MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

ENGINEERING AND FOOD TECHNOLOGY
YEARBOOK 2014

THE ENGINE
OF THE NEW
NEW ZEALAND

FOR MORE INFORMATION

email: **engineering@massey.ac.nz**
or visit: **www.massey.ac.nz/engineering**
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Welcome

Engineering and Technology at Massey University will celebrate its 50th anniversary in 2015. Graduates can now be found in New Zealand and around the world in careers including technical design, manufacturing and general management. Today, Massey University offers a wide range of courses at both undergraduate (B.Engineering, B.FoodTechnology, B.Science, B.InformationScience and B.Construction), and postgraduate (Diploma, Masters and PhD) level.

While providing a strong grounding in the principles of engineering and technology we have recognized the need for graduates who are well rounded in their problem solving skills, communication, ability to work in teams and appreciation of the wider commercial, economic and social environment. Our courses are designed to develop these skills with a strong emphasis on activity-based learning.

Right from day one students are immersed in projects that challenge their problem solving ability in a range of different contexts - from designing solutions to improve living conditions for the people of the Mekong Delta to developing products for a new start-up company.

The culmination of the undergraduate degree programme is the final year capstone project. Here the students apply their knowledge to the solution of real life commercial or industrial problems. This booklet presents summaries of the Engineering and Food Technology 4th year projects from 2014.

Students can choose to major in one of 5 key areas – Product Development, Mechatronics, Electronics and Computers, Chemical and Bioprocessing, and Food Technology. Each major provides the opportunity for further specialisation.

A Massey University engineering or technology degree provides you with the high level of technical knowledge AND the professional skills to truly make a difference – today and into the future.

The Butterfly

By replicating the complex micron - and nanometer-scale photonic structures that help give butterfly wings their colour, researchers have demonstrated a new technique that uses biotemplates for fabricating nanoscale structures that could serve as optical waveguides, optical splitters and other building blocks of photonic integrated circuits.

INDUSTRIAL MANAGEMENT & INNOVATION

Successful innovation demands the understanding and integration of a wide range of inputs. Industrial Management & Innovation at Massey Engineering provides the students with an excellent basis in engineering, complemented with industrial management, quality assurance, marketing and innovation practice.

Graduates in Industrial Management & Innovation are well places to take on roles which demand an ability to work in a multi-functional environment where a high level of communication and integrated problem solving is essential.

Kahumana Cracknell

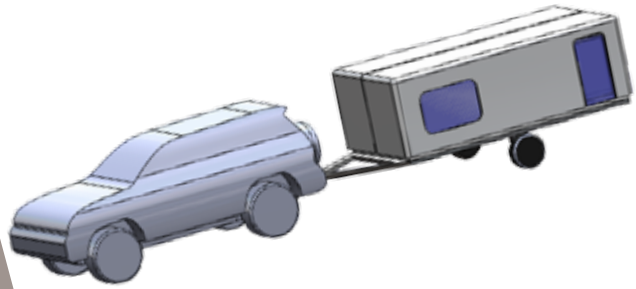
Colenso High School
Major: Engineering and Industrial Management
Supervisors: Dr Greg Frater, Mr Ralph Ball

Veterinary Irrigation Cannula

The client (a veterinary surgeon) wanted a device that he could quickly snap on to his surgical rotary burr hand piece to apply water to the site of operation. Relevant patents were found and an alternative solution that lay outside of the patent scope was potentially identified. Most of the development work over the year was spent verifying and developing the solution in the workshop. It was tested in the vet department and iteratively developed with a vet surgeon's feedback to the point where we had a device that was nearly complete. The next step was to pursue commercialisation by incorporating market research, manufacturing and a quality study into the project. We needed to know how many we could sell, who our market was and how large it was. To protect the design legally, we sought the input from a patent lawyer and incorporated this into the project as well. Over the year, the project has been very challenging and had high points as well as low points. It will be exciting to see where it heads from here.

Expendable Caravan

Mobile lifestyle is increasingly popular among New Zealanders who enjoy exploring the countryside at leisure. However, petrol and diesel prices are also increasing over the past five years and shown no sign of decreasing. As a result, there are growing concerns regarding the cost of travelling with recreational vehicle. Drag force is one the key factors that contributes to a high fuel consumption. Findings from literature review suggested three major sources of air drag on a towed caravan; 1) frontal area 2) distance between towing vehicle and caravan 3) overall shape. With foldable/collapsible/expandable caravans, what comes into one's mind first is the existing products in the market. Despite their advantages of being easy to tow and store, folding caravan does not allow access to the unit while travelling. Besides that users face major problem if they want to leave camping site on a rainy day. Unfolding will expose furniture and electrical appliances to rain water. Thus, the objective of this project to propose a new way of expanding a caravan in order to address stated problems.



Mohamad Ajmal Abdullah

Federal Islamic School Secondary Kajang
Major: Product Development
Supervisors: Mr John Gawith, Mr Tom Robertson

Split-Frame Wall Design for Domestic Buildings

This is a feasibility project to determine a new framing design for the outer walls of a domestic building.

The goal is to produce a design that will improve the thermal and noise properties of a frame, while still maintaining structural integrity.

The new design will do this by providing better insulation within the studs and dwangs of a frame, while still being strong enough to withstand expected forces.

This project focuses on determining whether such a design is possible, and if so, whether it will be cost effective; that is, whether the savings in heating costs would outweigh the required costs of installing such a system.

This project also focuses on how the new design, if feasible, would be incorporated into current building systems such as plumbing and electrical; flooring; and roofing.

CONFIDENTIAL

Charlotte Berghofer

Freyberg High School
Major: Product Development
Supervisors: Dr Greg Frater, Mr John Gawith
Industrial Sponsor: Timothy Smith

Michael Davis

Lytton High School, Gisborne
Major: Product Development
Supervisors: Tom Robertson

Paint Roller Cleaning Machine

Paint rollers are a problem for professional painters due to the fact that they cannot be easily cleaned for reuse. This means that painters replace rollers with new ones once they have been used. Knowing this, painters tend to buy cheap, low quality rollers which negatively affects the quality of the paint application. This makes painting with rollers an extremely wasteful process as either the roller is wasted or a large amount of water is contaminated with paint, making it difficult to reuse without treatment. The purpose of this project is to create a paint roller cleaning product that is capable of cleaning rollers faster and more effectively than current solutions.

CONFIDENTIAL

Akshay Deshpande

Massey University
Major: Product Development
Supervisors: Mr Chris Chitty, Dr Aruna Shekar

Treatment Device and Packaging for Bananas from Plantations in Samoa to New Zealand

New Zealand is the largest consumers of bananas per capita thus reliable supply is needed to meet the growing demand. Currently New Zealand import bananas from Ecuador and small portions from Philippines. Samoa is another nation who produce large quantities of bananas, and have previously been supplying to New Zealand.

However, the ministry of primary industries (MPI) detected some form of tropical insects which had been harvested on the bananas. This essentially became a bio security hazard. With immediate effect, Samoa lost significant market share.

Thus, the objective of this project was to develop a washing device as well as packaging solution, in order for the bananas from Samoa to meet the MPI regulations of New Zealand.

The system which has been developed primarily consists of high pressure steam and water jet system which are two insulated chambers respectively. Through research, it was identified that such system was very effective in eradicating tropical insects in other industries. The bananas are processed sequentially, where they are first undergone through steam chamber followed by the water chamber. Each group of bananas spend 5 seconds in each chamber, which also increases its efficiency.

Lumbosacral Joint Implant for Dogs

Andrew Worth of the Institute of Veterinary, Animals and Biomedical Sciences (IVABS) commissioned this project in an effort to find an improved surgical solution to lumbosacral disease in working dogs. Lumbosacral disease is arthritis of the joint between the last lumbar vertebra and the sacrum (the bottom of the spine). This solution would extend the working life of these dogs protecting both the financial commitment made and the dog's own wellbeing. This condition is very prominent in German Shepherds which are the desired breed for police and military dogs.

Initial work on the implant has already been conducted prior to this project including a tested prototype; however significant engineering analysis has not been conducted.

The purpose of this project is to introduce additional engineering analysis, specifically, guidelines for design parameters of the implant. This includes an estimate on the forces and mechanics involved in the dog and on the implant/screws, coupled with minimum geometries to meet the required strength. This information can be utilised as a basis for improving the implant and as justification for design decisions made.

Ben Hassall

Tawa College
Major: Product Development
Supervisors: Dr Karl Dahm, Dr Greg Frater
Industrial Sponsor: Andrew Worth (IVABS)

Chris Maxwell

Ma jor: Product Development
Supervisors: Mr John Gawith, Mr Alan Wright
Industrial Sponsor: Massey University, Prof. Benoit Guieysse

Photosynthesis Intensity Meter

The Photosynthesis Intensity Meter (PI Meter) is being developed to facilitate the use of a new experimental method developed by Quentin Béchet as part of his PhD thesis in Micro-algae. The PI Meter is a new-to-the-world product which measures the intensity of photosynthetic activity in a micro-algae broth using dissolved oxygen concentration as a proxy. This is done in a fraction of the time and at a higher level of accuracy than current experimental methods and systems are capable of. The PI Meter can complete an experimental cycle in less than 30 minutes, as opposed to 72 hours for the common dry weight and optical density proxy methods.

The PI Meter has the potential to revolutionise the field of micro-algae and photosynthesis research, with potential applications including biofuel research and eco-toxicity assessment. It can also be adapted to measure a number of other aspects of the micro-algae life-cycle, such as NO_2 production.

Valencia

My project is a product that is being developed for the consumer market, specifically in the food service industry. It is something that can be used by people in all walks of life, though is targeted towards the high end market. It has been developed and tested through computer-aided design modelling and rapid prototyping, as an innovation on current products in what has been a relatively recent field, but one with a lot of potential for new developments. If commercialized it could potentially be a game changer within that market, being targeted towards international companies. This is a client-sponsored project and the details are confidential right now.

Anna McDonald

Kingsway School & Westlake Girls High School
Major: Product Development
Supervisors: Dr Aruna Shekar, Mr Chris Chitty, Mr Eric Thompson
Industrial Sponsor: Bernie Radford

Electronic Control of Vehicle Pneumatic Suspension

Air suspension upgrades offer specific benefits in vehicle handling and stability; however these benefits remain underutilised if a system is implemented with no automatic control, as are the majority of installations. This project aims to develop, implement and test an electronic controller designed to utilise specific benefits while taking the manual work and excess components out of traditional air suspension operation. The completed project will include a functional air suspension controller installed in a vehicle for demonstration after thorough experimentation and tuning on a test rig (pictured).

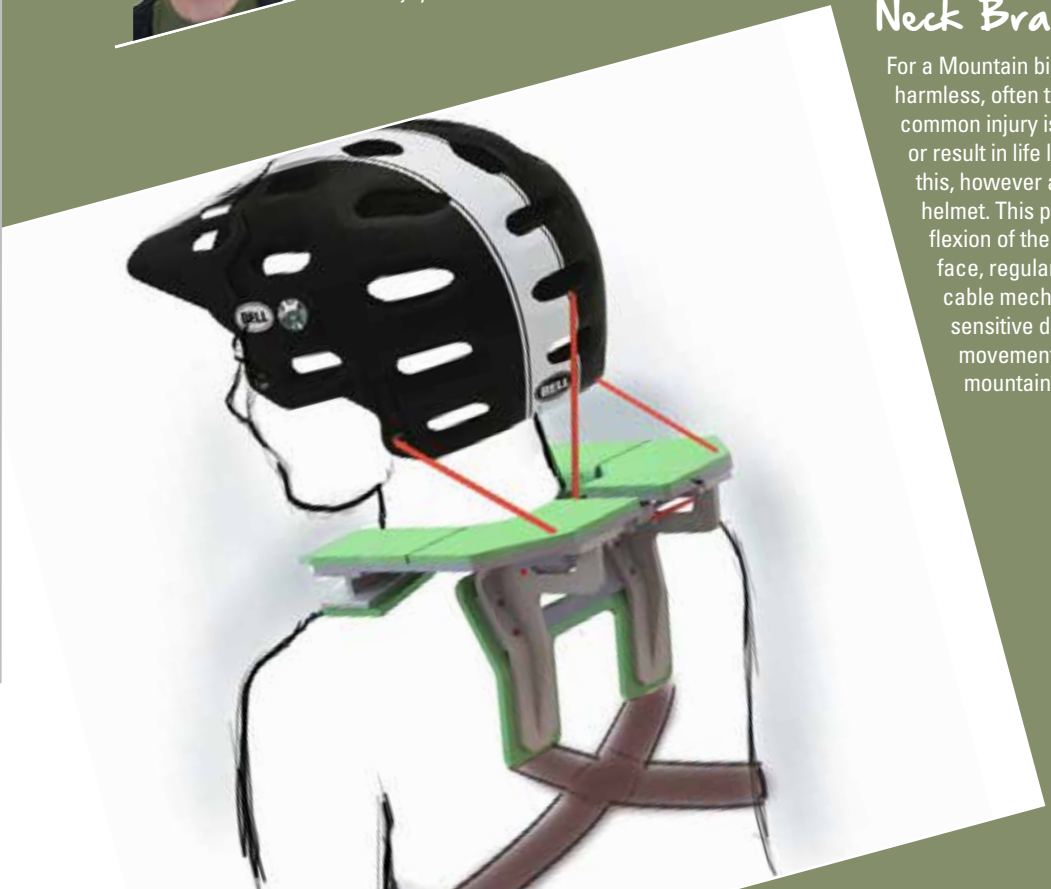
Simon Monteith

Palmerston North Boys High School
Major: Product Development
Supervisor: A/Prof Gourab Sen Gupta

Aidan Moyle

Kerikeri High School
Major: Product Development
Supervisors: Mr Chris Chitty, Mr Eric Thompson, Dr Sanjay Mathrani

Neck Brace for Mountain Biking



For a Mountain biker, crashing is innevitable. While sometimes harmless, often this can result in serious injury. An unfortunately common injury is a broken neck, which can be life threatening or result in life long disability. Products do exist to help prevent this, however all require the use of a full face (motorcycle style) helmet. This project looks at preventing hyper extension and flexion of the neck while enabling the user to wear an open face, regular helmet. This is achieved through the use of cable mechanisms to limit extreme movements with speed sensitive damping, without restricting the user during normal movements. This is a unique neck brace that helps protect mountain bikers from serious injury in falls.

James Tingey

Tauranga Boy's College
Major: Product Development
Supervisors: Dr Ibrahim Al-Bahadly, Mr Tom Robinson

Renewable Energy Power Pack for Disaster Relief

My project is to design a small portable power pack that is powered by the three renewable energy sources: wind, solar and hydro. The power pack is designed for, first response, disaster aid crews when providing assistance to disaster zones in remote areas or communities, where electricity is lost and transport infrastructure is compromised.

The power pack is designed to have the capacity to consistently run a small medical vaccine fridge and basic satellite communication equipment. Each module of the design will weigh less than 25 kg is transportable by a person in a range of different ways. It also eliminates the need for a constant supply of diesel that comes with diesel generator solutions and can also be stacked into the cargo area of a helicopter as sometimes access to remote areas is not possible by road.

Anago Whizard Blade Sharpness Tester

Anago is a Hamilton based company that designs, manufactures and markets machinery used to test the sharpness of knife blades. The core market is meat processing plants which include beef, pork, lamb, fish and poultry. Anago has assigned the project to develop a blade sharpness testing machine for the Bettcher Whizard Trimming tools. These trimmers are used in most meat processing plants but are unable to be tested on the current Knife Sharpness Testing machines (KST) due to its circular blade. Current market research has shown that with the use of the current KST machines, meat processing plants are able to improve quality through reduced user strain injuries, increase cutting speeds, yield improvements and increased longevity of the knives used in the plant. The aim of this project is to be able to offer Anago's customers a solution to test their Whizard trimmers the same way they test their straight knives.

Stefan van Woerden

Hamilton Christian School
Major: Product Development
Supervisors: Mr Chris Chitty, Mr Eric Thomson, Dr Sanjay Mathrani
Industrial Sponsor: Anago, Peter Dowd

The Dragonfly

The body of a dragonfly looks like a helical structure wrapped with metal. Two wings are cross-placed on a body that displays a colour gradation from ice blue to maroon. This structure equips the dragonfly with supreme maneuverability. No matter at what speed or direction it is already moving, it can immediately stop and start flying in the opposite direction.

MECHATRONICS

Increasingly, modern industry relies on the solution of problems requiring a range of engineering skills. Mechatronics is a combination of precision mechanical engineering, electronic control and computer technology for the design of products and processes.

Graduates in Mechatronics are sought after around the world and are found in a wide range of occupations including project management, industrial automation, product and process design and manufacturing.

Mashroor Abdullah

Rutherford College
Major: Mechatronics
Supervisor: A/Prof Johan Potgieter

Light Dependent Mechanical Lampshade

The aim of this project is to combine precise mechanical design; electronics, automation and creative aesthetics to make a lampshade with flower like characteristics. The lampshade blooms open like a flower depending on the light intensity of the atmosphere. The mechanical design is 3D printed as assembled with all working mechanisms. The project then focuses on the electronics and automation features. This includes, measuring the light intensity of the atmosphere and have all the working mechanisms proportional. This is, petals mechanically start to open as it gets dark and slowly diverts back as the environment brightness starts to increase.

Mechatronic Industrial Inspection Device

The inspection device is a mechatronic design used to perform maintenance inspection for a specific industrial product to check for creep damage and assess the remaining lifetime. As part of vacation student employment at a well-known industrial company, I re-designed the data acquisition of the prototype system to be more cost effective. This project is being undertaken to make the existing system into an effective, reliable and robust tool that can be re-manufactured and used in the company's plants across the globe. The key tasks of the project include designing new mechanisms, improving electronic and communication/ software systems, and upgrading existing systems to produce a quality mechatronic inspection device that meets industrial standards and the company's requirements.

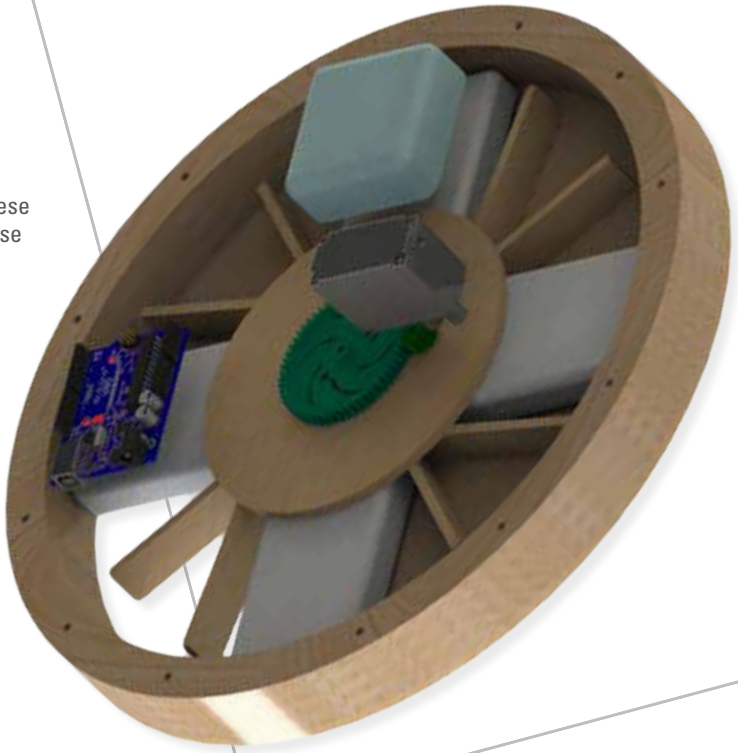
CONFIDENTIAL

Leo Allom

Western Heights High School, Rotorua
Major: Mechatronics
Supervisor: Dr Liqiong Tang

DROP – Dynamic Range-Extending Operational Platform

As technology advances robotic machines are becoming more and more prominent in everyday life. Robots not only deliver superior performance but are capable of many tasks which humans are not. One such application of robotics is within search and rescue. Traditionally search and rescue operators must put their lives at risk in order to save others. Unmanned robots in these situations have the potential to save lives while removing these operators from harm's way. To allow for the maneuverability required in these often tight spaces these robots must be wirelessly operated. This however means that one of the largest limitations of these technologies is the range. This project aims to develop wireless repeating devices and a system that can be equipped on to these robots. These devices will be dropped from the system automatically based on the signal strength and will repeat the original wireless signal. This would increase the effective range of these robots and would be invaluable for saving lives in dangerous situations such as a collapsed mine or house fire where range is the limiting factor.

