times the Liquid Limit of Kaolinite provided suitable consistency for mixing and moulding, as well as an accurate representation of the conditions often encountered with clay on site, where the natural water content tends to be in close proximity to, or above, the clays liquid limit. Samples with varied cement contents, by percentage, of the clays dry weight were used. The specimens were placed into cylindrical moulds with varying surcharges applied for 7 days under sealed conditions. The samples were then saturated for 7 days before being tested for compressive strength. Control samples, for each cement content, were kept in similar conditions.

As expected the results showed the soil-cement columns increase in strength with greater cement content. In addition the results show a trend of increased strength with greater surcharge. It is concluded that properties of DSM improved ground can be improved by surcharging the ground immediately after construction, during the curing phase. This could potentially provide a cost effective and environmentally beneficial alternative replacing the excessive cement content being added to soil to achieve a certain strength.
DISPLAYING LARGE SETS OF DATA IN A MEANINGFUL WAY (12cp)
Steve Munro - A10-099

Supervisor : Zenon Chaczko
Assessor : Robin Braun
Major: Software Engineering

As our lifestyles are progressively becoming more digitally based, with tools such as GPS devices, cameras, and mobile computing devices becoming more mainstream, greater and greater quantities of data are constantly being produced. Consequentially, the ability to analyse data without the aid of dedicated tools is becoming less infeasible.

The capstone project undertaken aims to study the emerging issue of data overload, and provide a utility that may be used to facilitate the visual representation of these large sets of data in a manner in which an end-user may rapidly identify trends embedded in their data.

The project has involved the creation of a system that offers the end-user the ability to upload and analyse geodetic based data sets. This uploaded data is processed by the system, being analysed and optimized based upon rules defined by the end-user. Finally, the results of the analyses are rendered visually within the system, allowing for the end-user to make judgments on their data set that would be previously impossible, due to the data trends being obscured by the sheer scope of the raw source.

Finally, the system has been designed and implemented following object-oriented principles. A focus on the use of open source technologies has been maintained throughout the design. The modular fashion of production seeks to allow the further development of plug-in modules that may extend the functionality of the overall system at an end-user’s discretion, without the need to undertake fundamental changes within the core system implementation.

The final implementation offers not only a tool that may be used to perform hitherto unavailable analyses on large sets of data through means of a visual medium, but also the ability to rapidly develop additional techniques that can be applied at an end-user’s behest.
THE ADOPTING OF LEACHATE IRRIGATION PRACTICES AT CLOSED LANDFILL SITES: A SYDNEY CASE STUDY (6cp)
Harry Nour S10-115

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

Water security, although it has always been instrumental in the functioning of human society, has recently taken on a new significance as the population continues to grow and drought occurrences become more common. This has seen a recent shift towards the recycling and utilization of water sources such as rainwater and sewage that have traditionally been considered as unwanted wastewater.

One form of wastewater harvesting is landfill leachate irrigation, a process whereby leachate collected from landfill sites is used to irrigate vegetation on or around the landfill site itself. This practice helps provide additional sources of non potable water and also eliminates the need for expensive chemical and energy intensive leachate treatment processes. Despite this, leachate harvesting has so far only been adopted to a very limited extent.

However, as water security and costs continue to become more pressing social and environmental issues it is likely that leachate irrigation will become an increasingly popular option. Testament to this is the fact that the owners of a landfill site in Sydney are currently looking at the feasibility of using the leachate from their site to irrigate a golf course and other recreational areas constructed on top of the landfill. Work undertaken so far on leachate harvesting has been quite limited in that it has tended to focus on specific issues involved in leachate irrigation or associated fields rather than addressing the numerous facets collectively.

As such, this capstone paper provides a comprehensive literature review that gathers, collaborates and finally critically examines the many facets related to leachate irrigation especially in regards to its practice in the Australian context. Building on this it then seeks to discuss and address the possibility of undertaking leachate irrigation at the aforementioned Sydney landfill site.