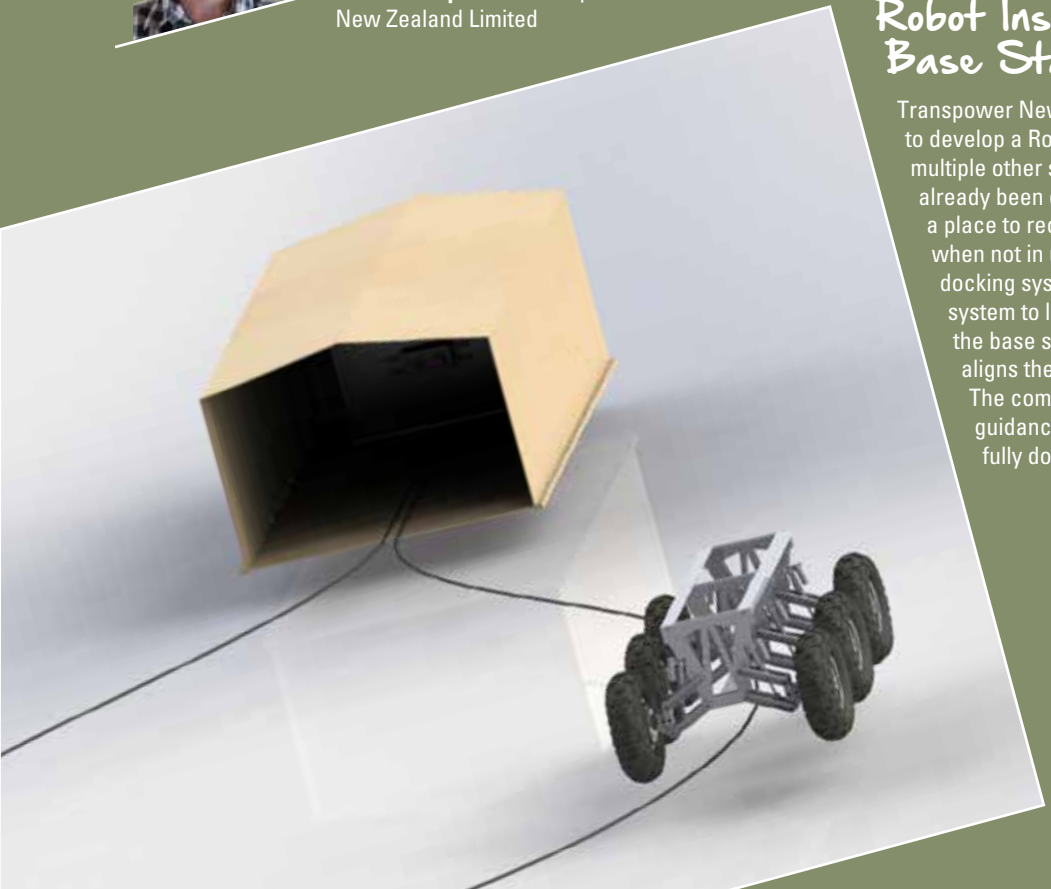


Mafdy Bassalious

KingsWay
Major: Mechatronics
Supervisor: Dr Fakhrul Alam

Byron Brooks

Takapuna Grammar School
Major: Mechatronics
Supervisor: A/Prof Johan Potgieter
Industrial Sponsor: Transpower New Zealand Limited

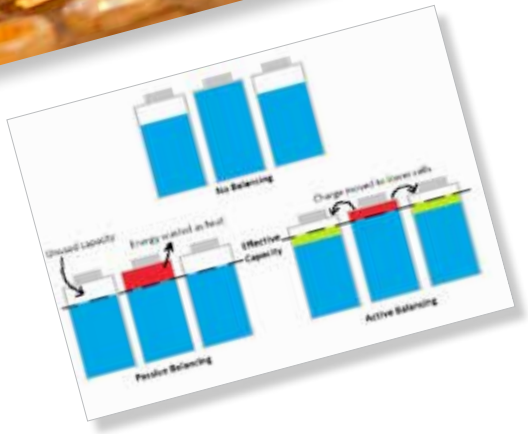


Robot Inspection Vehicle Base Station

Transpower New Zealand has commissioned Massey University to develop a Robot to monitor substations. The project has multiple other students working on it and a prototype has already been developed. The Robot Inspection Vehicle needs a place to recharge its batteries and stay out of the elements when not in use. The outcome of my project is to develop a docking system which includes a custom inductive guidance system to lead the robot back to the base station. Once in the base station, there is a passive docking system which aligns the contacts on the robot with the charging system. The combination of this docking system with the inductive guidance system allows the Robot Inspection Vehicle to fully dock autonomously.

David Burr

Major: Mechatronics
Supervisor: Prof Subhas Mukhopadhyay
Industrial Sponsor: Zero Emission Vehicles Ltd (ZEV)

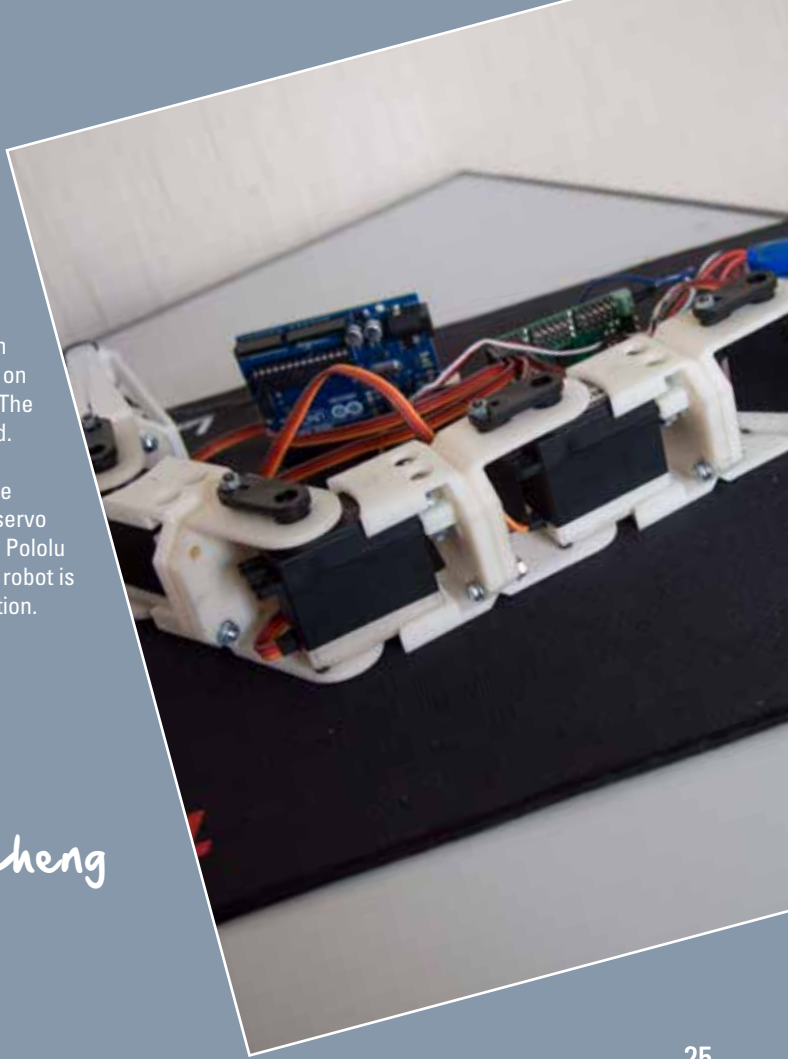


Battery Cell Active Balancing System

This project has been sponsored by Zero Emission Vehicles Ltd (ZEV), a New Zealand manufacturer of commercial electric vehicles. To incorporate fast charging technologies into their vehicles, they are looking at the benefits of active balancing systems over passive balancing systems. So the purpose of this project is to develop a cost-effective balancing system to transfer charge from string cells to weak cells in a battery pack consisting of many lithium cells connected in series. The benefits of balancing the battery pack via active balancing are: (i) improvement in efficiency, (ii) decrease of charging time, and (iii) increase in the effective capacity of the battery pack which corresponds to increased range per charge.

Design and Development of a Robot to Navigate Through (Flexible) Pipes

A robot that can navigate through pipes and inspect the inside wall for cracks as well as corrosion. It is important to keep pipes in good condition, as cracks in the pipes can have catastrophic environmental impact. An example of this is water contamination if dirt is to fall through the cracks. Another example is when a pipeline is carrying gas; a crack on the pipe will cause a weak spot and potentially cause the pipe to burst. The pipe inspection robot is a modular snake type robot that is self-propelled. It is able to navigate through various pipes with various bends. With the exception if the head and tail very other part of the snake is modular. The modules consist of a U-joint and a fixed part attached to an hd-1201mg servo motor. The microcontroller of choice is an Arduino Nano coupled with a Pololu micro servo driver, allowing me to use up to 23 servo motors. Finally the robot is controlled wirelessly with an Android device through Bluetooth connection.



Cheung Yin Dennis Cheng

Rangitoto College
Major: Mechatronics
Supervisors: Dr Khalid Arif

Adam Collie

St Peter's College (PN)
Major: Mechatronics
Supervisors: Dr Rory Flemmer, Dr Claire Flemmer

Hysteresis Loss Testing Rig for Viscoelastic Materials

Rapid deformation happens in in many places in the real world: sports, cars crashing, safety equipment protecting people from projectiles and impacts. Often the materials involved are viscoelastic and involve common biomaterials such as muscle, spider silk, leather, and even blood cells.

The nature of viscoelastic materials is complex due to the effects of hysteresis in their stress-strain curves, being strain rate dependent and non-linear. This usually leads to an increasing material strength. The hysteresis is of importance as it tells of how much energy is lost in deformation (particularly in collision events).

Currently the general problem that exists is how to precisely measure this at intermediate strain rates ($10^{0}s^{-1}$ to $10^{2}s^{-1}$), where stress wave propagation can interfere with the specimen and test rig, affecting results.

This project aims to solve this by developing a novel pendulum impact tester method that can determine the hysteresis loss in viscoelastic materials at these strain rates. We look at synthetic and natural leather under tensile loading conditions. An encoder measures the displacement during the downswing, the collision and the recoil swing. This data, sampled every 8 milliseconds and totalling some 2000 data points per test (several swings), allows the mathematics of the impact to be modelled at a resolution of microseconds in terms of viscolelastic properties. These are therefore deducible.

Force Feedback for Pilot Training Simulator

In flight, aerodynamic forces act against the control surfaces of the craft and are transmitted back to the pilots control column and rudder pedals. Through these forces the pilot gains tactile input about the flight, gaining a "feel" for the current flight situation.

The purpose of this project was to develop a feedback path from the flight simulation software to apply dynamically controlled forces to the pilots control column. Data detailing the current flight situation is extracted from the simulation process and passed through a force model to determine the level and orientation of force to apply. The force experienced by the pilot is then updated in real time to match the simulation result.

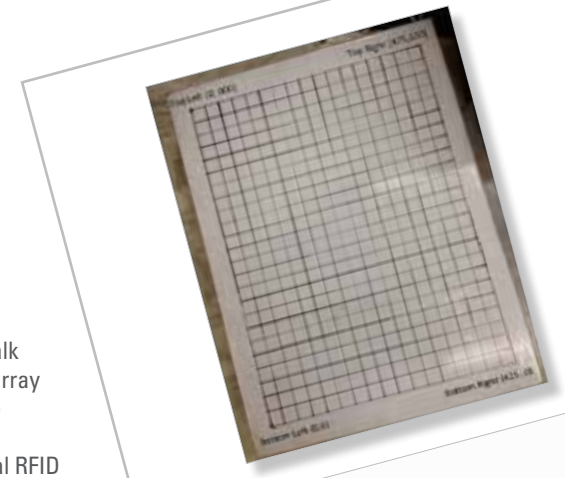
Joshua Crawford

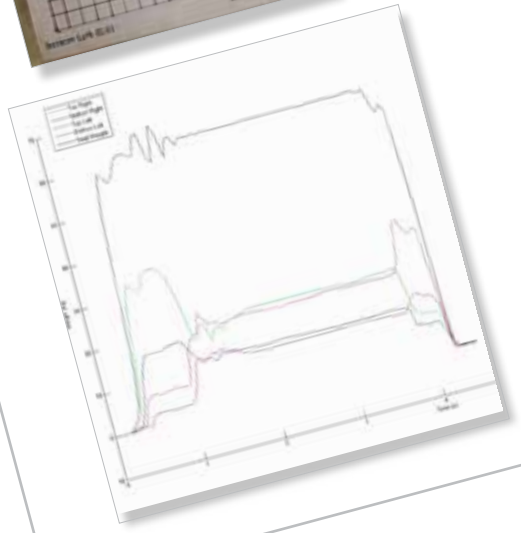
Freyberg High School
Major: Mechatronics
Supervisors: A/Prof Gourab Sen Gupta, Dr Rose Davies, Dr Savern Reweti

Cattle Lameness Detection

Traditionally, the identification of lame cattle has involved passive observation with the farmer noticing the cattle walking more slowly and with irregular steps. This identification method is very time consuming and labour intensive and is not particularly efficient as it often results in a significant delay between the onset and detection of lameness.

The aim of this project is to electronically detect lameness when cattle walk over the designed platform by measuring ground reaction forces with an array of pressure transducers. The independent platform sections communicate the total weight, the position and the duration of the force to the master microcontroller. This data is stored into a database together with individual RFID readout for further processing to detect lameness.



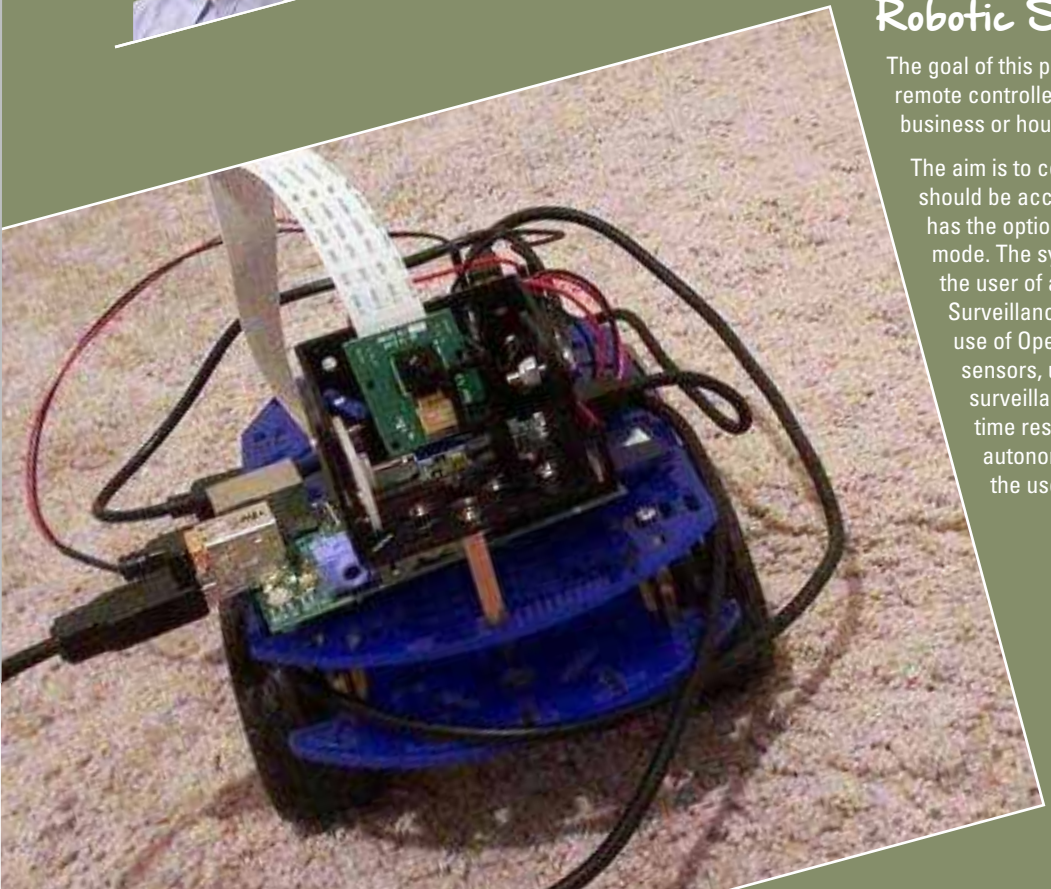


Aaron Dalbeth

Onewhero Area School
Major: Mechatronics
Supervisors: A/Prof Gourab Sen Gupta, Mr Ken Mercer
Industrial Sponsor: Tru-Test

Siju David Mathews

Glenfield College
Major: Mechatronics
Supervisor: Dr Mohammad Rashid



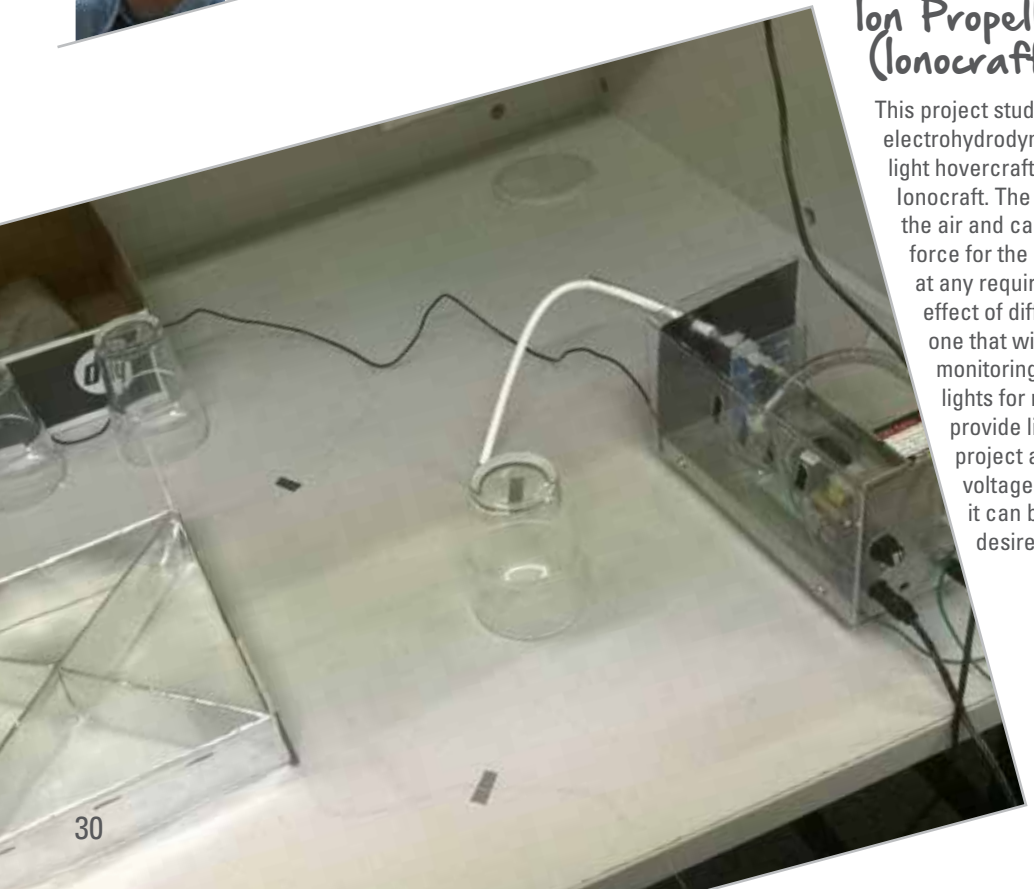
Robotic Surveillance System

The goal of this project is to design, develop and implement a remote controlled surveillance system which can be used in small business or household at an affordable price range.

The aim is to control the robot via a web interface, which should be accessible through a smart phone or computer. It has the option to work under user control or autonomous mode. The system streams live real-time footages and informs the user of any break-ins or such via the web interface. Surveillance monitoring is done by human detection with the use of Open CV software. Additional sensors, such as PIR sensors, used to increase the detection of intruders. The surveillance robot will be running in real time giving real time responses. Safety to the environment when under autonomous mode is ensured to the surroundings with the use of object avoidance sensors.