By providing a single coherent and comprehensive body of work on leachate irrigation at landfill sites this capstone project will hopefully serve to in some way draw attention to or even facilitate the more widespread adoption of leachate irrigation at landfill sites, especially in Australia.
AN INVESTIGATION INTO ENERGY EFFICIENT AIR CONDITIONING (12CP)
Frank Packer - A10-110

Supervisor : Mr. John Dartnall
Assessor : Assoc. Prof. Guang Hong
Major: Mechanical Engineering

Strong evidence exists that the planet’s greenhouse warming effect has been significantly increased by human activities. International frameworks aimed at stabilizing atmospheric concentrations of greenhouse gases have been established in an effort to avoid dangerous changes in world climate. Energy consumption is the main contributor of greenhouse gas emissions to the atmosphere and energy efficiency has become an important abatement strategy.

Buildings account for approximately forty percent of the world’s primary energy consumption and one-third of global greenhouse gas emissions. A significant proportion of total building energy consumption is due to the operation of heating, ventilating and air conditioning (HVAC) equipment. The growing challenge for the HVAC engineer is to design more energy efficient HVAC systems that meet the increasingly demanding needs for thermal comfort and indoor environment quality of occupants.

Dedicated outdoor air systems (DOAS) are a technology that has experienced significant growth in the HVAC market. DOAS units provide benefits of improved indoor air quality, better humidity control and improved energy efficiency. Studies of the performance of self-regenerating active desiccant dehumidification systems for DOAS applications are limited. This project has built upon previously published work to model and predict the energy performance benefits of a commercial system fitting this description.

The investigation used manufacturer’s performance data and established simulation algorithms to develop an energy modeling method to compare a conventional direct expansion dehumidification system with a self-regenerating active desiccant dehumidifier. Energy performance analysis was conducted over a typical meteorological year (TMY) for several Australian cities in a variety of climates. The results from these simulations are presented and conclusions formed about the energy performance of the systems investigated.
Sustainable development has been conceptually existent for decades with initial focus on the principles of ecologically sustainable development. More recently, there has been a shift from the concept of ecologically sustainable development to one of sustainability, to recognise that environmental principles are not the sole guiding criteria for development. Economic and social sustainability have also been affirmed as important criteria. Nevertheless, its recognition on a commercial stage still although embryonic at the moment, is burgeoning in response to one of the greatest challenges faced today.

In today’s society there is indubitably an accelerating level of awareness and redress in response to the anthropogenic impacts on the environment. However, the underlying problem remains to understand whether the measures implemented are in fact auspicious. In order to determine ‘absolute’ sustainability it is important to quantify the effect of the measures comparably against the resource requirements produced by the project. It can then be established whether the controls in place not only reduce the rate of unsustainable increase of resource consumption yet nullify the escalation of resource consumption.

It is with this in mind that a focus on the Central Park development in Chippendale has been taken, with quantification of the project’s otherwise nebulous effects. The controversial project has been subject to a theatrical series of events in its processes of design development and planning approval both of which will be elaborated on. This thesis will clarify key sustainable measures proposed in the design, not to mention demonstrate the differentiation between the project’s sustainable requirements and its responsibility de jure.

The economic outcomes and financial implications that are resultant from the evolution in the concept plan will be devised and discussed to round off a complete analytical picture on the project to date.
A PRELIMINARY INVESTIGATION INTO THE DETERMINATION OF THE
INAUDIBILITY LEVEL OF MECHANICAL PLANT AND MUSIC NOISE IN THE
PRESENCE OF AMBIENT BACKGROUND NOISE (6cp)
Stanley R Phillips - S10-122

Supervisor: A/Professor David Eager
Assessor: Chris Chapman
Major: Construction Engineering

The term inaudibility is implied by local councils and policy makers alike when setting requirements for noise emitted from mechanical plant and entertainment venues which are located close to noise sensitive receivers. However, this term has not been clearly defined to date. As a result, stakeholders are met with uncertainty and designers are left with an inadequate subjective term when attempting to meet location-specific noise criteria.

This Capstone Project involves an investigation into the possibilities of conducting a psychoacoustic experiment that will test for the inaudibility of mechanical services noise and music noise in the presence of ambient background noise typical of the home environment situated in urban and suburban locations.

A preliminary psychoacoustic experiment was designed and trialed within a controlled space and administered with both speakers and headphones. Noise sources were electronically combined with a number of ambient backgrounds at varying relative levels and played back to a number of subjects to determine whether or not an experiment of this nature could provide conclusive data for determining inaudibility levels.

The results of the preliminary psychoacoustic experiment have been presented, along with a detailed analysis of the processes that were required to create and administer such an experiment.

This Capstone Project attempts to provide the framework for future larger scale investigations and provides the relevant findings and a methodology to assist in reducing the subjective nature of the responses observed in order to obtain a subjective definable criteria from which to establish the inaudibility of mechanical plant and music noise in the presence of ambient backgrounds.

AD-HOC NETWORKS FOR SHIPPING CONTAINERS AND PREPARATION OF AN
ARC LINKAGE GRANT APPLICATION (12cp)
David Parr - A10-115

Supervisor: Prof. Robin Braun
Assessor: Dr. Zenon Chaczko
Major: ICT (Telecommunications) Engineering

Shipping containers are logistically problematic for shipping and stevedoring companies in terms of tracking, stacking, de-stacking and content management. The limitations of
conventional wireless networks in reliably penetrating metal shipping containers further add to the logistical problem of not being able to locate a particular shipping container within a stack or storage site nor determine vital information about the contents within.

This research project investigates this shortfall, and a solution of utilising a system of ad-hoc wireless ultrasonic sensor nodes within each shipping container is proposed to overcome the problem. The ultrasonic transducers proposed in the project, resonating at a frequency of 40khz, have the ability to use metal shipping containers as a transmission medium, thus allowing a communication system of transmitting and receiving nodes to effectively penetrate the container stack. The multifaceted ad-hoc network system is comprised of a number of innovative technologies that needed to be investigated in order for the overall system to function. These include the ultrasonic transducers, a long life, low maintenance power source for the complete device, a microcontroller to collect data and manage container to container communication, a low powered routing algorithm, and of course mounting and packaging considerations of the device.

Various tests, both in laboratories and in the field, have taken place to prove the validity of certain fundamental aspects of the project inclusive of the ability of the ultrasonic transducers to be able to effectively transmit and receive signals between metal shipping containers under varying conditions. The subsequent field testing took place on actual shipping containers.

This Capstone project has also included the development of the foundations of an ARC linkage grant proposal to be used to gain further research support and funding for this unique and innovative project.
MODELLING & ANALYSIS OF METROPOLITAN RAILWAY TRACTION RETURN NETWORK (12cp)
Huw Price - A10-117

Supervisor : Quang Ha
Assessor : Steven Su
Major: Electrical Engineering

The increasing complexity of metropolitan railway network requires effective modelling and analysis techniques in order to monitor and maintain safe operations and to evaluate the electrical compatibility of the whole electrical system with respect to current standards. In NSW, responsibility for the safe operations, crewing and maintenance of passenger trains and stations rests with RailCorp, whose electric network is electrified with 1500 volts DC traction supply.

Due to increasing loads across the network as a result of new trains and frequently updated timetables there have been serious concerns raised as to the integrity of signalling infrastructure that comes in contact with traction currents. To investigate these issues, the existing traction return network needs to be accurately modelled and thoroughly analysed to determine currents flowing through signalling equipment and remaining capacity of equipment. The analysis can then be used to flag potential failure points to Signal Engineers which can then be investigated further.