Dmitriy Dovgal

Western Springs College
Major: Mechatronics
Supervisor: A/Prof Edmund Lai

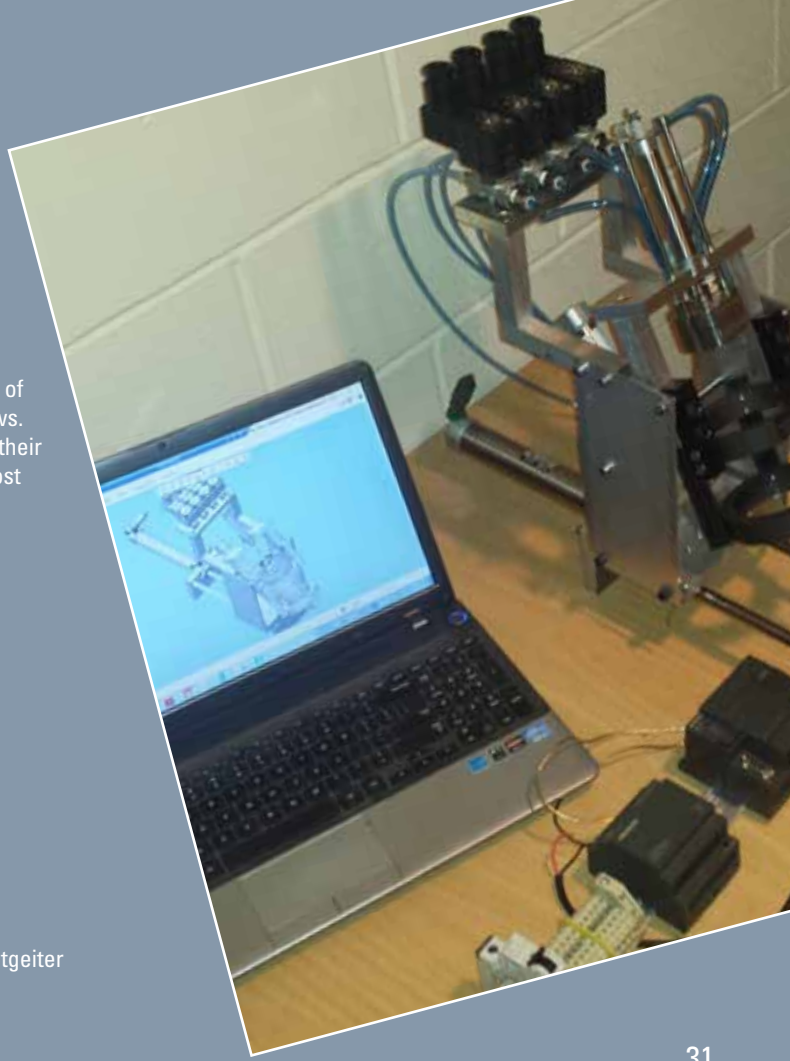


Ion Propelled Hovercrafts (Ionocrafts)

This project studies the use of the Biefeld-Brown effect, or electrohydrodynamics (EHD), to provide propulsion for a very light hovercraft frame. It is also known as an Ionic Thruster/ Ionocraft. The idea is that a high voltage difference ionizes the air and causes a flow of ions which provides a lifting force for the hovercraft. The craft is able to lift and hover at any required set height. The aim is to investigate the effect of different frame designs, and come up with one that will be able to lift a small camera to act as a monitoring system and/or other gadgets such as LED lights for night applications. The set up camera will provide live streaming to a desired interface. This project also involves the construction of a high voltage power supply that is light and mobile so that it can be transported and set up with ease at the desired locations.

The Bartender Wingman

The bartender wingman is a machine that pours drinks. This machine is capable of pouring beer (complete with tilt function), mix drink and orange juice, available in short and tall glass options. The user interface consists of simple push buttons. The liquid levels and glass registry is controlled by various sensors. The mechanics are controlled by pneumatic cylinders and the whole system is PLC controlled. The mechanism is constructed from engineering plastics and aluminum. All of this is wrapped up in an anodized aluminum frame with Perspex windows. The intention of the machine is not to replace a bartender, just to make their job easier. The machine is simple to use, elegant, cost effective and, most importantly, safe to operate.



Simon Eccleston

Rangitoto College
Major: Mechatronics
Supervisors: A/Prof Edmund Lai, A/Prof Johan Potgeiter

Daniel Etherington

Hillcrest International School
Major: Mechatronics
Supervisor: Dr Liqiong Tang

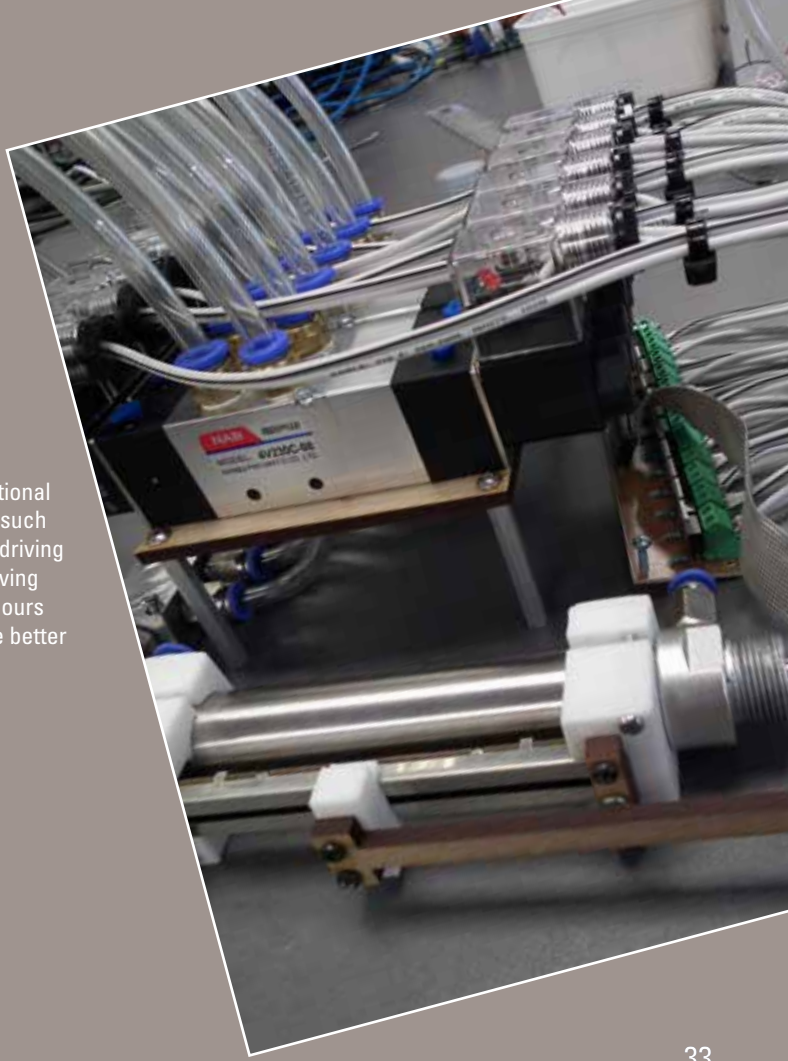
CNC Machine Robotic Head Design

NZIC is a New Zealand industrial company that specializes in CNC machines. Due to market demand, the company is moving towards the manufacture of multi-axis CNC machines. The project is part of a large research project into the development of a multi-axis robotic head design for a specific industrial application and includes robotic head mechanism design, modelling and simulation, control methodologies, communication strategies, real time control and software development. This 4th year project focused on the robotic head design, an investigation into a feasible control and communication system, and prototype testing. The project work confirmed that it is possible to implement a robotic head based on the company's current CNC machine structure and the CNC controller. A robotic mechanism was developed and the analysis and simulation showed that the company's requirements can be met. A prototype control system was also developed and the results of testing are positive.

Educational Driving Simulator Electronics

At least one third of car accidents in New Zealand are caused by people aged 15 to 24. This is a serious problem that needs to be solved. A cheap commercial educational driving simulator would be a cost effective, wide spread solution to this problem. SimSity have been producing various simulators for the past 15 years, and want to expand into the educational market.

The goal of this project is to design the control electronics for an educational car simulator. A low cost solution will allow many units to be produced, such that it can be introduced into schools. The simulator will teach children driving fundamentals without any of the risk when controlling an actual car. Driving lessons are expensive, and are not risk free. Children can spend many hours in a simulator repeating tasks and dangerous situations, so that they are better equipped to get behind the wheel.



David Graham

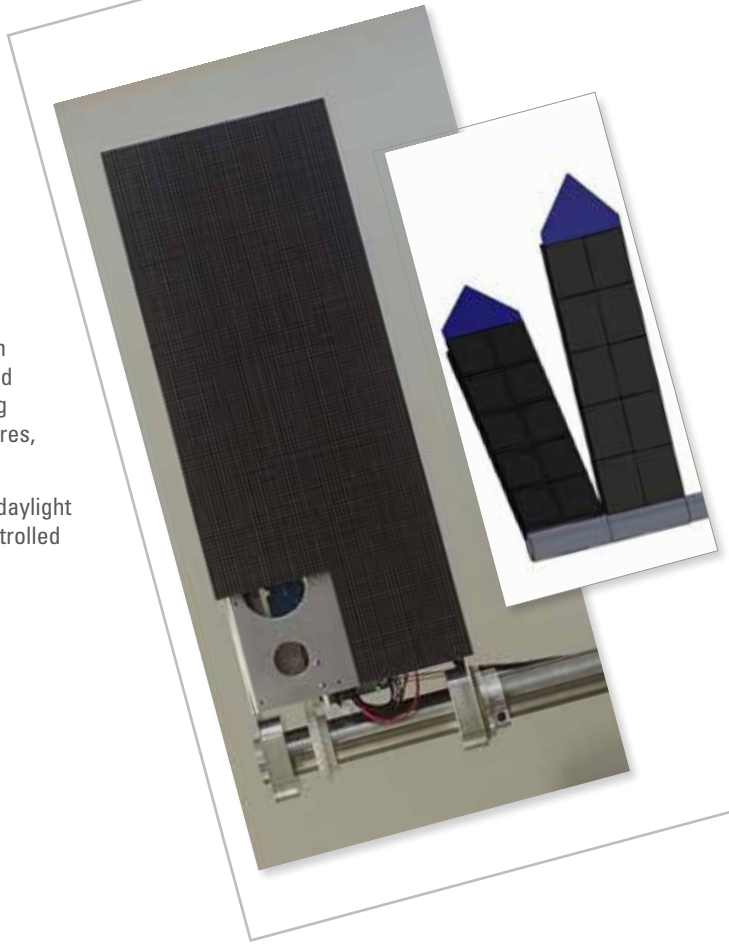
Rutherford College
Major: Mechatronics
Supervisor: A/Prof Johan Potgieter

Development of Rotary Digital Signage System

Digital signage is not a new technology, it is however a developing one. As the cost of LED and LCD displays decreases, it is becoming economically viable to replace traditional signs and billboards with digital screens. Currently these screens are typically quite large and static installations.

The purpose of this project is to develop a small rotary digital screen system to enable rotation-dependent information to be displayed. This could be used for advertisement or to make announcements, depict the location and timing of events, point in the direction of an event or venue, show videos and pictures, broadcast news or interact with social media sites.

The display is composed of an array of LED modules which are readable in daylight and at night. The system communicates using wireless networks and is controlled using an embedded Linux device.



Tobin Hall

Western Heights High School
Major: Mechatronics
Supervisor: A/Prof Gourab Sen Gupta

Ethan Holden

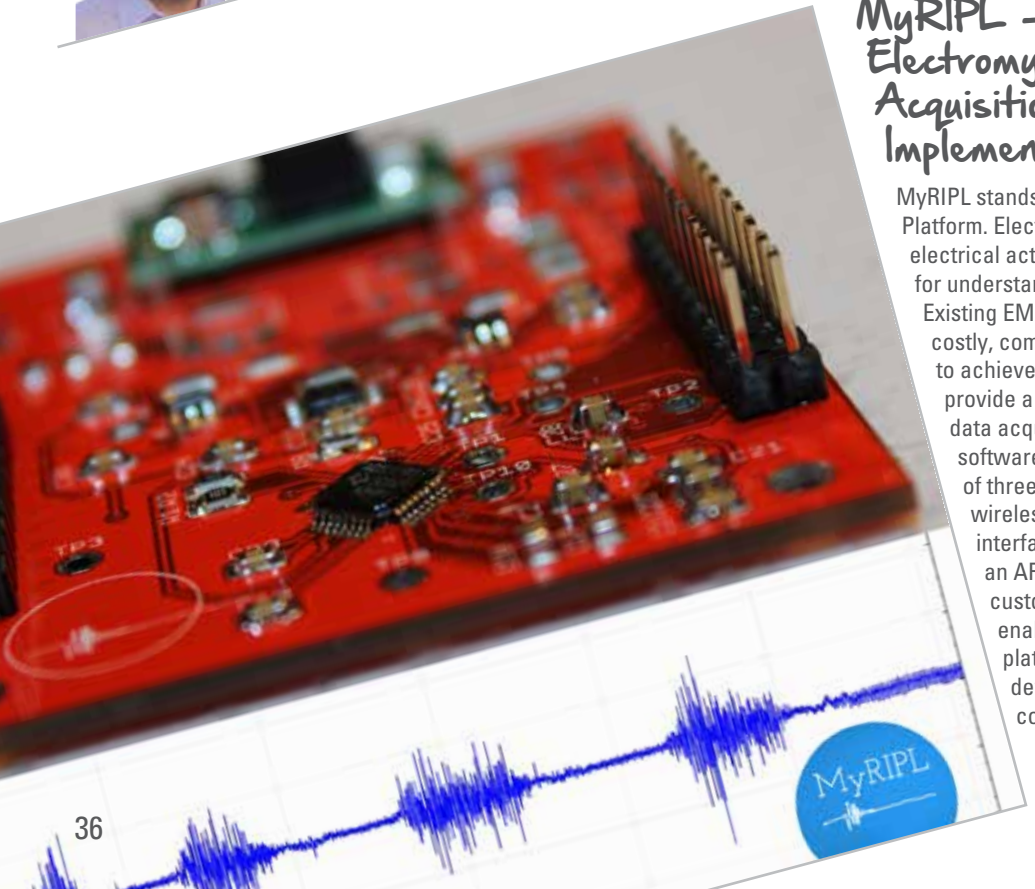
Rathkeale College
Major: BE (Mechatronics)
Supervisors: A/Prof Gourab Sen Gupta, Dr Savern Reweti, Dr Rose Davies

Trim Control Mechanism for a Flight Simulator

A flight simulator is a machine built for the purpose of artificially creating aircraft flight characteristics and the environment in which the aircraft operates. Flight simulators are used by pilot training organisations and aircraft operators around the world as a highly effective and an economical method for training and evaluating pilot skills. Savern Reweti of the Massey School of Aviation has developed and constructed a low cost flight simulator system that provides a flying experience comparable to the more expensive simulator systems that currently dominate the market. This project was commissioned to design and build an improved mechanical trim control mechanism and develop a system that allows this mechanism to interface with the trim features available in the flight simulator software (Microsoft Flight Simulator X Gold Edition) to provide a more realistic representation of the actual aircraft's trim control systems. The trim tabs of the plane model in the software are to be controlled by manually adjusting the trim mechanism and also have the feature to adjust the trim mechanism via electronic means.

Zachary Holly

Home School
Major: Mechatronics
Supervisors: A/Prof Edmund Lai, Dr. Rezaul Hasan



MyRIPL – Wireless Electromyography Data Acquisition: Software Implementation

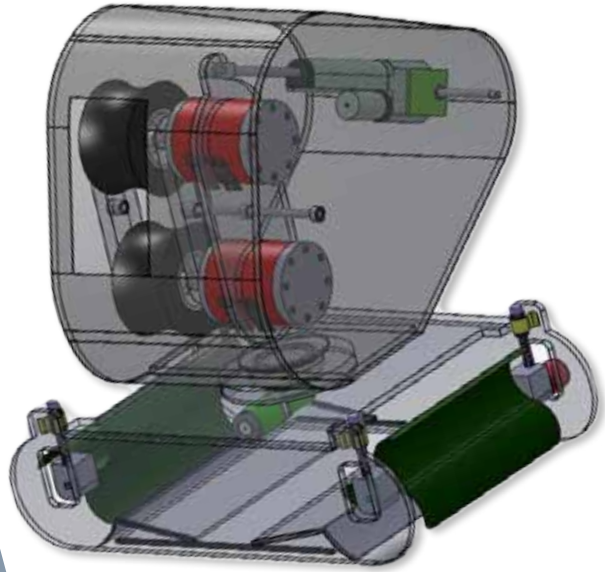
MyRIPL stands for Myoelectrical Research Informatics Platform. Electromyography (EMG) is a measure of the electrical activity of skeletal muscles and is widely used for understanding the health and state of these muscles. Existing EMG data acquisition devices are table bound, costly, complex devices that require extensive training to achieve quality results. The aim of MyRIPL is to provide a low-cost, portable, wireless device for EMG data acquisition to researchers and practitioners. The software implementation of this project is comprised of three subsystems: digital signal processing (DSP), wireless communication and the graphical user interface. The DSP implementation is executed on an ARM Cortex M3 microcontroller platform. A custom wireless protocol was constructed to enable efficient real-time data transfer. The platform independent graphical user interface developed using Qt is designed to run on a host computer to view the data acquired.

Automated Tennis Ball Machine

Over many years commercial companies as well as individual inventors have tried to develop a device that can help athletes practice and therefore improve their performance without the need of a practice partner. A tennis ball machine is an example.

The goal of this project is to produce an intelligent fully automated tennis ball machine that can be used not only for personal practice, but also as a coaching aid.

The specifications consist of: remote controlled mode settings, automated spin and speed control settings, automated direction capabilities, and, a self-collecting ball system.



Nicolai Justice

Massey University
Major: Mechatronics
Supervisor: Dr Rezaul Hasan

Alex Kesala

Freyberg High School
Major: Mechatronics
Supervisor: Dr Huub Bakker
Industrial Sponsor: Mega Fluid Systems

PLC Evaluation and Network Improvement with SQL

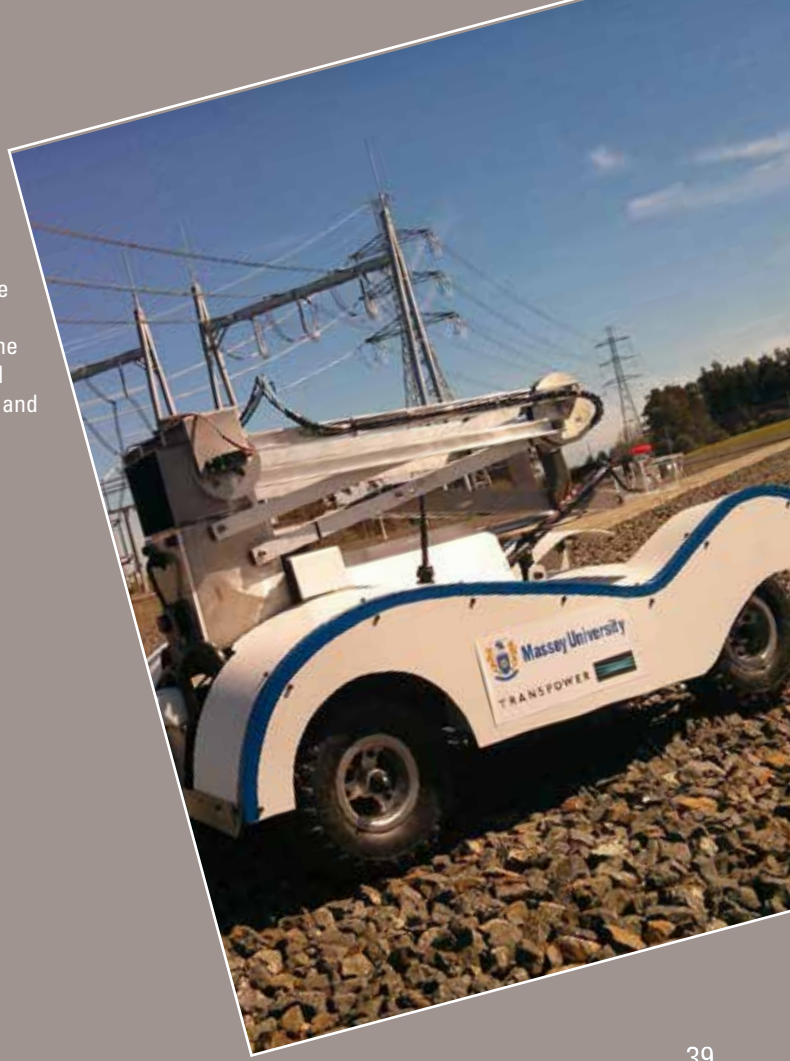
The purpose of this project was to test the functionality of a new PLC (Programmable Logic Controller) and update existing control software to allow for an improved SQL based data network.

To analyse the functionality of the PLC, a fluid control system was designed. This system was made to control the conductivity of a solution at a given level whilst correctly responding to periodically varied flow rates of high conductivity saline solution. Tests were run with a number of different control methods to robustly analyse the effectiveness of the PLC.

SQL was added to existing software to radically improve data-logging. This change was necessary to more robustly manage data and allow for easy manipulation and extraction.

Robotic Inspection Vehicle

The Robotic Inspection Vehicle is a versatile remote utility platform. It is designed from the ground up to be used in remote locations for mobile video surveillance in various terrain and weather. It can be controlled via the Internet of Things (IoT) over large (global) distances with real time video and sensory feedback. Based off a children's quad-bike this initial version was a proof of concept that the technology could be developed and would be capable of providing useful information.



Manu Lange

Mahurangi College
Major: Mechatronics
Supervisor: A/Prof Johan Potgieter
Industrial Sponsor: Transpower

Tow and Fert Calculator

A calculator software that calculates the optimum mix of fertilizing materials, as well as the speed of the operating Tow and Fert vehicle, for any given type of fertilizer and area of spread.

Muhammad Mansor

International Education Centre (INTEC)
Major: Mechatronics
Supervisor: Dr Ibrahim Al-Bahadly
Industrial Sponsor: Metalform Ltd.

Simon Mathis

Hamilton Boys High School
Major: Mechatronics
Supervisor: Dr Karl Dahm
Industrial Sponsor: SATCO Logging Attachments

Tree Felling Shear Attachment

The aim of the project was to develop a tree-felling head for SATCO Logging Attachments suitable for harvesting plantation Eucalyptus found in South America. The key requirements developed with both SATCO and the operators included:

- Using a shearing method rather than sawing
- Ability to shear trees up to 300mm in diameter
- Ability to fell and then accumulate multiple cut trees before releasing a bunch
- Designed to be installed on a 12-15 tonne excavator with standard hydraulic functions

The engineering design process included mechanical design, hydraulic and control system design, CAD and FEA, fabrication, and assembly.