In this work, three lines were chosen to be modelled with each line possessing its own unique qualities such as single-line sections, steep grades and busy terminus stations. From the point of view of a worst case study the combination of these three lines provides a useful overview of the whole railway network. The data obtained from the models showed that although most signalling infrastructure could handle the increase in traction currents there was some equipment that would need to be upgraded to a higher rated capacity. It also became apparent that during a fault condition such as a broken rail or broken tie-in bond there was little to no redundancy left in terms of current carrying capacity of equipment.

Verification testing showed the coincidence between theoretical and actual results and supported the usefulness and effectiveness of the generated models.
OSI REFERENCE IMPLEMENTATION OF A HOME AUTOMATION AND LIGHTING CONTROL PLATFORM (12cp)
Ken Quach - S10-125

Supervisor: Bruce Moulton
Assessor: Steven Murray
Major: Computer Systems Engineering

The majority of current home automation and lighting control systems in the marketplace are proprietary and closed systems which lock consumers into a single platform. The lack of a reference model or a prevailing standard has limited innovation and take-up of what should be a booming market.

Increased consumer focus on sustainable products and a reduced carbon footprints should result in demand for simple applications such as motion activated or scheduled home heating/cooling cycles, however implementation of such systems is neither simple nor cost effective.

Concurrently growth in the number of personal handheld gadgets, consumer electronics, smart phones and ‘Internet’ capable televisions presents a key opportunity to utilise the increasing ubiquity of computer terminals – what’s missing is a common method to allow these devices to communicate together seamlessly, without locking end users into particular products or vendors.

This project aims to utilise the Open Systems Interconnection (OSI) reference model to implement a prototype home automation and lighting control system, thereby proving that a common platform can be created which is abstracted from any one application, function or product and further can be re-used and built upon for future products.

The use of what has become a common household communications technology, the Internet Protocol (IP) allows further commodity style appliances and technologies to be used in connecting peripherals, dispersing information and automating common functions. As many gadgets now implement OSI compatible protocols such as Ethernet, 802.11a/b/g ‘WiFi’ and HTTP, the use of IP as a common backbone allows seamless control through a system which abstracts their functions into generic procedure calls.

The resulting prototype is standards based implementation of a system which allows a common Apple iPhone/iPad style device to wirelessly control and automate a household light bulb – built on a platform which allows for growth and scalability for further functionality.
Towards Automated Window Cleaning: Mechanical Design (12CP)
Jaspreet Singh Rai  A10-118

Supervisor: Quang Ha
Assessor: Steven Su
Major: Mechanical

There have been more and more high-rise buildings in urban cities. These buildings incur a costly expenditure for having their windows cleaned. Human cleaners who are suspended from the top of the building always face a risk to their life when it comes to cleaning these windows. A probable solution to this problem can be made using robotics and automation technologies. This capstone project is on Automated Window Cleaner, with two focuses on mechanical and mechatronic design to address important issues in window cleaning for high-rise buildings. This equipment shall clean the windows from the outside of tall buildings.

This project is currently being undertaken by two students at UTS with one working on the Mechanical aspect of the project whilst the other works on Mechatronic design. The mechanical aspect of the project deals with proposing a practical design that can be built and tested. Making Computer Aided Design (CAD) drawings of the proposed design was initially a difficult task as there were several alternatives to the table and choosing the best was not so easy without a priori constraints. Manufacturing the selected design was the task that followed next, this proved many challenges in itself. Integration of the Mechanical and the Mechatronic system will need to be done as to provide the proof that a final working product has been made. Challenges such as learning a software, performing various calculations, manufacturing the product and building a test area where the prototype can be tested and verified have been carried out in the project.
ALGAE MANAGEMENT IN THE PENRITH LAKES SCHEME (6cp)
Alysse Reedy - S10-129

Supervisor : Prasanthi Hagare
Assessor : H.H Ngo
Major: Civil and Environmental

The Penrith Lakes Scheme is located in western Sydney, north of Penrith and adjacent to the Nepean River. The development of the scheme involves the construction of eleven man made water bodies (lakes and detention basins) which form the system. Currently, seven water bodies have been completed and operate as a system to maintain recreational quality water in the Sydney International Regatta Centre (SIRC) and Penrith Whitewater Stadium (PWS.)