The felling head design utilises a shear system consisting of a blade and shear arm which applies the force to the tree while 2 additional arms accumulate cut trees. To match available hydraulic functions and still provide fast and efficient operation of the head, sophisticated hydraulic regeneration and sequencing is used along with optimised mechanical geometries to provide strength and speed. To minimise development and maintenance cost and ensure reliability, the felling head makes use of field-tested existing SATCO parts and features already application proven.

Brett McAlpine

Fish Hoek Senior High School
Major: Mechatronics
Supervisors: Dr Fakhrul Alam, Dr Frazer Noble

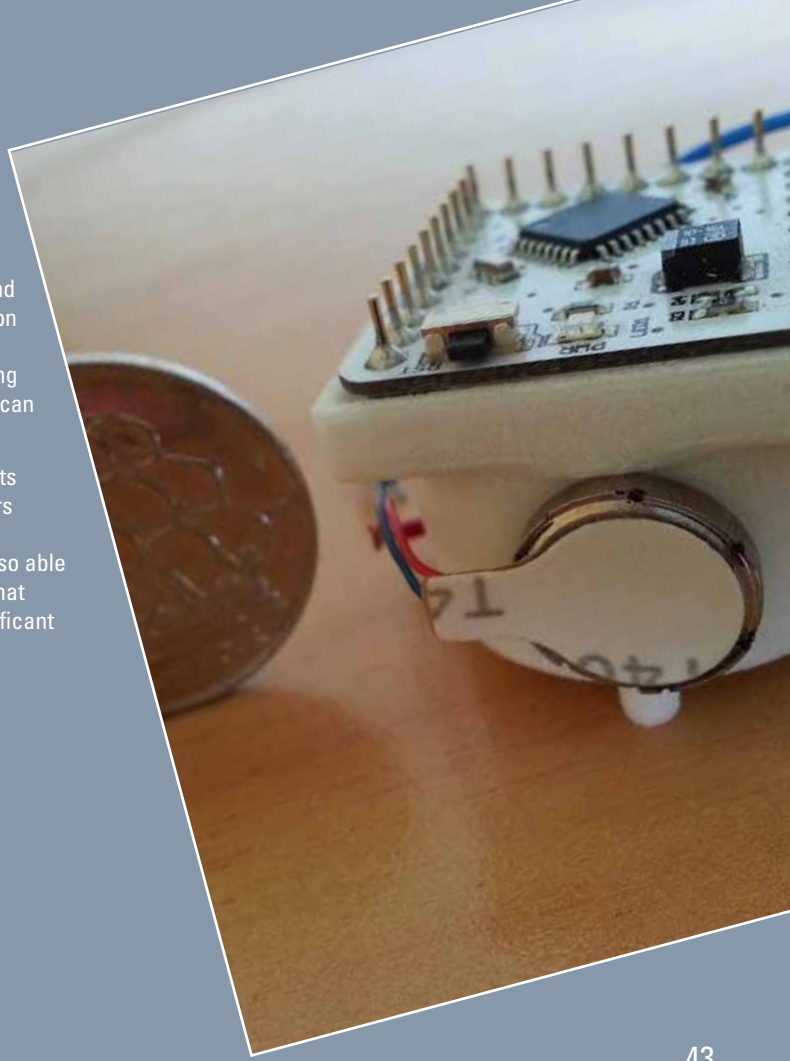
Decentralised Vehicle-to-Vehicle Communication

A decentralised warning and information communication system between cars and stationary beacons utilising existing WIFI technology. This works in tandem with GPS to determine warning zones being broadcast nearby to notify the driver.

Development of a Micro-robot for Swarm Robotics

A group of autonomous robots that interacts locally with each other has been found to exhibit collective behaviour such as moving in formation and performing tasks too difficult for a single robot to achieve. Experimentation in swarm dynamics has been hindered by the cost in replicating a large number of identical robots. This project involves designing and assembling a robot that is both small and inexpensive so that a large number of them can be produced at low cost for experimentation in swarm robotics.

The robot designed in this project is small in size (26x26x21mm) and costs under NZ$30 each. Locomotion is through a set of three vibration motors which are similar to those used in cell phones. These micro-robots are equipped with infra-red sensors to detect objects close by. They are also able to communicate with each other wirelessly with an add-on module so that they can interact with each other. This robot is expected to make significant contributions to the swarm robotics research community.



Joshua McIntosh

KingsWay School
Major: Mechatronics
Supervisor: A/Prof Edmund Lai

Harley McNae

Longburn Adventist College
Major: Mechatronics
Supervisor: Dr Liqiong Tang

Autonomous Mobile Robot

Autonomous mobile robots are being used in a wide range of applications. Numerous research reports have predicted that in the near future, many households will have an autonomous mobile robot that will take care of different tasks.

The aim of this research project is to apply autonomous control to a mobile robot with multi-directional movement to be used in an interior environment. Multi-directional movement will prevent the robot from getting trapped in a narrow corners or compact spaces. A modular design concept is used for the development of the mobile robot. The system will become a platform for different application modules to attach and integrate with.

Omni-Wheels have been used in this project to allow the mobile robot to move in any direction without first orientating itself towards the desired direction. This is done by rotating the Omni-Wheels at different speeds and directions relative to each other for each direction of movement. This is made possible by the rollers on the Omni-Wheels that mean each wheel can drive in one direction and slides in every other direction.

MyRipl – Wireless Electromyography Data Acquisition – Hardware Implementation

Electromyography (EMG) is a way of investigating the electrical activity of skeletal muscles. By measuring the electric potential of muscle cells, the level of muscle actuation can be qualitatively described and studied.

The systems used to capture this data are traditionally expensive, and are confined to use in laboratories and clinics. Companies that offer wireless systems, charge a premium for the mobility that comes with them. This project aims to address these issues by creating a cost effective wireless EMG solution.

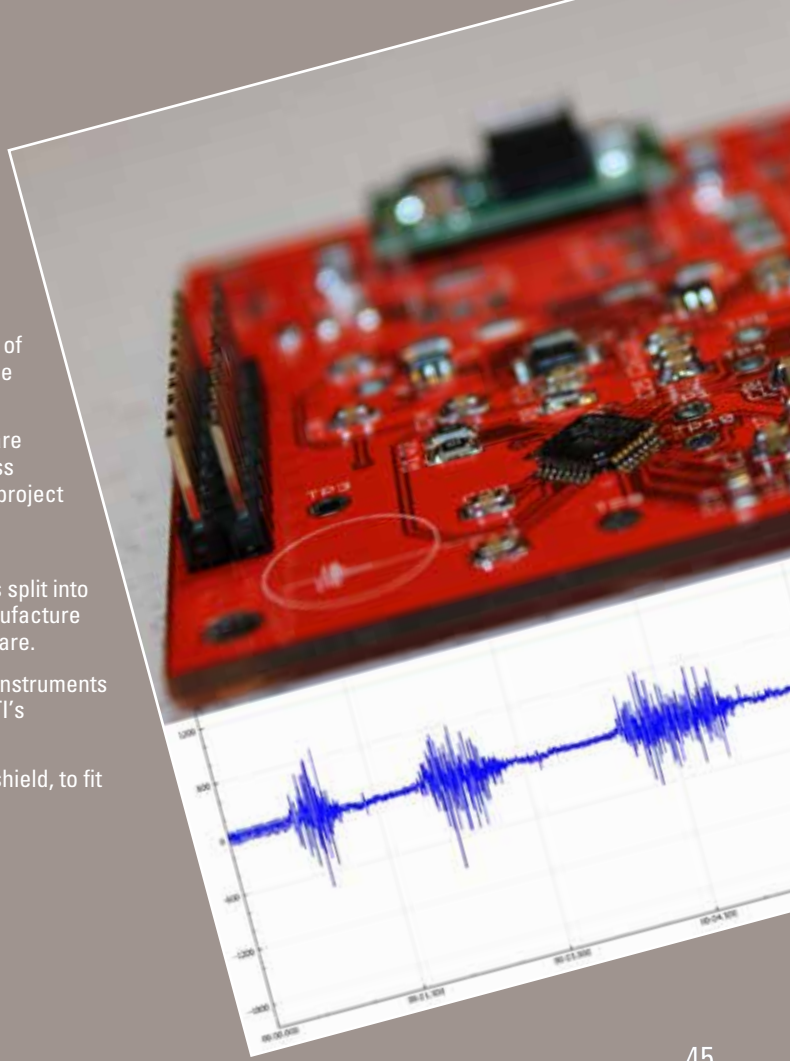
MyRIPL is the latest version of this technology and its development was split into two projects. This one, which focuses on the hardware design and manufacture of the device, and another which involves the development of the software.

The hardware used at the core of this project, was chosen from Texas Instruments stable of Arm cortex M4 microcontrollers. This was paired with one of TI's extremely capable multi-channel biopotential front ends.

All of the biopotential hardware was designed onto a booster-pack, or shield, to fit the Texas Instruments Tiva-C development board.

Llewellyn Morgan

Paeroa College
Major: Mechatronics
Supervisors: A/Prof Edmund Lai, Dr Rezaul Hasan



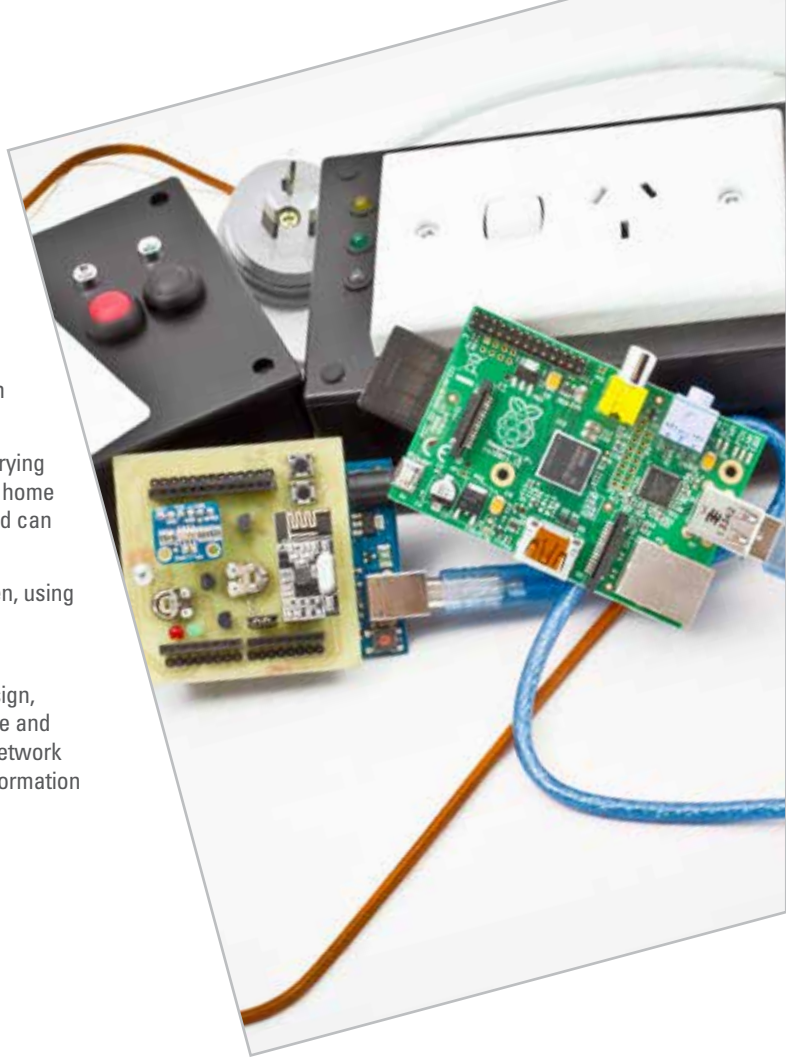
Home Automation as Educational Springboard

We are living in the digital era, it is important to inspire interest in engineering and technology as this is a profession that is becoming highly sought after. Currently, the prevailing vehicles used to inspire interest and captivate minds are robots, specifically robots that move themselves around, and interact with their environment.

This project aims to provide an alternative option to locomotive robots when trying to expose potential students to engineering concepts. This project provides a home automation system that is available to anyone that can access the internet and can be assembled by most computer literate young adults.

A home automation system records information about the world around it, then, using a central computer, carries out actions based upon this information.

Using the Raspberry Pi single board computer and Arduino microcontrollers, users will be introduced to several important concepts. For example; web design, web communications, operating in the command line, programming (hardware and software), hardware and electronics, networking, wireless communication, network routing protocols, sensors and their operation, automation, databases and information management, to name a few.



Scott Newberry

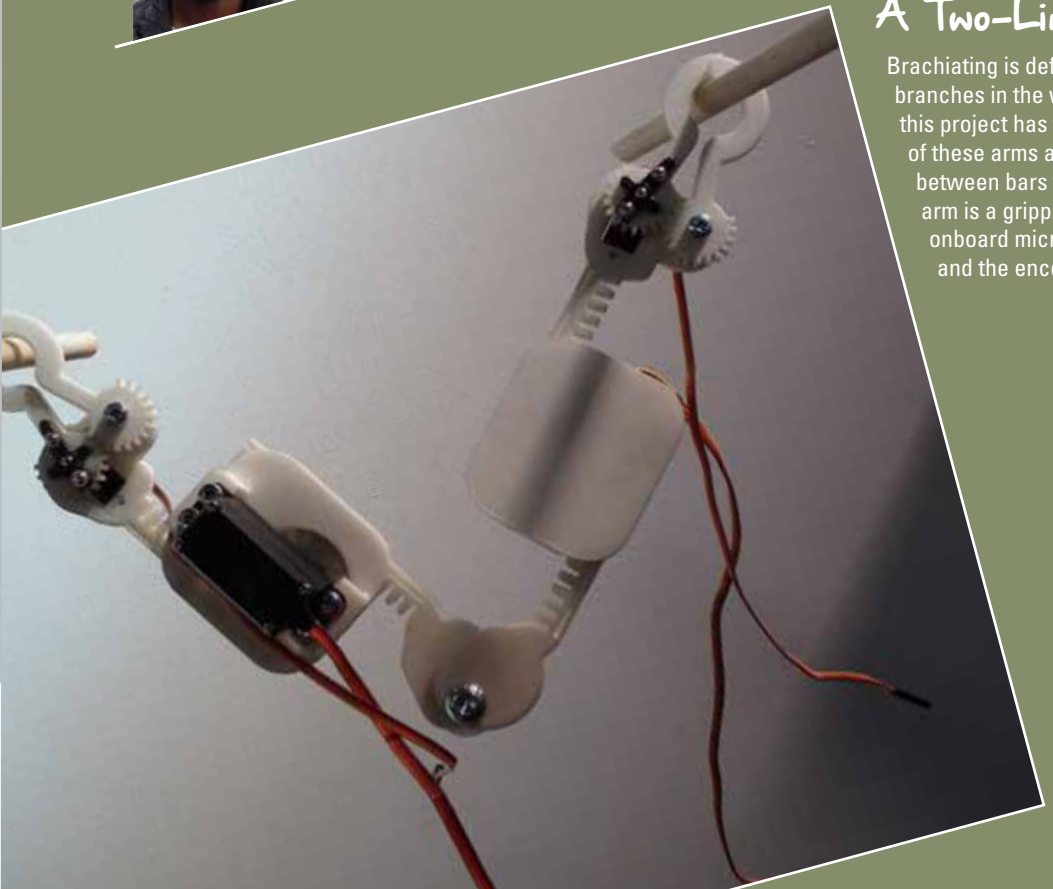
Upper Hutt College
Major: Mechatronics
Supervisor: A/Prof Gourab Sen Gupta

Alain Nshuti

Liston College
Major: Mechatronics
Supervisor: A/Prof Edmund Lai

A Two-Link Brachiating Robot

Brachiating is defined as moving in a form of swinging through branches in the way apes or monkeys do. The robot designed in this project has two links representing the two arms. The lengths of these arms are independently adjustable to enable swinging between bars that have variable spacings. At the end of each arm is a gripper that allows the robot to hold on to the bars. An onboard microcontroller collects information from the sensors and the encoder to control the swinging motion.



Brandon Pothoven

Waiopehu College
Major: Mechatronics
Supervisor: Dr Liqiong Tang

Motorised Marker Robot

The goal of this project is to develop a prototype platform and the control system for a motorised robot to mark lines, curves, and patterns on a large horizontal surface such as a sports field or car park. The project work involves mechanical and electronic system design, manufacturing, and building the prototype platform. The project also includes developing the hardware for sensing, and the control system software including programming to drive the robot in both straight lines and curved radii. While this specific project is for marking, the platform and control system could be used for various different tasks such as automatic weed detection and eradication within a defined area.

Electric Car Chassis

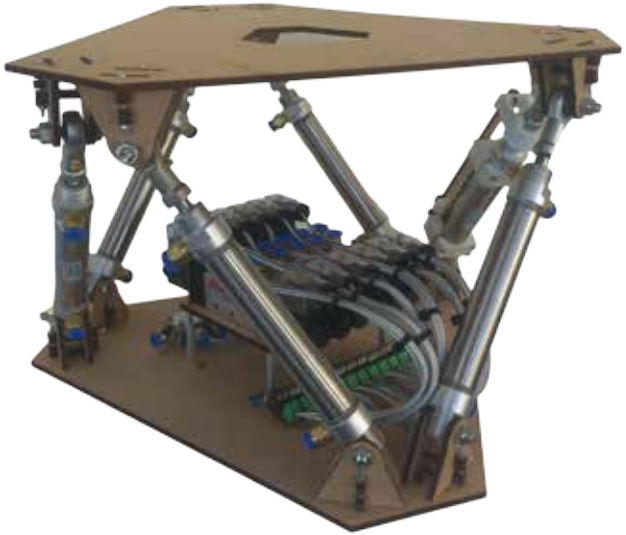
The end result of this project is to create a complete chassis designed to be used as a custom built two-seated electric car. The chassis will be constructed using 4130 Chrome-Moly tube and the running gear from a Toyota Starlet. Along with the construction I will also be carrying out finite element analysis on the structure of the chassis to ensure it will stand up to regular use and load. The aim of this project is to have a complete chassis with digital plans on Solidworks so that future students can complete the electronics and body of the car. At the end of this process Massey University will have a drivable electric car able to be registered put on the road.

Alex Scott

Rangitoto College
Major: Mechatronics
Supervisor: A/Prof Johan Potgieter

Stephen Shaw

Long Bay College
Major: Mechatronics
Supervisor: A/Prof Johan Potgieter
Industrial Sponsor: SimSity



Eduational Driving Simulator

At least one third of car accidents in New Zealand are caused by people aged from 15 to 24. This indicates a serious problem in New Zealand that needs to be solved. Giving driving training to young person's whilst still at school can be very expensive. This is why a cheap commercial education car simulator would be one of the most effective solutions to this problem. In various training applications a virtual simulator is the most cost effective solution. SimSity is a company based in Pukekohe and have been producing various simulators for the past 15 years.

The goal of this project is too begin the design of a prototype Car simulator that can be mass produced and introduced into schools as a driving course. Current simulators are very expensive. Designing a cost effective simulator that can be mass manufactured is key to help solve the problem. My major role in this project is to create a simulator platform that will be able to give users the sensation of real driving and sudden movements associated with crashes.

Cost-Effective Laser Sintering

Currently 3D printing is a new field of research. A lot of emphasis has been put on current companies to prototype ideas quickly and easily as well as create ideas that couldn't be realised using any other process. This project will be open source to allow people to build their own machine.

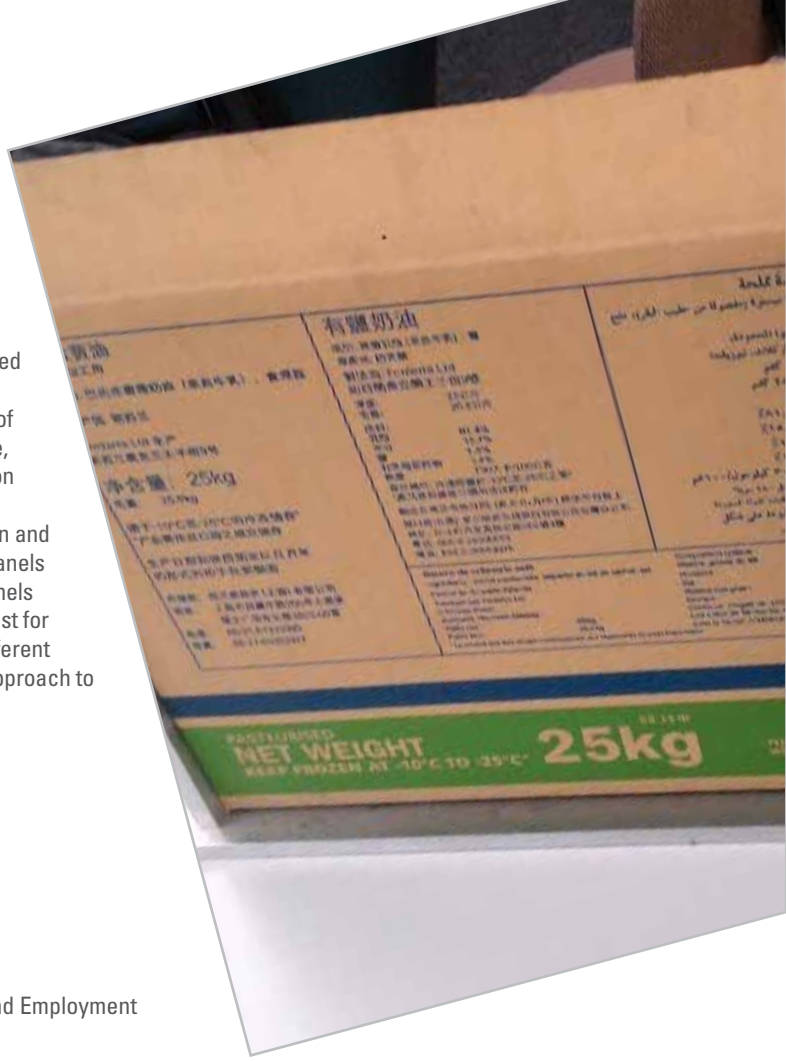
The basis for this project is split into three main goals. The first was to create a SLS system. This SLS system should be cost-effective when compared to the current industry machines. The second is that it will use the left over powder from another SLS machine saving thousands of dollars. The third is that is can be a research base for trying different materials and different 3D printing methods. This project could be altered easily without trying to make changes to a big industrial SLS printer you own and void the warranty.

Kevin Silver

Whangarei Boys High
Major: Mechatronics
Supervisor: A/Prof Johan Potgieter

Corrugated Fiberboard Panel Test Rig

Corrugated fiberboard is a paper-based material consisting of a fluted corrugated sheet and one or two flat linerboards. They are widely used in the manufacture of corrugated boxes. The actual global consumption of corrugated board stands at 102 million tonnes as of 2011 and corrugated fiberboard packaging is the key packaging technology in New Zealand to enable export of more than $10 billion worth of biological products a year. Given its importance, Research at Massey University funded by the Ministry for Business, Innovation and Employment (MBIE) is looking into improving the design features of their fiberboards to enhance structural strength. The aim of this project is to design and construct a panel test rig that can simulate the failure modes of corrugated panels in a standard box compression test. The rig supports full-sized corrugated panels in a compression test. The panel test is then compared with a standard box test for similarities in panel failure, load curves and deformation corresponding to different features. A reliable panel tester will provide a more time and cost-effective approach to the design optimization process.

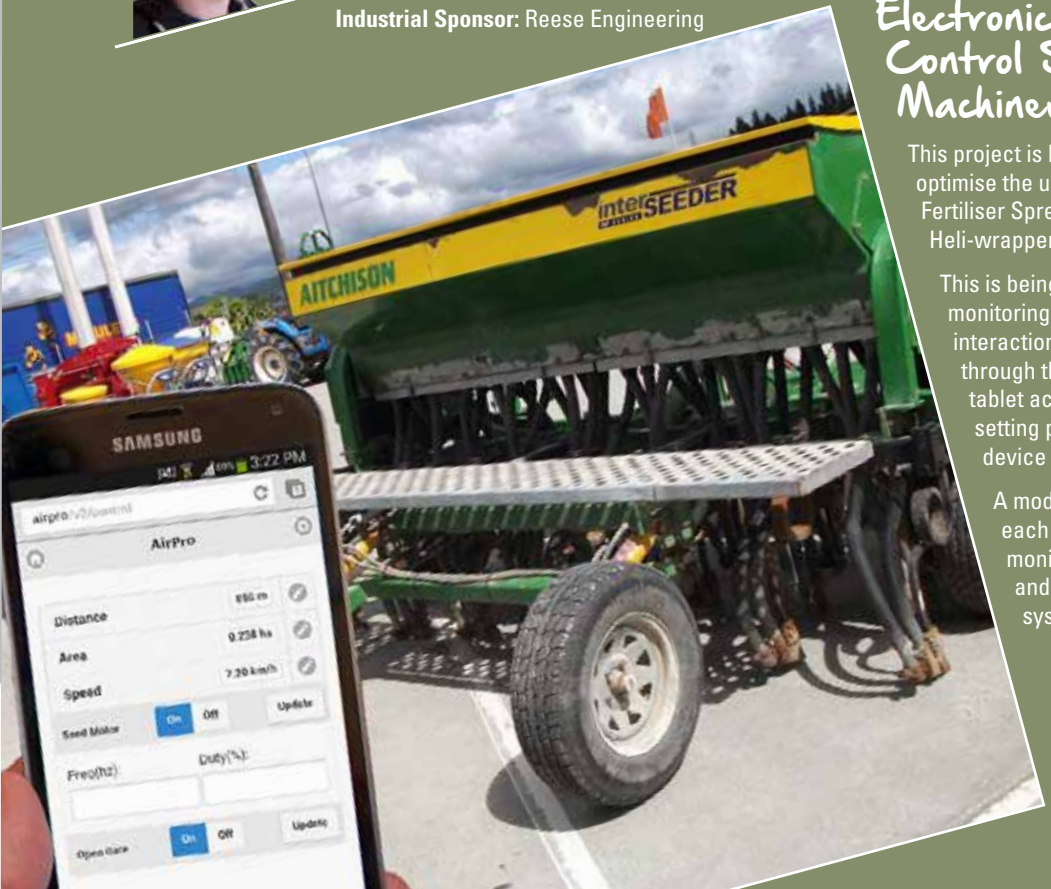


Yang Yenn Tan

Sunway University, Malaysia
Major: Mechatronics
Supervisors: Dr Karl Dahm, Prof John Bronlund
Industrial Sponsor: Ministry for Business, Innovation and Employment (MBIE), Carter Holt Harvey Packaging

Brendan Taylor

Central Hawkes' Bay College
Major: Mechatronics
Supervisors: A/Prof Gourab Sen Gupta, Mr Ken Mercer
Industrial Sponsor: Reese Engineering



Electronic Monitoring and Control System for Agricultural Machinery

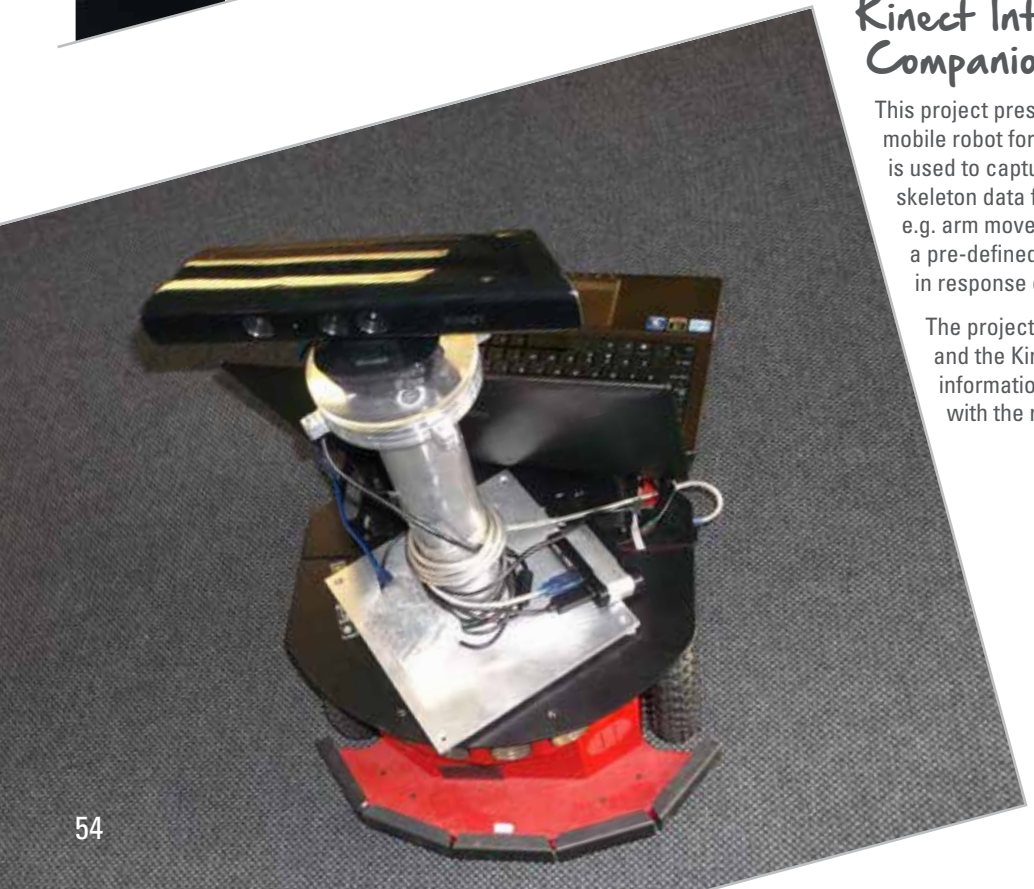
This project is being developed for Reese Engineering to optimise the use of their agricultural machinery such as Fertiliser Spreaders, Hay Mowers, Bale Bugs, Seed Drills and Heli-wrappers.

This is being achieved through the design of a wireless monitoring and control system. This system provides easy interaction between the operator and the machinery through the use of a mobile phone or tablet. The phone or tablet acts as an input device to control the machine by setting parameters for operation and as an output display device to monitor the performance of the machine.

A modular program design has been used because each machine requires different aspects to be monitored and controlled. This provides high flexibility and easy-to-use features to change and expand the system's functionality.

Robert Tubman

Long Bay College
Major: Mechatronics
Supervisor: Dr Khalid Arif



Kinect Interfaced Elderly Companion Robot

This project presents a Microsoft Kinect Sensor interfaced mobile robot for elderly companionship. The Kinect sensor is used to capture colour and depth images as well as the skeleton data for the recognition of simple human gestures e.g. arm movements. If the computed gesture matches with a pre-defined gesture, the robot shows certain behaviour in response e.g. moving around or playing sounds.

The project mainly involves programming the robot and the Kinect sensor to process and act on received information and also involves testing and interacting with the robot.

Race Timing with Artificial Vision

Large multisport events e.g. marathons, are generally timed using a small RFID chip worn by each competitor. These chips could be replaced with a camera watching over the race finish line. As each athlete crosses the finish line, the computer could read the athletes bib number and know who had just finished the race. This would save a large number RFID chips which are normally thrown away at the end of each race. Ideally the camera and computer within a modern smart phone could be used to implement this task.

Guido von Mulert

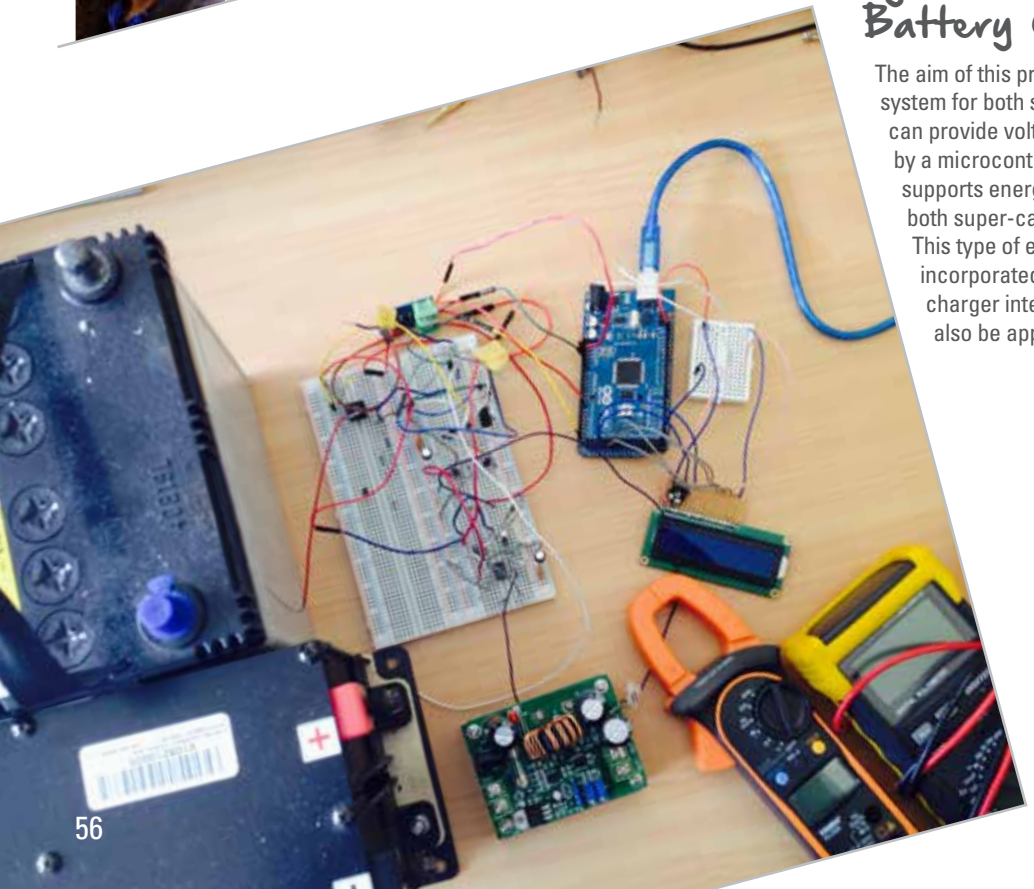
Freyberg High School
Major: Mechatronics
Supervisor: A/Prof Donald Bailey
Industrial Sponsor: Outcome Management Services

Eric Lien Wang

MAGS
Major: Mechatronics
Supervisor: A/Prof Edmund Lai

Hybrid Super-Capacitor and Battery Charging System

The aim of this project is to design and implement a charging system for both super-capacitors and batteries. The charger can provide voltage and current regulation and is controlled by a microcontroller for precision charging. This system supports energy storage systems that combine the best of both super-capacitor and battery energy storage properties. This type of energy storage systems can potentially be incorporated into vehicular hybrid systems with the charger integrated into a vehicle's charging system. It can also be applied to uninterruptable power supplies.



Visual Fault Detection For Electric Power Cable

This Project is proposed by Prysmian Cables & Systems in Auckland that manufactures electric cables for the energy and telecommunications sector. A computer vision system is needed to automatically detect any defects on the insulator coating of the cables on the production line. An embedded system with an integrated video camera is used to capture structured light. This enables any bumps and troughs on the surface to be measured and accept/reject decision can be made automatically.

Yue Wang

Major: Mechatronics
Supervisor: A/Prof Edmund Lai
Industrial Sponsor: Prysmian Cables & Systems

Microscope Camera Unit

The current way of taking images of slides is either very expensive, or unreliable. In conjunction with another student, I am designing a Microscope Camera Unit, which is an automated device used for medical slide imagery. The unit uses microscope lenses to zoom and take photographs of medical samples at a zoom level of up to 1000x.

The unit will streamline the slide imagery process by automating it, and remove the need for an operator to individually take photographs of slides through a regular microscope. Using stepper motors and servos along with machine vision, the device will be able to take photos of the entire sample over the X-Y range, as well as autofocus itself.

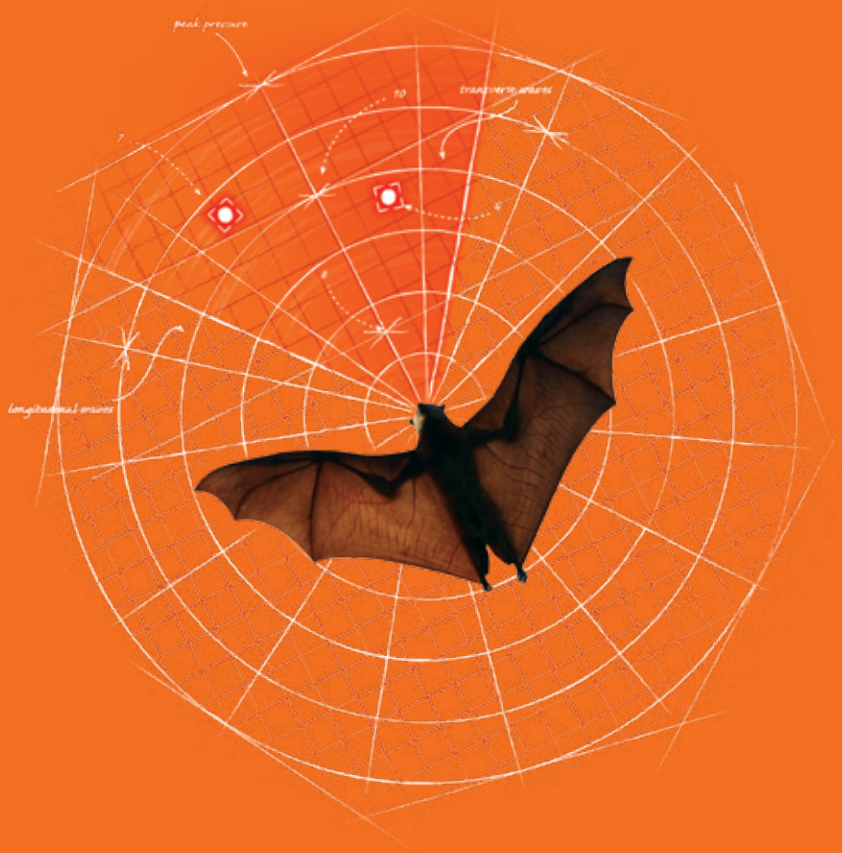
This device should speed up the imaging process, reducing wait times on test results and therefore improving the efficiency of some lab testing.

Aidan Wood

Rangitoto College
Major: Mechatronics
Supervisors: A/Prof Johan Potgieter, Dr Frazer Noble

The Bat

Bats use other methods than sight to navigate or hunt. They are able to "see" in the dark by sending out sound waves that bounce back to the bats' ears from objects such as fruit on trees and flying insect prey. The echolocation or biosonar is a simpler way for robots to perceive shapes than pattern recognition programmes, and is much more applicable in areas without light.



ELECTRONICS & COMPUTER ENGINEERING

Electronics and Computer Engineering at Massey Engineering incorporates electronics, information and signal processing, computer engineering and, telecommunications and networks. Students become skilled in the development and application of electronic and computer systems, both hardware and software, in industrial and commercial contexts.

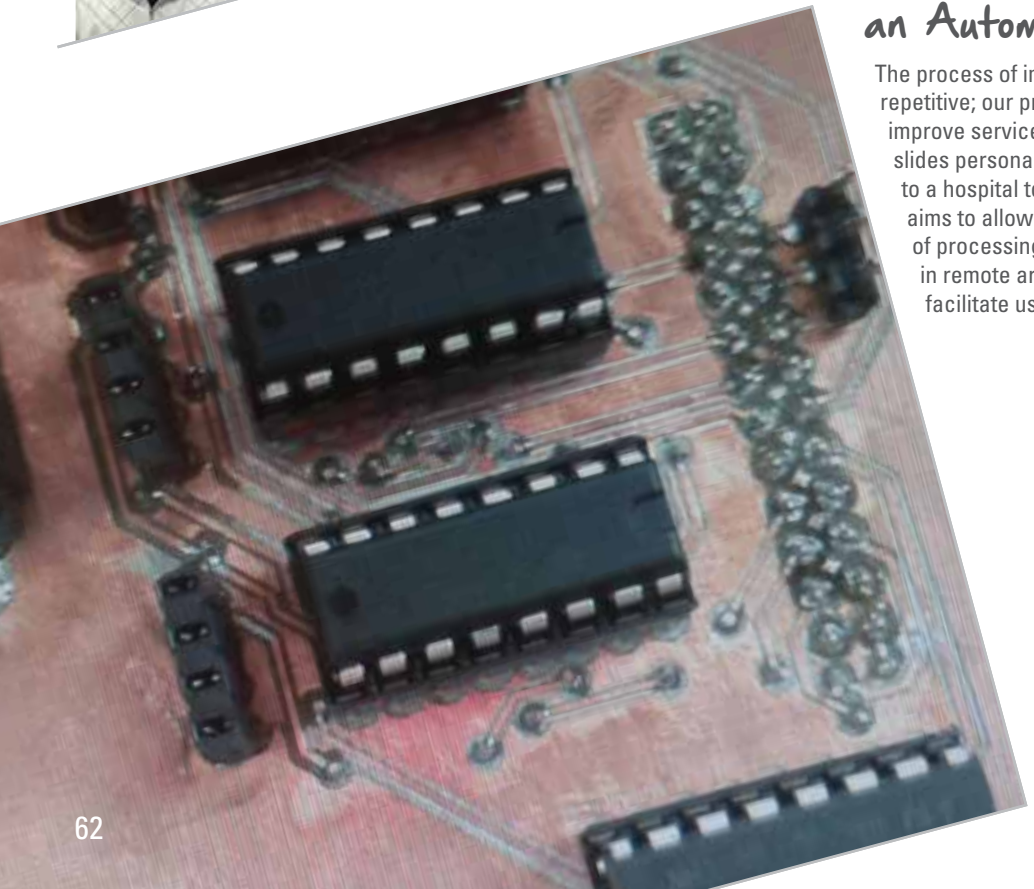
Graduates in Electronics & Computer Engineering can be found in a range of occupations including systems programming, network operations and management, performance analysis and project management.