In the 2009/2010 Summer, the Penrith Lakes Scheme experienced sustained toxic cyanobacterial blooms (specifically cylindrospermopsis and anabaena) resulting in closure of the public lakes and criticism of the system’s water management by government departments.

The aim of this capstone project is to investigate the ecological health of the lakes and detention basin systems within the scheme and identify the potential causes of the algal blooms. This was achieved by analysing water quality data from the lakes using multivariate data analysis, single variable techniques in conjunction investigation into changes in the surrounding land use. The results of the analysis indicate that total phosphorous levels, oxidised nitrogen levels and thermal stratification all correlate with the occurrence of high algae biovolume levels. Excess nutrients are entering the system from an external source and are exacerbated in the Final Basin due to decline in aquatic plant abundance.

Literature research was conducted into potential management strategies and evaluation of their application to the lakes taking into account effectiveness in the system, environmental impacts, social impacts and short and long term implementation costs. The investigation recommended that a combination of techniques should be used with a focus on establishing floating macrophyte systems in the Final Basin, collecting further data to establish the effectiveness of the currently installed aeration systems and isolated trials of ultrasonic algae control.
Timber Concrete Composites (TCCs) are a hybrid technology that combines timber and concrete to form structural members that demonstrate exceptional strength. TCCs are increasingly considered to be an environmentally feasible construction material as it is more carbon neutral when compared to other conventional materials. It is for these reasons that TCCs are currently used for the structural enhancement of structures.

Previous research concentrated on measuring the strength of various TCC shear connections and changes in structural member deflection due to environmental factors. However, minimal research has been carried out to assess the impact of variations in humidity on deflection.

The primary aim of this project is to assess the long term deflections resulting from creep and mechano-sorptive effect when various TCC shear connections are exposed variations in humidity at a constant loading.

The experimental setup involves four TCC beams each constructed with a different type of shear connection. Each beam experiences varying degrees of composite action and is subjected to a constant load with climate cycles simulating dry and humid conditions. The theoretical model predicts that the rapid cycling of moisture content will notably induce a larger long term creep.

Preliminary test results found that prior to the commencement of moisture cycling, the deflection of the TCC beams increased but at a declining rate. When the humidity of the system was increased, an increase in the rate of deflection was found. This phenomenon was also accelerated when the humidity was decreased. It was observed that moisture cycling increased the effect of creep on the TCC beams.

Future research should focus on assessing the extent of moisture cycling in TCCs by including variations of long term loadings on the same TCC beams used within this investigation. In addition, an expansion of this investigation should incorporate the utilisation of TCC flooring systems.
AUTONOMOUS MANIPULATOR BASED OBJECT GRASPING FOR DOMESTIC APPLICATIONS (12cp)
David Richards - A10-120

Supervisor : Nathan Kirchner
Assessor : Alen Alempijevic
Major: Mechanical and Mechatronic Engineering

Robotic technologies continue to evolve and increase in complexity leading to a greater applicability and usability within society. A fundamental requirement for the majority of robotic systems used as domestic assistive technologies is the ability to interact with and manipulate objects in their environment. However, object manipulation is complex and challenging problem with no specific solution and many different applications and implementations.

This project presents a novel alternative to the widely used inverse kinematics solution for mobile manipulator grasp pose selection which integrates obstacle avoidance and joint limit checking into the goal pose selection process. The proposed method uses end effector pose objectives to create a series of cost functions based on sigmoid functions. These functions are optimised using Levenberg-Marquart’s algorithm to determine a valid pose for a given object. This optimisation pose selection method, when combined with an existing path planning algorithm (rapidly-exploring random trees) has been shown to allow autonomous object manipulation over a greater workspace and with greater efficiency, combining collision checking and joint limit checks into the pose selection process.

The method of object grasping developed in this project has been successfully implemented on a 6 degrees of freedom manipulator both in simulation and in the real world environment. The simulation results show that there is a 34% improvement in the ability for the manipulator to find a valid pose and hence grasp an object in its workspace when using the proposed optimisation pose selection method compared with inverse kinematics. This method has been integrated into the Centre for Autonomous Systems RobotAssist project and was key to the success of the project at the 2010 RoboCup@Home competition in Singapore.
According to the Federal Chamber of Automotive Industries (FCAI), July 2010 sales of new SUVs (Sport Utility Vehicle) reached a total of 19,032; 4276 more than the same period in 2009 (FCAI, 2010). This presents an indicator that the SUV market is a strong market contender. This may account for an increase in rollover accidents, as studies have shown that 1/3 of fatal SUV accidents are due to rollovers (Zhang, Smith, Jeyakumeran, and Hu, 2007), which have led to an increase in demand for SUV safety.

Currently, majority of SUV vehicles are used more on road than on rough terrain. This poses issues relating to vehicle stability dynamics as from my experience a high-end SUV still has less handling characteristics than a low-end compact sports car. This coupled with the need for consistent comfort and stability in SUV’s is why improvements need to be made to the suspension dynamics.

This capstone will validate whether the use of a passive interconnected suspension system presents evidence of improved handling dynamics and safety to SUVs from a series of controlled tests with both the standard and modified vehicle. This completed analysis with conclusions made will provide facts and data for the verification that the risk of rollover accidents and resulting fatalities will be considerably reduced whilst the handling dynamics and ride comfort of the vehicle will be significantly increased.

The capstone will conclude with recommendations for the future to ensure that the project can be implemented in the field of automotive and mechanical engineering at the earliest possible time.
We have created a phenomenon that we cannot control, since our origins, water, air and forms of life are intimately linked. However, recently, we have broken those links. Let’s face the facts; we must believe what we know. All in what we have seen is the reflection of human behavior, we have shaped the earth in our image, we have little time to change, and how can this century carry the burden of approximately 7 billion (2008) human beings, if we refuse to be called to account for this problem to stop.

Australia and the globe are experiencing rapid climate change. Since the middle of the 20th century, Australian temperatures have, on average, risen by about 1°C with an increase in the frequency of heat waves and a decrease in the numbers of frosts and cold days. Rainfall patterns have also changed - the northwest has seen an increase in rainfall over the last 50 years while much of eastern Australia and the far southwest have experienced a decline.

This project investigates the remedies of climate change across the countries such as China, India and the United States of America compared to Australia’s rectification in following how these issues have been addressed. In particular, this report focuses on the environmental analysis of how each country is addressing the issue of climate change in such areas as social, technological, political, economical and environmental aspects.

This project compared to the way Australia is addressing climate change. It will be in a tabulated form outlining the issues that needs to be meet followed by statements and ideas that can assist either lowering or eliminating greenhouse gases. These recommendations will be used on a practical basis which can be exercised as an alternative approaches.

In conclusion, this project explores each countries way of dealing with climate change. It is evident that they all acknowledge the effects of climate change; however to what extent would they achieve to receive the ultimate elimination of climate change.
ELECTRONIC CONTROL OF A TOYOTA 2GR-FE ENGINE FOR LABORATORY DEMONSTRATION PURPOSES (12cp)
Mina Tadros - A10-134

Supervisor: Peter Tawadros
Assessor: Guang Hong
Major: Mechanical Engineering

A new engine has been acquired by the university for the purpose of creating a new undergraduate laboratory which will demonstrate thermodynamic power cycles and emissions output of petrol engines. This project is of great interest to, not only academics but also anyone in the automotive industry as it will further develop the understanding and future developments in automotive advancements through the mechanical engineers of the future.

The main purpose of this project is to create a laboratory for upcoming undergraduate mechanical engineering students that participate in UTS subjects, Thermodynamics and Internal Combustion Engines. The purpose of providing hands on learning experience for better understanding of the theories taught in these subjects as well as creating a platform for future capstone students. These capstone students will have the opportunity to conduct vibration analysis of real systems, test theories such as thermodynamic efficiency of the 4 stroke power cycle and understanding emissions control of petrol engines.