Andrea Antonino Capri

Major: Computing and Electronic Engineering
Supervisor: A/Prof Johan Potgieter

Bioscanner, an Automated Microscope

The process of imaging biological slides is tedious and repetitive; our project aims to automate this task in order to improve service delivery. Doctors often need to examine slides personally and this leads to a doctor having to drive to a hospital to look at a couple of slides. The Bioscanner aims to allow remote viewing of a slide, lowering the cost of processing slides. Other applications include diagnosis in remote areas. This product is portable and low cost to facilitate use in areas without adequate infrastructure.



Passive Radio Tomographic Imaging

Radio Tomographic Imaging is an emerging technology that locates moving objects within areas surrounded by simple and inexpensive radios. My project involves the fabrication of a research test bed which can be used for further research into the technology. This has been accomplished through the use of microcontrollers connected to Zigbee radios. They use a master/slave relationship with token ring network protocols and handshaking to collect RSSI values, which are then passed to a PC for post processing. A GUI on the PC is used to first fingerprint an area by recording the expected RSSI values. When the program is run, it will continually check the current RSSI values against fingerprinted values to determine the location. This has been done so that in future research an algorithm could easily be implemented to either replace fingerprinting, or work alongside it to produce optimal results.

Daniel Konings

Westlake Boys High School
Major: Computer and Electronic Engineering
Supervisors: Dr Fakhrul Alam, A/Prof Edmund Lai

Wireless Pulse Oximetry Sensor

Blood oxygen saturation is an important medical indicator for evaluating people's health condition. Normal blood oxygen levels for human body are considered 95%-100%. Blood oxygen levels below 80% may compromise organ function. This project aims at constructing a real-time blood oxygen levels monitoring system. This system constitutes a wireless pulse oximeter device, an Android application and a website application. The wireless pulse oximeter monitors patients' blood oxygen levels and transfers the data to Android powered smartphones using Bluetooth technology, and via the cellular network the smartphone continuously updates the data to a server's database which can be accessed by physicians via a website application. This means the physicians are able to monitor their patients' blood oxygen levels in real time as long as they are within cellular coverage.

Zhengbang Shi

Taylors Collage
Major: Computer and Electronic Engineering
Supervisor: Dr Khalid Arif

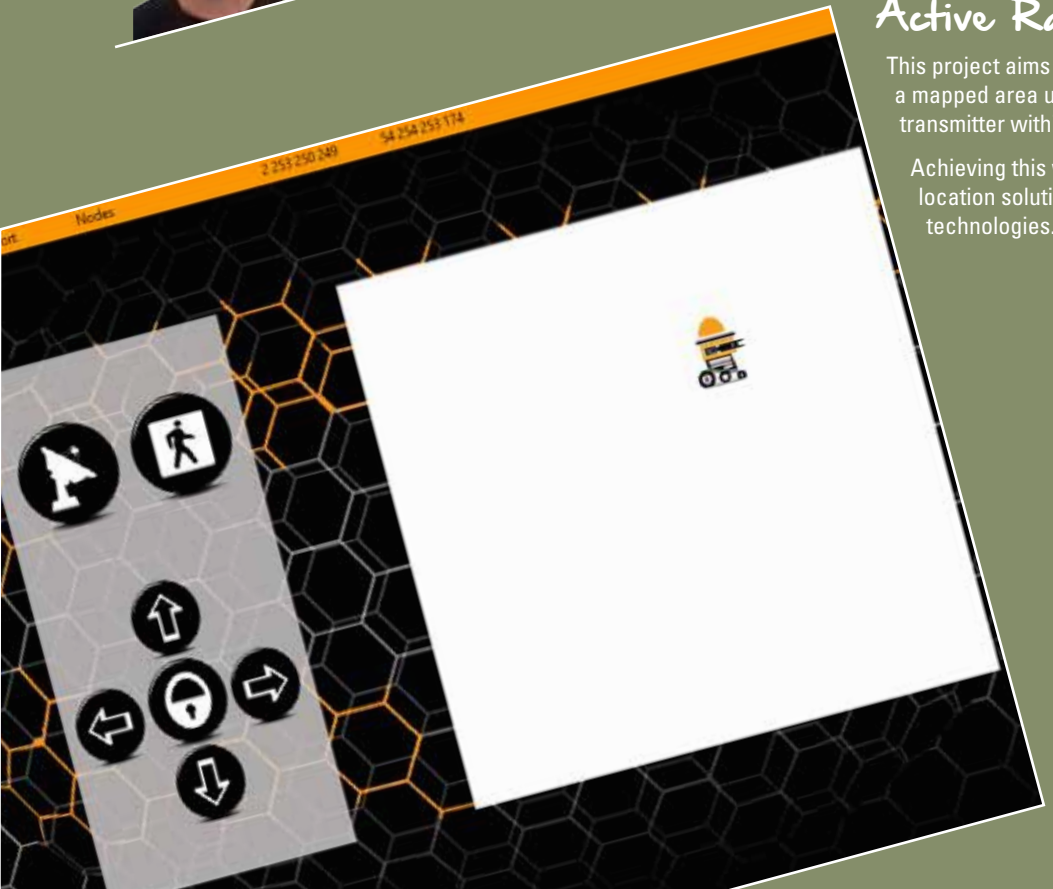
André Budel

Rosmini College
Major: Electronic and Computer Systems Engineering
Supervisor: Dr Fakhrul Alam

Active Radio Tomographic Imaging

This project aims to triangulate the position of a transmitter in a mapped area using receivers which interpret the RSSI of the transmitter within a ZigBee network.

Achieving this will provide a low cost , low power position location solution in the absence of other positioning technologies.



Sarsha Jones

New Plymouth Girls' High School
Major: Electronic and Computer Systems Engineering
Supervisor: A/Prof Donald Bailey

Detection of Movement in Surveillance Footage with Rain

Kinopta Ltd make and sell surveillance cameras which contain on-camera tools to search and find the photos of interest quickly and easily. It does this by using image processing techniques to identity changes in the footage as the photos are taken.

My project was to develop an algorithm for these cameras in order to prevent the motion of rain from producing false positives, while still identifying other movement within the raining frames.

Mobile Application for Crowdsourcing Land Cover Information

Land cover is the physical material at the surface of the earth. In New Zealand, Landcare Research is contracted by the Government to develop the current iterations of the national Land cover databases (currently LCDBv4). The purpose of this project was to develop an android application for Landcare Research which allows users in the field to provide change information when they find the Land cover at a location has changed from the classification specified in the LCDB.

Murray Lucas

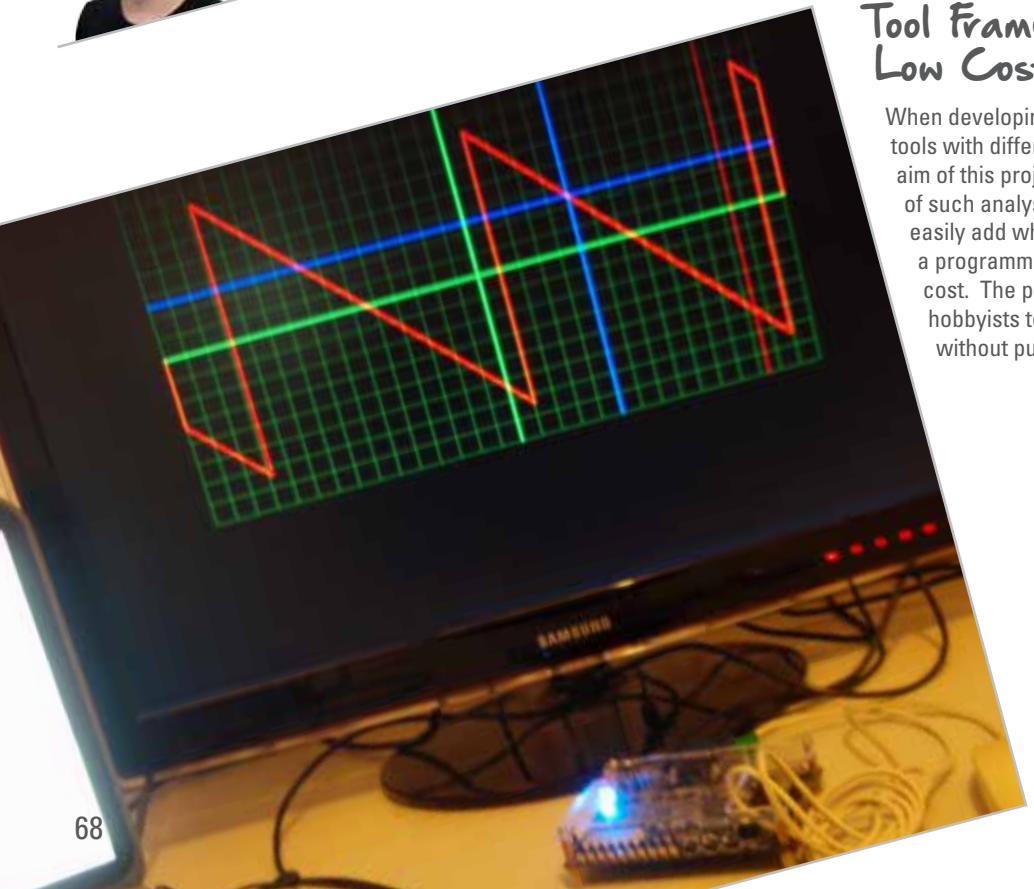
Freyberg High School
Major: Electronic and Computer Systems Engineering
Supervisor: Dr Rachel Blagojevic
Industrial Sponsor: Landcare Research

Tsubasa Nakata

St Peter's College, Senri International School
Major: Electronic and Computer Systems Engineering
Supervisor: A/Prof Donald Bailey

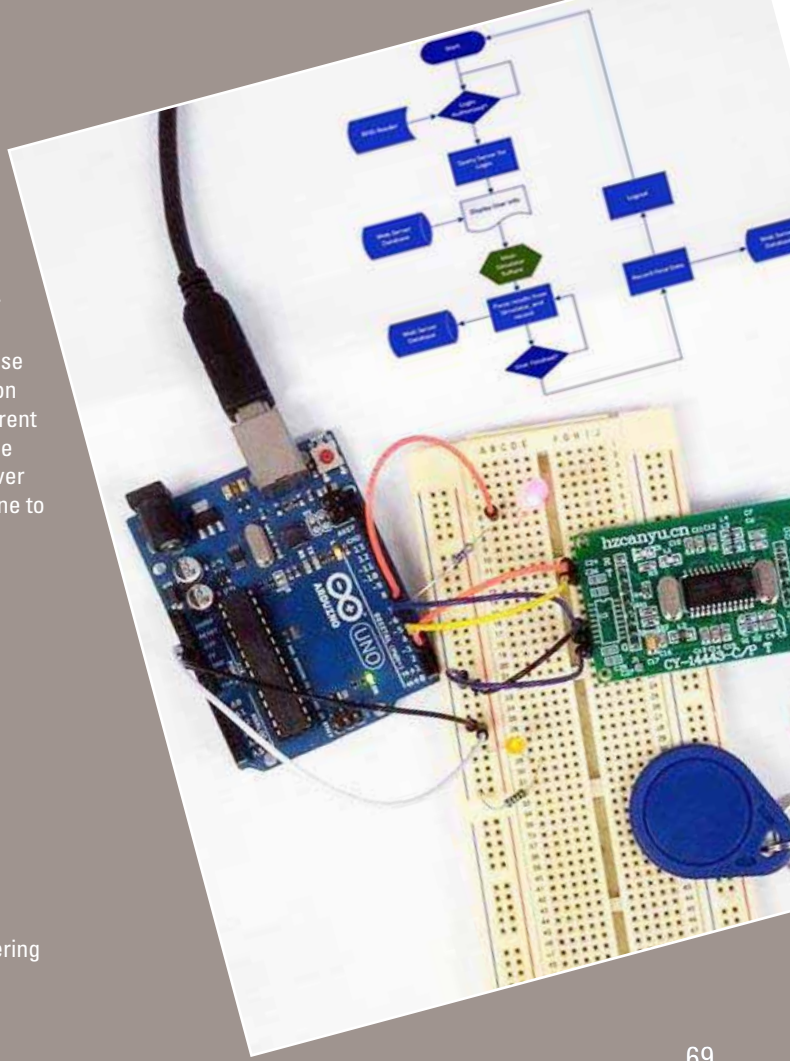
Customisable Circuit Analysis Tool Framework with Low Cost FPGA

When developing electronic devices, varieties of analysis tools with different capabilities are used for testing. The aim of this project is to implement a low cost framework of such analysis tools on FPGA that enables the users to easily add whatever functionality they require. An FPGA is a programmable 'parallel' processor that is fast and low cost. The purpose of this device is to enable electronic hobbyists to perform analysis in the way they like without purchasing expensive analysis tools.



User Management for Educational Driving Simulator

My Project is to design a suite of software to manage user accounts for a new system of educational driver machines. My software must cover login and authentication at the simulator end, and also an online database to track statistics about all drivers; both to help individual drivers work on their specific areas of difficulty, and also to build up a picture of the current state of young NZ drivers. A student enrolled in this program will be able to easily login to any machine around the country, and complete whatever lesson they are up to in their progress. They will then be able to go online to their personal profile, and find information about their results.

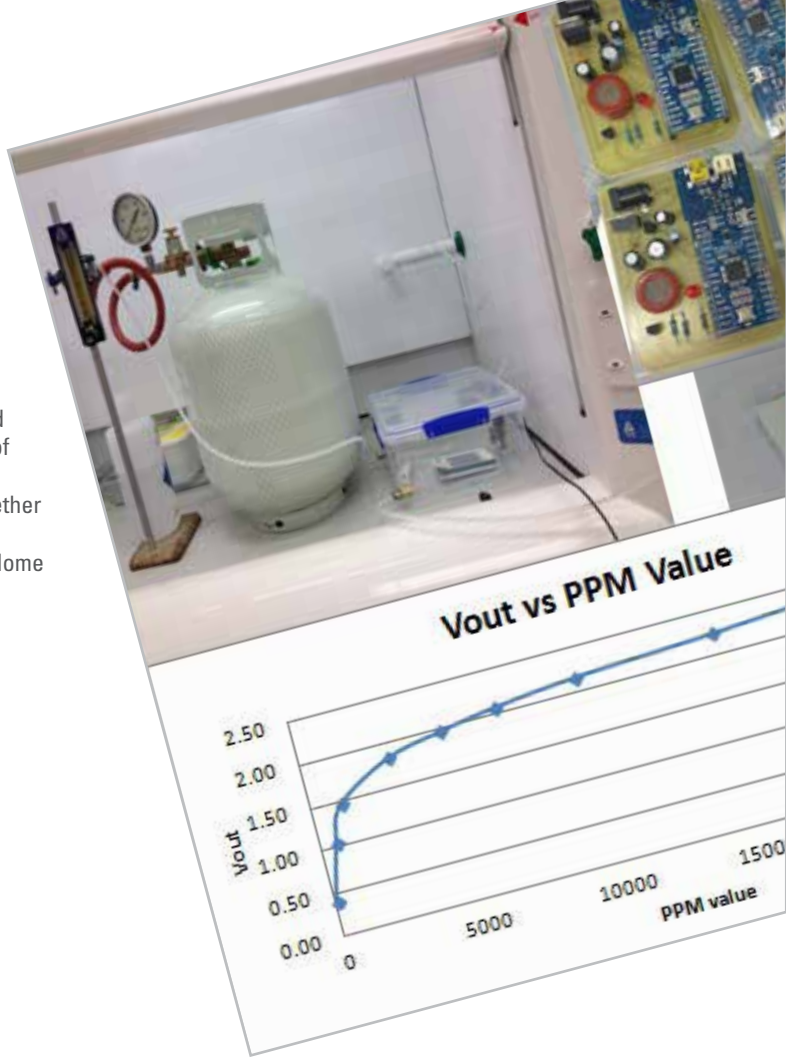


Richard Paul

Homeschool
Major: Electronic and Computer Systems Engineering
Supervisor: A/Prof Johan Potgieter
Industrial Sponsor: Virtech Simulators Ltd

Smart Sensing System for Residential Gas Detection

Gas leakage will cause injury or explosion when gas air mixture reaches a critical value. The aim of this project is to develop a smart sensor system used for detecting the dangerous gases such as Methane and LPG at residential home. Each sensor node consists of gas sensor and microcontroller with ZigBee. The detected gas level data will be transmitted to computer via wireless communication and will be displayed on the web of the system. The warning message will be sent to user's mobile phone when the gas leakage reaches a warning level. This project also investigates whether the interdigital sensor with SnO_2 coating can detect the gas better than the commercial sensor. The developed system will be used as a part of Smart Home Project of the S2IS group.



Li (Shelly) Xie

Donghua University, Shanghai
Major: Electronic and Computer Systems Engineering
Supervisor: Prof Subhas Mukhopadhyay

Dmitri Roukin

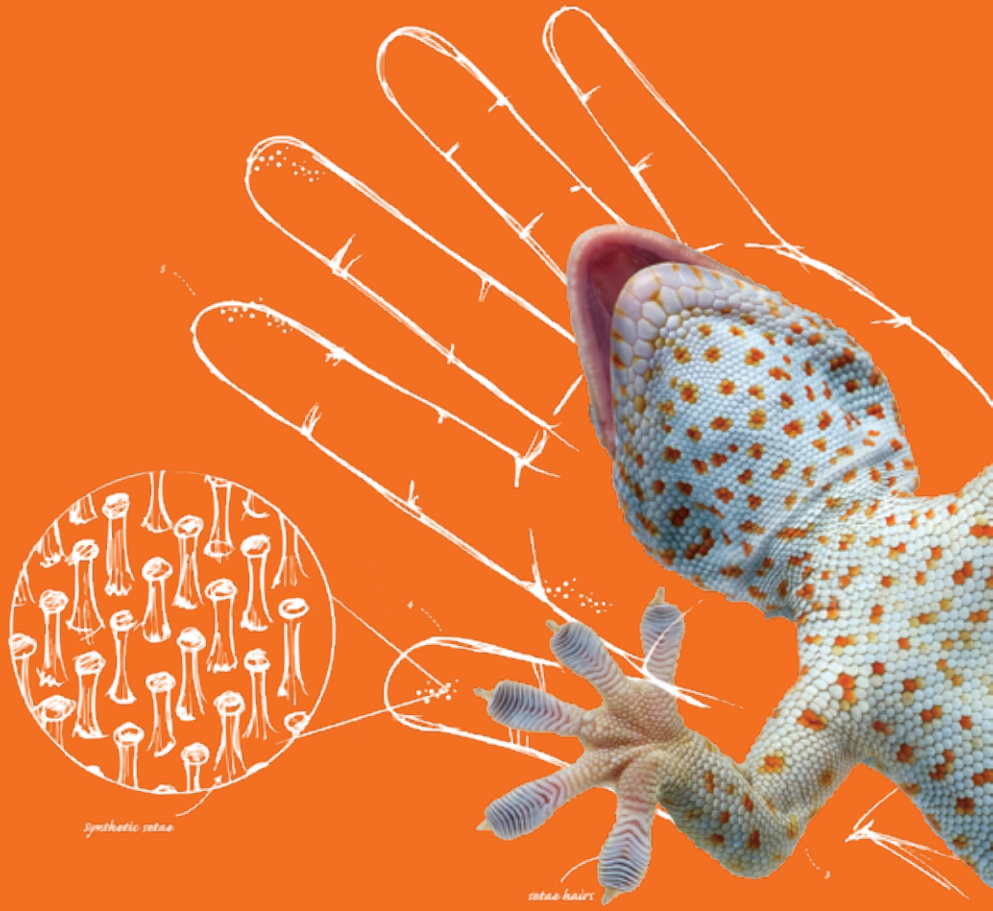
Major: Electronics and Communication Engineering
Supervisor: A/Prof Edmund Lai

Autonomous Flight Control of a Quadcopter

The aim of the project is to allow a user to program a quadcopter for an autonomous flight from point A to point B on a map. It involves the development of a user friendly interface to specify a flight path and the electronics for wireless communication and control of the quadcopter. By using a Raspberry Pi computer together with an Arduino microcontroller on board, it is possible to fully utilise the power of web server for networking and at the same time providing fine control of the motors and electronic sensors. One of the truly unique features of the hardware deployed on the quadcopter is multiconnectivity – any device can be incorporated via USB, WiFi, Ethernet and direct IO, thus making the system extremely versatile and expandable.

The Gecko

Gecko feet are covered in little hairs. Each hair is about 200 to 500 nanometers wide. The adhesive power of a centimeter of gecko foot is about 10 Newtons. The principles of the Gecko feet have formed the foundation for the development of Gecko tape, which is projected to have a wide range of industrial applications due to its strength, ease of removal and lack of residue.



Chemical & Bioprocess Engineering

New Zealand's economy is strongly based on adding value to bio-derived materials through processing. Traditional export industries are increasingly looking to innovations in biotechnology and nanotechnology to develop processes for new products or ingredients from New Zealand resources.

Graduates in Chemical & Bioprocess Engineering are found in a wide range of chemical and bioprocessing industries worldwide. They hold positions as process engineer, production manager, consulting engineer and chemical engineer.

Jeremy Hill

Freyberg High School
Major: Biotechnology
Supervisors: A/Prof Pak-Lam Yu, Mr Andrew Patrick
Industrial Sponsor : Fonterra Cooperative Group Microbial Fermentation Unit

Increasing Viability of Freeze-dried Yeast

It is well known that Fonterra is the world's largest milk producer and dairy exporter. Less well known is that Fonterra is one of New Zealand's largest ethanol producers, converting serum, a by-product of casein manufacture, into approximately fifteen million litres of ethanol annually. The purpose of this project is to continue existing research, to develop a process for freeze-drying *Kluyveromyces marxianus*, the yeast Fonterra uses for fermentation in its ethanol production process. Freeze-drying the yeast would make its storage and distribution easier and improve its shelf life. Currently, the yeast cells do not survive freeze-drying in sufficient numbers to make a viable product. Several factors have been investigated to improve cell viability including time of harvest, cryo-protectant concentration, substrate concentration, and broth aeration level, but none has improved the very low survival rate of *K. marxianus*. However, other factors are being investigated which show promise in achieving a successful outcome.

Palm Oil Biodiesel for Turbine Aircraft Engines

Biodiesel has been recognized as a way of meeting the increasing demand for crude oil by blending it with petroleum fuels; its use also lowers green house gas emissions. Palm oil stands out compared to other vegetable oils due to its high oil production yield and the principal focus of this project is to produce a fuel that is compatible with the requirements for its use in turbine aircraft engines. Palm oil biodiesel was produced via the transesterification process with particular attention given to the washing step in order to produce a fuel with low content of Group I metals. The degradation of the palm oil biodiesel under different storage conditions of light intensity, temperature and exposure to air is also investigated. Lastly the performance of a model jet engine is measured and compared when running on palm oil biodiesel, canola oil biodiesel, and commercial biodiesel.

Syaida Liyana Akmal Hisham

Kolej MARA Kuala Nerang
Major: Chemical and Bioprocess Engineering
Supervisors: Prof Clive Davies, Dr Colin Brown, Dr Rose Davies

Process to Convert Wineries Waste into Profit

Wine is New Zealand's largest horticultural export product, with exports reaching an estimated value of $ 1.2billion in 2013. New Zealand produced approximately 250 million litres of wine in 2013. Grape pomace is a by-product of the wine industry, which is known to be a rich source of fibre and antioxidants. Pomace is commonly used as a component of compost and cattle feed. However, most of the grape pomace is disposed to landfill. Massey IFNHH realised the economic potential of turning grape pomace into a higher value product. The aim of this project is to develop a financially feasible process to turn grape pomace into a high value food ingredient rich in fibre. The grape pomace is preconditioned, dried, and then milled to produce a grape powder. A financial feasibility analysis is used to determine the profitability of grape pomace powder production on a commercial scale.

Therick

SMAK IPEKA Pluit
Major: Chemical and Bioprocess Engineering
Supervisors: Dr Alistair Carr, Dr Colin Brown, Mr Sina Hosseiniparvar
Industrial Sponsor: Massey IFNHH, Riddet Institute

Mohsen Alshahrani

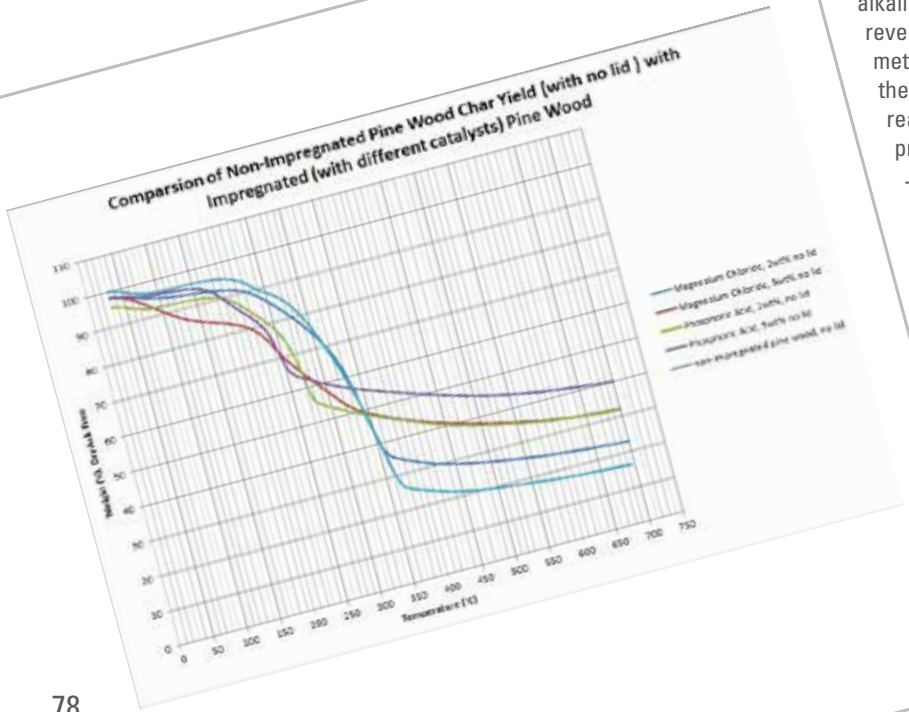
Major: Chemical and Nanotechnology
Supervisor: Prof Tony Paterson

Investigation of the Cohesive Force in Bulk

To understand a particle's cohesive properties, one must measure the strength of the connection between particles. The cohesive strength is influenced by water content. By calculating the cohesion strength of liquid bridges and experimentally measuring how strong they are, the relation between the two tests can be correlated to the actual theory of strength of cohesion that has been derived from the liquid bridge theory. My results showed that there is a good correlation between the effect of moisture content on the liquid bridge strength compared to the theory.

Saleh Alyami

Ibn Khaldun High School
Major: Chemical and Nanotechnology
Supervisors: Prof Jim Jones,
Georg Ripberger (PhD student)



Catalysis of Char Formation

Research has shown that the yield of char can be increased considerably when pyrolysis is performed with alkali and alkaline earth metals. Preliminary work in our laboratory revealed that this catalytic action only occurs when the metals are impregnated into the wood, which suggests that the mechanism is catalysis of the primary char forming reactions, rather than secondary catalysis of the tar as proposed in the literature.

The aim of this study was to investigate the role of acid catalysis (phosphoric acid, H_3PO_4) on the char formation process, i.e. primary and secondary reactions, and how this compares to catalytic pyrolysis by metal impregnation, KCl and $MgCl_2$, including its economic implications. Pyrolysis was carried out in a thermogravimetric analyser in the slow pyrolysis regime used for manufacturing biochar. The effect of catalyst on primary and secondary reactions was simulated by employing crucibles with (increasing the contact time of tar vapours) and without a lid. The results show that all catalysts increase char yield (with H_3PO_4 by up to 100%) and the pyrolysis temperatures were lower than without a catalyst. In this way, the knowledge gained in this project will make the manufacture of char more efficient and deliver greater carbon sequestration for biochar.

Understanding the Differences between Char and Tar-char

Most of the energy demand today is met through the combustion of fossil fuels, a process which results in the release of harmful greenhouse gases (GHG) into the atmosphere, which is the main contributor to the rise in global temperatures. Methods are required to sequester the CO_2 currently in the atmosphere so that global warming can be mitigated. One such promising method is the production of bio-char via pyrolysis.

Pyrolysis is the thermochemical decomposition of organic material under oxygen free condition and high temperatures (200-700°C). The process produces three products: char (called bio-char if it is produced from a sustainable source of biomass and its intended purpose is to be added to soil), tar and non-condensable gases. If the tar is then re-pyrolysed, the solid residue is called tar-char.

This project investigates the differences between char and tar-char. Properties of interest are basic density, apparent density, porosity, surface area, calorific value, proximate analysis, and ultimate analysis. The findings will be used to understand the char formation mechanisms.

Nadeem Caco

Papatoetoe High School
Major: Chemical & Nanotechnology
Supervisor: Prof Jim Jones

Aaron Edmunds

New Plymouth Boys High School
Major: Chemical and Nano Technology
Supervisors: Prof John Bronlund, Dr Karl Dahm
Industrial Sponsor: Carter Holt Harvey and MBIE

Corrugated Fibreboard Crease Stiffness Analysis

Worldwide the corrugated fibreboard packaging industry is worth $52 billion and is expected to expand to $67 billion by 2017(Smithers Pira, 2012). In New Zealand a large amount of products are exported, imported and sent domestically in corrugated fibreboard packaging. One of the primary roles of this packaging is to provide protection of the product. In storage and transport, corrugated fibreboard can become damaged and weakened by the stacking load and ambient conditions.

Packaging manufacturers add creases to corrugated fibreboard to allow them to be folded into a box. The aim was to develop a measurement and data analysis method to characterise crease stiffness as a function of ambient conditions, crease depth and angle of crease to the flutes within the corrugated fibreboard. A new method was designed that can be used to quantify stiffness as a function of folding speed and angle. This knowledge will assist in new packaging design.

Granule Strength in SSP Stockpiles: Measurement and Modelling

Ravensdown is one of the two main fertilizer manufacturers in New Zealand and fuels New Zealand's extensive farming industry. Ravensdown's product is Superphosphate (SSP) which is made through the reaction of phosphate in rock with sulphuric acid. The SSP is then granulated to small granules and stored in large piles. Ravensdown would like to maximise the strength of this product as a weaker product corresponds to an increase in powdering. The powdered SSP disperses when spread and it is therefore important that the product has uniform and predictable sizing for accurate spreading. The focus for this project is the strength development that occurs in the large storage piles after manufacture.

The primary deliverable for this project is a robust mathematical model to determine the physical strength of SSP granules matured in a pile. A secondary aim is to gain improved understanding of the mechanisms involved in the development of granule strength.

Gary Leishman

Palmerston North Boys High School
Major: Chemical and Nano Technology
Supervisor: Prof Clive Davies
Industrial Sponsor: Ravensdown Awatoto

Bubble Generation for Film Coating

Films are a new application method that has being explored in granulation, where better distribution of binder is expected. This project explores the use of film for coating, driven by a need for smart surfaces for food and pharmaceutical powders and particles. The current state-of-art is to spray droplets at particles suspended in a fluidized or spouted bed. This leads to considerable loss of coating materials especially for hydrophobic particles as the adhesion between particle and coating droplet is poor and also a proportion of spray droplets dry before contacting particles. This project aims to deliver bubble generation system for small bubble, 1-4 mm using T-junction and then to detach the bubbles from the nozzle.

Siti Sarah Mohd Arupin

International Education College (INTEC), Shah Alam, Malaysia
Major: Chemical and Nanotechnology
Supervisors: Prof Jim Jones, Shakti Singh

Maaruthaah Senthilnathan

Palmerston North Girls' High School
Major: Chemical and Nanotechnology
Supervisors: A/Prof Mark Waterland, Prof Richard Havercamp, Mr Mark Linton
Industrial Sponsor: Massey University

Low Cost Photovoltaic Solar Paint

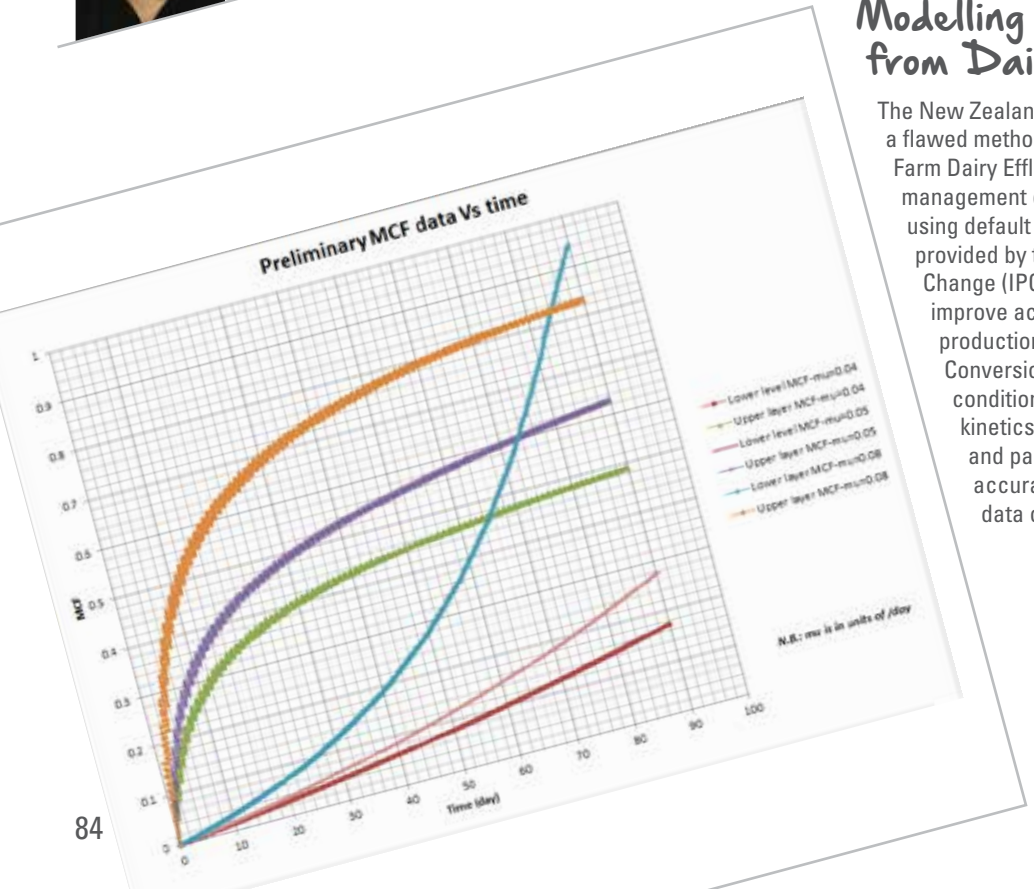
Every month when the electricity bills arrives, many consider resorting to home-integrated renewable energy alternatives like solar power! However, saving money with solar energy is harder than we realise. According to the chief executive of the Energy Efficiency and Conservation Authority, "It still costs about $10,000 just to install a 3kW solar panel system without storage batteries". Although conventional solar panels have a relatively high Power Conversion Efficiency (PCE) of 10%, from a national perspective, the economics of solar power are questionable. This is the basis of this project. Ultimately, the photovoltaic industry is governed by two things; the PCE and the manufacturing and installation costs. My project is about developing a low-cost photovoltaic solar-paint that can convert light energy into electrical energy with a PCE of 2%. The paint employs semiconductor, quantum-dot-based nano-crystals and is a mixture of two types of core-shell quantum dots. Both kinds are made of TiO_2 core but have CdSe and CdS shells.

Fatima Shehata

Palmerston North Girls' High School
Major: Chemical and Nanotechnology
Supervisor: Prof Benoit Guieysse

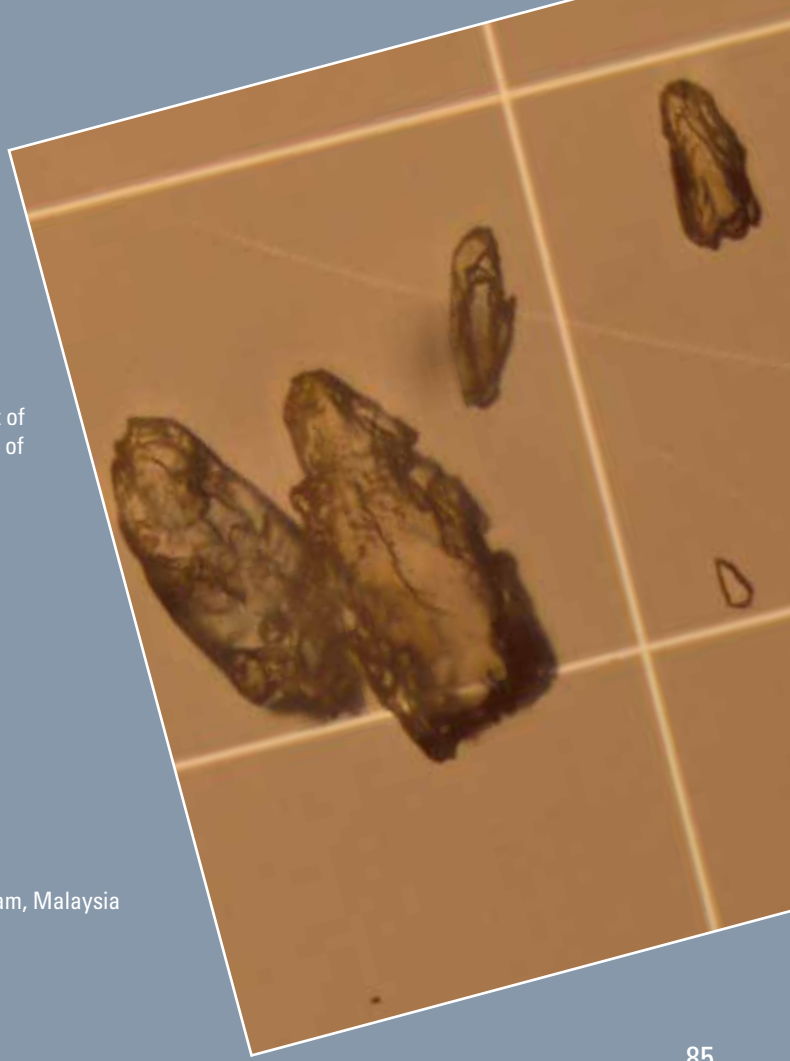
Modelling Methane Emissions from Dairy Farm Effluent Ponds

The New Zealand Greenhouse gas inventory currently uses a flawed methodology to estimate methane emissions from Farm Dairy Effluent (FDE) treatment ponds in the manure management category. A general 'Tier 2' methodology using default parameters for the Oceania region is provided by the Intergovernmental Panel for Climate Change (IPCC) but country-specific data is needed to improve accuracy. This project aims to model methane production from FDE ponds in order to allow Methane Conversion Factors (MCFs) to be estimated under conditions relevant to New Zealand. For this purpose, kinetics and hydraulic models are first constructed and parameterised using lab scale data. The accuracy of the models is then evaluated against data collected from full-scale ponds.



Effect of Citric Acid on Lactose Crystallisation Kinetics

Crystallisation is one of the primary procedures in the production of lactose powder. It involves two major steps which are nucleation and growth. During the lactose crystallisation process, calcium fouling condition can occur in the evaporator. Therefore, citric acid is added to prevent the fouling condition. This project aims to understand the effect of citric acid on the α-lactose monohydrate crystallisation kinetics in term of nucleation rate and lactose solubility.



Wee Kie Tang

International Education College (INTEC), Shah Alam, Malaysia
Major: Chemical and Nanotechnology
Supervisor: Prof Tony Paterson
Industrial Sponsor: Hilmar Cheese Company

Christopher Van Tiel

St John's College Hamilton
Major: Chemical and Nanotechnology
Supervisor: Prof John Bronlund

Automated Atto-Brewery Development

Craft brewing in New Zealand is rapidly becoming very popular as a means providing beer enthusiasts with a variety of alternative beverages. Research and development in craft breweries is the life blood of these companies, giving them a greater variety of products to compete in the market. However R&D is costly in terms of both money and time. This project was created as a means of dramatically reducing the hands on time required in R&D brewing and also reducing the cost involved. The major aim is to produce an automated five litre brewing system, that allows complete flexibility to the brewer in terms of temperature, time, grain/hop addition, specific gravity etc. I have been tasked with the development of the wort production process, looking at hop addition to the boil as well as other automating aspects in producing wort for fermentation. The project so far has been enjoyable and has taught me a lot about process design of food grade systems, as well as the fundamentals of all grain brewing.

Single Cylinder Diesel Engine Performance with Biodiesel

Biofuel has attracted worldwide attention in recent years as a form of renewable energy to replace fossil fuels. An incentive for using biofuel is lower net emission of greenhouse gasses. The focus of this project is to test and compare the performance of a five horse power, single cylinder diesel engine with petroleum diesel, biodiesel and biodiesel blends. A test circuit comprised of a single cylinder engine and integral centrifugal pump, water reservoir, pumping loop with flow control valve and platform scales, for flow rate measurement, has been developed. Biodiesel for the tests has been made from canola oil. In each test, pump delivery, fuel usage, delivery pressure and engine speed are recorded, and used to quantify engine performance.

Wan Nina Liyana Wan Ahmad Nizar

MRSM Taiping, Perak, Malaysia
Major: Chemical and Nanotechnology
Supervisors: Prof Clive Davies, Dr Rose Davies, Dr Colin Brown

The Squid

How does a squid, whose body is soft and supple, have a beak that is considered on of the hardest organic materials in natures? Here you have a 'cutting tool' that's extremely hard and stiff at its tip and is attached to a material – the muscular buccal mass – that has the consistency of Jell-O.