There are also research applications utilising this engine within UTS – primarily to do with investigation of emissions control and alternative fuels. Besides these research applications new theories, concepts and ideas can also be applied to this laboratory and the relevant research and testing can all be under taken in-house at UTS.

By providing future undergraduate mechanical engineering students with a better understanding of these topics, will have a great impact to areas such as society, global warming and the future of sustainability as these have evidently been the driving force of engineering the last couple of decades, especially in the automotive industries.
AN EVALUATION OF THE RELIABILITY OF TWO-DIMENSIONAL HYDRAULIC MODELS IN THE APPLICATION OF THE DIRECT RAINFALL APPROACH (12cp)

Erika Frances Taylor - S10-158

Supervisor: James Ball
Assessor: Jaya Kandasamy
Major: Civil and Environmental Engineering

This paper furthers research performed by Clark (2007 and 2008). The aforementioned research was conducted at the request of the Engineers Australia, Australian Rainfall and Runoff (ARR) (1987) Revision Technical Committee. Within the revised version of ARR there will be the inclusion of a chapter concerning direct rainfall, to which this paper will be considering.

The technique of applying direct rainfall in a 2D hydraulic model is comparatively new. It implements the softwares’ theory of the hydraulic behaviour of water to route the rainfall from the discrete grid cells to the downstream outlet of the catchment. The software achieves this through a combination of user input parameters and 2D grid defined physical attributes of the catchment. The latter includes grid cell area and computational determination of the slope based upon the height differential between grid cells within the catchment. However, unlike the more traditionally employed, hydrologic models, to which comprehensive verification within gauged Australian catchments has been undertaken, direct rainfall in hydraulic models still requires research to be performed.

The research performed by Clark (2007) employed two 2D hydraulic modelling software packages, namely TUFLOW (WBM Pty Ltd, 2006) and SOBEK (Delft Hydraulics, 2007), and one hydrologic modelling software, the Watershed Bounded Network Model (WBNM) (Boyd et al, 2007), within an ungauged catchment. These models were consequently compared to each other to assess the sensitive to model parameters of the two hydraulic models against the hydrologic model. Expanding upon this research within the same catchment, this paper will employ the 2D hydraulic modelling software, MIKE 21 (DHI, 2008).

The conclusion of both this paper and Clark’s (2007) research is that the 2D hydraulic models have a degree of variability dependent upon the parameters such as roughness coefficient, time-step, grid cell size, and threshold for the wetting-drying calculations.
Concrete is a kind of construction material widely used for highway bridges in current civil engineering industry. According to the properties of concrete, it has relatively low tensile strength, but significantly higher compressive strength. Therefore, concrete would always fail by the tensile strength it takes. The conventional concrete material, which has been widely used to overwhelm this problem, is the concrete reinforced by the steel bars. The steel bars are cast in the part of the concrete which takes the tensile strength from the load action taken by the concrete structures in order to reinforce the concrete structures.

However, since the development of this reinforced concrete, there was another idea from the industry to overwhelm the weakness of the low tensile strength of concrete by adding the compression into the section of it before the external load action was applied. This action of inducing a precompression in concrete elements is called prestressing.

In the highway transportation system, “Highway Bridge” is defined as the structure that can carry the highway or motorway over the body of water, over or under railroad, or highways. At the same time concrete is the most popular construction material for highways bridges in the world currently. In this project, there are four sections will be adopted to study the two different sorts of concrete structure of highway bridges: reinforced concrete structure, and prestressed concrete structure: literature review, strength limit check & comparison, serviceability limit check & comparison as well as cost analysis & comparison. The method of finite element analysis will be applied into this project in order to obtain accurate and complete results. By applying these methods, we can figure out the advantages as well as the disadvantages of them so that the optimal solution including the cost analysis can be offered to the industry.