FOOD TECHNOLOGY

New Zealand's economy is largely reliant on the production and export of food products. As such, adding value to raw products like milk, meat and fruits are paramount to maintaining growth in New Zealand. Food Technology encompasses core science and engineering to take raw ingredients and convert them to highly valuable and sort after products.

With a broad knowledge of the food industry, Food Technology graduates are well respected in industry and fill a wide range of roles from new product development to manufacturing and process improvement positions.

Chelsea Amm

Long Bay College
Major: Food Product Technology
Supervisor: Dr Kylie Foster

Formulating an E-number Free Marinade for Poultry Fillets

The primary purpose of commercial poultry marinade is to enhance production yields while simultaneously tenderising the meat; both can be achieved using phosphates which carry an e-number, and can be perceived negatively by consumers.

This project was aimed at developing a marinade for poultry that is free of food additives, which portrays a natural image to the consumer. The key objective was to determine a natural ingredient that could provide equivalent performance to phosphates as the functional ingredient in poultry marinade, with strong emphasis on enhancing the production yield.

Performance was quantified using measures such as marinade uptake, cook losses, and storage losses, as well as instrumental texture analysis to determine tenderisation. This project is relevant to the current market because natural, additive-free products are becoming increasingly sought after, with particular application in the free range sector of the poultry industry.

New Development of Extruded Bean Crisps

This project is aimed to develop a third generation snack or pellet snack which is a hard, dense, pasta-like product that require further expansion process before it can be consumed. The product can be sold to snack manufacturers who will then expand the pellets by frying or air-puffing to produce a tasty crisp product. Targeting the health-conscious consumers, this product development will explore the potential of using navy beans and/or broad beans in order to produce a healthy, natural and gluten free product. The dense form of this product provides reduces volume requirements and provides greater resistance to damage in transportation compared to expanded ready-eat crisps

Arifah Dana Asbullah

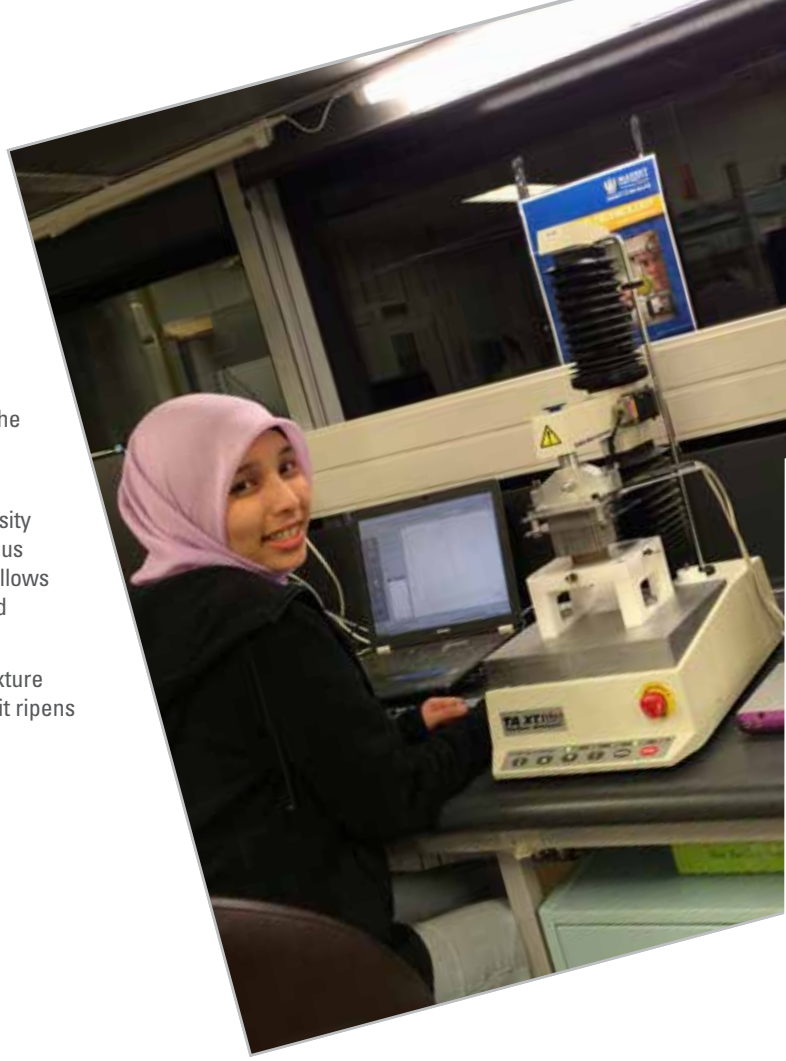
International Education Center, Malaysia
Major: Food Product Technology
Supervisor: A/Prof Matt Golding

Measuring Spatially Specific Softening of Kiwifruit

An important aspect of kiwifruit is its texture which relates directly to its palatability. Kiwifruit has a heterogeneous texture which consists of three edible flesh regions: the outer pericarp, the inner pericarp and the columella (core). This makes measurement using existing methods such as the penetrometer and acoustic firmness sensor to be a blunt estimation of the texture of kiwifruit because the location at which the measurement is done affects the firmness value.

A spatially distributed food texture analyser was developed in Massey University which consists of positioning a multiple pin penetrometer probe on a TA.XT Plus Texture Analyser before being driven into a food. This texture measurement allows textural profiles at different locations throughout a kiwifruit to be obtained and changes in its texture to be observed as the kiwifruit ripens.

The aim of the project is to understand how the spatially distributed food texture technique can measure the change in the textural properties of kiwifruit as it ripens and to compare it to different standard methods.



Syafiqa Badrul

International Education Centre (INTEC)
Major: Food Product Technology
Supervisors: Dr Andrew East, Grace Ng

Caitlin Briasco

Napier Girls' High School
Major: Food Product Technology
Supervisors: Dr David Reid, Dr Lara Matia-Merino

Cost Reduction of Processed Cheese using Polysaccharides

Processed cheese sits at the heart of a good burger. The manufacture of processed cheese is a global industry in which cost reduction is a major focus. The most expensive component of processed cheese by far, is casein. However casein has unique properties and plays a key role in the structure of processed cheese. It has the ability to emulsify fat and provide body through casein-casein interactions.

Starch is cheaper than casein. Modification of native starches can give ingredients with enhanced properties such as emulsification and gelling.

The objective was to determine if the cost of processed cheese could be reduced by replacing casein with a blend of modified starches whilst maintaining product quality. Starch suppliers were approached and samples of recommended starch systems obtained. These starches were tested in a model processed cheese system at lab scale in a RVA. The viscosity, firmness and melt properties were measured and the most promising starch systems identified. Pasting curves were generated for these starches and were used to help tweak the starch ratios in the blend to optimise their performance.

Madeleine Brown

Samuel Marsden Collegiate
Major: Food Product Technology
Supervisor: Dr Jon Palmer

Catching and Refining Yeast for Brewing

The Bloom Theory are brewers that use the environment to help create their beers, using natural resources and produce to create a beer inspired by the location. However very few wild yeasts are good fermenters, and so the aim of this project is to find a wild yeast that can be used for brewing beer. Yeasts are the controller in the fermentation process in brewing. Ideal yeasts for brewing would produce alcohol, flocculate after most of the fermentation is complete for easy removal, and produce an appealing flavour profile without unpleasant flavours and aromas. Yeasts are present everywhere in the environment, however the number that meet these criteria is likely to be very slim, and so a series of tests will be conducted to assess the yeasts suitability for brewing.

Improving the Textural Qualities of Kway Teow during Storage

Kway Teow is a type of rice noodle produced by steaming of the rice slurry with the addition of potato, tapioca and corn starches. During the steaming process, starch from the rice slurry gelatinised to form a gel contributing to its unique textural attributes. During storage, retrogradation takes place whereby the amylose molecules re-associate into ordered structures. This causes the product to harden, resulting in syneresis.

The aim of this project was to retain/improve the textural attributes of *Kway Teow* over storage time. The approach to retard retrogradation was by the addition of monoglycerides (MG). Two types of monoglycerides were evaluated. The pasting curves showed that the control (without MG) had a significantly higher ($p<0.05$) final viscosity than that of the sample with MG. Bench top *Kway Teow* were made and evaluated by Texture Profile Analysis using a texture analyser. Preliminary data indicated that samples with MG showed a lower level of hardness as compared to the control after 3 days of storage at 4°C. This could suggest that MG aids in retaining the textural properties for a prolonged period.

Ying Jie Chen

Singapore Polytechnic
Major: Food Product Technology
Supervisor: A/Prof Kelvin Goh

Ee San Cheok

International Education College
Major: Food Product Technology
Supervisors: Mr Michael Parker, Dr David Thomas

Development of Complementary Pet Gravy

Due to a low thirst drive in cats and the prevalence of dry cat food that contributes to a lack of water consumption, Feline Lower Urinary Tract Diseases (FLUTD) has become one of the top feline health concerns. The trend of pet humanization has manifested the growth of premium pet food which would include premium "human grade" ingredients. This project was aimed at developing a new complementary pet food product to be consumed with dry kibbles for hydration purpose in pets (cats). Added to this the product would include functional ingredients intended to produce a range of gravy's product with potential health benefits for pets. To achieve this, appropriate experimental work was conducted including formulation, cat palatability testing and thermal processing resulting in an improved palatable product over time.

Developing a Marketable Dried Kiwiberry Product

Kiwiberry is known as a high value fruit due to its eating convenience, nutritional properties and superior flavour. However, each year approximately 20-40% of kiwiberries cannot not be sold into the market as fresh fruits due to physical damage. To minimise wastage, kiwiberry seconds could be developed into a dried product that could be sold into the market. This study investigated the drying methods used to develop a marketable dried kiwiberry product.

Kimberly Chew

Tampines Junior College Singapore
Major: Food Product Technology
Supervisor: Dr Sung Je Lee

Behaviour of Phospholipids-Based Emulsions Tested Under In-Vitro Infant Physiological Conditions

Lipid digestion has recently received extensive attention, especially concerning infant formula and intralipid emulsions. In infants, lipid digestion occurs mainly in stomach. This is due to the relatively low level of pancreatic lipase in infants and possible occurrence of temporary bile salt deficiency. It is reported that the rate of lipid digestion is affected by physicochemical characteristics and interfacial composition in emulsions. In order to further understand these factors on lipid digestion of infants, model emulsions were prepared using different lipids (soy bean oil and anhydrous milk fat) and were stabilised by various phospholipids (egg lecithin, soy lecithin and milk fat phospholipid). The model emulsions were digested in an *in-vitro* model that mimics the infant physiological conditions in the stomach. The changes in particle size, droplets charge and microstructure of the model emulsions during lipid digestion were observed over time. The findings from this study may aid in controlling of emulsion digestion by manipulating the initial interfacial layer and subsequent fatty acid production.

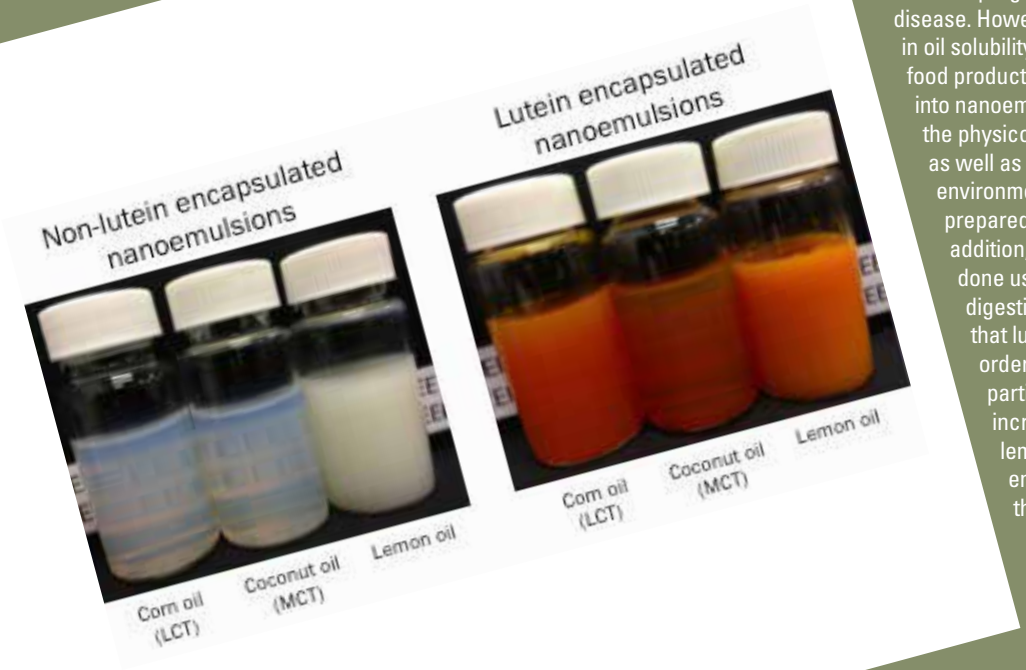
Feng Ming Chian

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Dr Lara Matia-Merino, A/Prof Matt Golding

Jie-Hong Chiang

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Dr Sung Je Lee, A/Prof Kelvin Goh, Miss Anges Teo

Development and Characterisation of Lutein Nanoemulsions



Lutein helps to maintain eye health by filtering off damage caused by short wavelength blue light and it acts as an antioxidant to slow down the progression of age-related macular degeneration (AMD) disease. However, carotenoids are water insoluble and are poor in oil solubility. Thus, it is more difficult to incorporate them into food products. The aim of this project was to encapsulate lutein into nanoemulsions using different carrier oils and to study the physicochemical characteristics of lutein nanoemulsions as well as the chemical stability of lutein under different environmental conditions. The nanoemulsions were prepared with corn oil, liquid coconut oil or lemon oil. In addition, the rate and extent of lipid phase digestion were done using an *in-vitro* model simulating small intestine digestion conditions. From the results, it was observed that lutein solubility in the lipid phase increased in the order: corn oil < lemon oil < coconut oil, while the particle size and digestion of lutein nanoemulsions increased in the order: coconut oil < corn oil < lemon oil. The encapsulation efficiency of lutein encapsulated in nanoemulsions was much higher than conventional emulsions.

Hui Yi Chua

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Professor Steve Flint

Biofilm Formation by Clostridia

In August 2013, whey protein concentrate was recalled by a New Zealand dairy manufacturer as it was initially suspected to be contaminated with *Clostridium botulinum*. This was later discovered to be the non-toxigenic *Clostridium sporogenes* which was thought to originate from a biofilm. The growth of *Clostridium* species as a biofilm in a dairy manufacturing plant has never been reported before so this project aimed to demonstrate if these clostridia could form biofilms in a dairy environment. *Clostridium* spores were used in this trial as these would survive heat treatment in the dairy system. Hence spores were harvested, purified and used in reinforced clostridial medium and 1/10 reconstituted skimmed milk in MOPS buffer in microtitre plate assays to screen for biofilm formation. Three out of five strains formed good biofilm. Strain 1097 was selected as it produced consistently high biofilm over five days of incubation. The results were confirmed using a reactor trial to determine biofilm growth on stainless steel coupons in an environment that more closely matches industrial conditions.

Atomization of Non-Newtonian Fluids

Atomization research has primarily focused almost entirely on Newtonian fluids and/or non-food related non-Newtonian materials. However, there are many types of foods that exhibit significant non-Newtonian rheological properties, which has not been studied extensively or are still in the early stages of research. The behaviour of non-Newtonian is both of practical and theoretical interest to most researchers. It is often necessary to design atomization equipment for fluids that are non-Newtonian, and yet very little knowledge is available as to what to expect above the general notion that non-Newtonian fluids are much difficult to atomize in contrast to Newtonian fluids. Therefore, an atomization rig was built specifically for the study of atomization in order to provide experimental data by investigating a series of non-Newtonian products which are still scarce. In this study, the primary outcome sought is to achieve a better understanding concerning certain critical parameters of the atomization processes of non-Newtonian fluids such as the determination of equivalent shear rate, capacity of nozzle as well as the critical pressure for full atomisation.

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Xian Ling Chua

Singapore Polytechnic
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Supervisors: Dr Xu Yun Yun, Dr Tay Hong Soon

Development and Characterisation of Edible Film Packaging from Natural Biopolymers

The aim is to develop and characterise edible films made from natural biopolymers that are suitable as food packaging materials with the following objectives: (1) develop an edible film using different sources of polysaccharides (namely, konjac, lambda carrageenan, rice and tapioca starches) and (2) examine the effects of the addition of soy protein on the resultant mixed-biopolymer composite films. Tensile strength (TS), elongation at break (EAB), water vapour permeability (WVP) and fourier transform spectroscopy of the films were investigated. 2% (w/w) of rice starch, 1% (w/w) of tapioca starch, 1.5% (w/w) of lambda carrageenan, 0.5% (w/w) of konjac gum were used and each combined with 3% (w/w) of soy protein isolate (SPI) and glycerol (30% w/w of SPI) to form composite films. Starch films were generally more brittle than non-starch films as shown by higher TS and lower EAB values. The addition of protein doubled the EAB and reduced WVP by 5 times. Konjac mixed SPI films displayed best properties amongst composite films with TS of about 1383.8 g; EAB of 31.67% and a low WVP of about 0.00325 g.mm/kPa.h.m^2.

Shelf-life extension of a Peanut Butter Chocolate

The Good Tempered Chocolate Company is a small chocolatier business located in Auckland. It provides premium hand crafted, fresh chocolates with no artificial flavours. The company has developed a peanut butter filled fresh chocolate confectionery with a unique taste and texture. The chocolate currently has a short shelf life due fat migration from the peanut filling through to the chocolate coating which affects the textural properties of the chocolate and reduces in quality of taste. The purpose of this project is to increase the shelf life of the chocolates to allow for wider distribution throughout New Zealand and overseas.

Gabrielle Cooper

Wanganui High School
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Supervisors: Dr Patrick Janssen

Development of a Chia Muesli Bar

This project was aimed at developing a new and healthy product for a company that currently sell endurance sports drinks with three unique flavours. Chia seeds have been growing in popularity for the past few years due to their rich in nutrients and health benefits. Chia seeds have one third of its weight being oil, meaning 60% of oil is Omega 3 or α-linolenic acid as well as they contain higher levels of complete protein, fibre, essential nutrients and antioxidants. The product needs to be shelf stable and also to be acceptable in New Zealand and overseas markets. To achieve this, appropriate experimental work including formulation processing, instrumental analysis and sensory analysis was conducted resulting in refined product prototypes.

Sampoorna Tulasi Dama

Palmerston North Girls' High School
Major: Food Product Technology
Supervisor: Mr Michael Parker

Christeen De Silva

Tauhara College
Major: Food Product Technology
Supervisor: Mr Allan Hardacre

Development of Soft Textured Confectionery Product

Confectionery products have an extremely diverse and variable range of textural properties. Unique and organoleptically interesting textures are often the drivers for the success of products in the extremely competitive confectionery market. Sugar and its unique crystallisation and setting properties are highly important in forming the texture of these products. Toffees are a favourite and can be soft and creamy or hard and brittle or anywhere in between. Boiling temperature is the key in this process because it controls the sugar concentration and this controls the colour and between texture of the toffee.

The aim of this project was to develop a formulation for a toffee confection with a texture similar to 'fruit burst' toffee product marketed by the Cadbury Pascall Company. Sensory analysis was conducted to determine where the changes to the formulation had modified the texture of the product and to determine the consumer acceptability.

Emily Dekker

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Development of a Nutritional Iceblock

It is a widely known fact that when a person is vomiting or suffering from nausea it is difficult for them to consume food. This means that often they do not always receive the daily requirements for important micronutrients, such as vitamins and minerals. One way of ensuring these people do not become deficient in these important micronutrients is to deliver them in an easy to consume form. This led to the concept of an ice block which contains a number of key nutritional components. An ice block is a suitable form for this purpose because it also hydrates the consumer which is vitally important if they have been vomiting.

The aim of this project was to develop a natural, tasty and refreshing ice block with added vitamins and minerals as an easy way to provide daily nutritional requirements when feeling nauseous or otherwise unable to retain food.

A Vegetarian Jerky from Extruded Soy-Protein

Vegetarian jerkies are foods usually made from plant proteins that imitate the texture and appearance of conventional meat jerky. The challenge is to make a tasty, chewy product with a long shelf-life at room temperature. A high quality vegetarian jerky high in protein (>30%) could be made by cooking and forming soy and wheat protein at high temperature and moisture content, using laboratory scale twin screw extruder fitted with a long temperature-controlled slit die. Increasing oil content contributes to a softer jerky, whereas increasing the glycerol concentration increases chewiness at shelf safe water activities.

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Shiyu Dong

TongLiao 5 High School
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Supervisors: A/Prof Marie Wong

Characterisation of Chemical Composition and Sensory Attributes for New Zealand Cold-Pressed Virgin Rapeseed Oil

Cold-pressed virgin rapeseed oils are becoming more popular in Europe. They are characterised by their specific taste and smell that resembles asparagus, cabbage or fresh, green vegetables. Virgin rapeseed oils are especially preferred by consumers for salad dressings and other preparation of dishes. There is little information on New Zealand cold-pressed virgin rapeseed oil, the aim of this project was to characterise the New Zealand cold-pressed virgin rapeseed oil in terms of chemical and sensory properties.

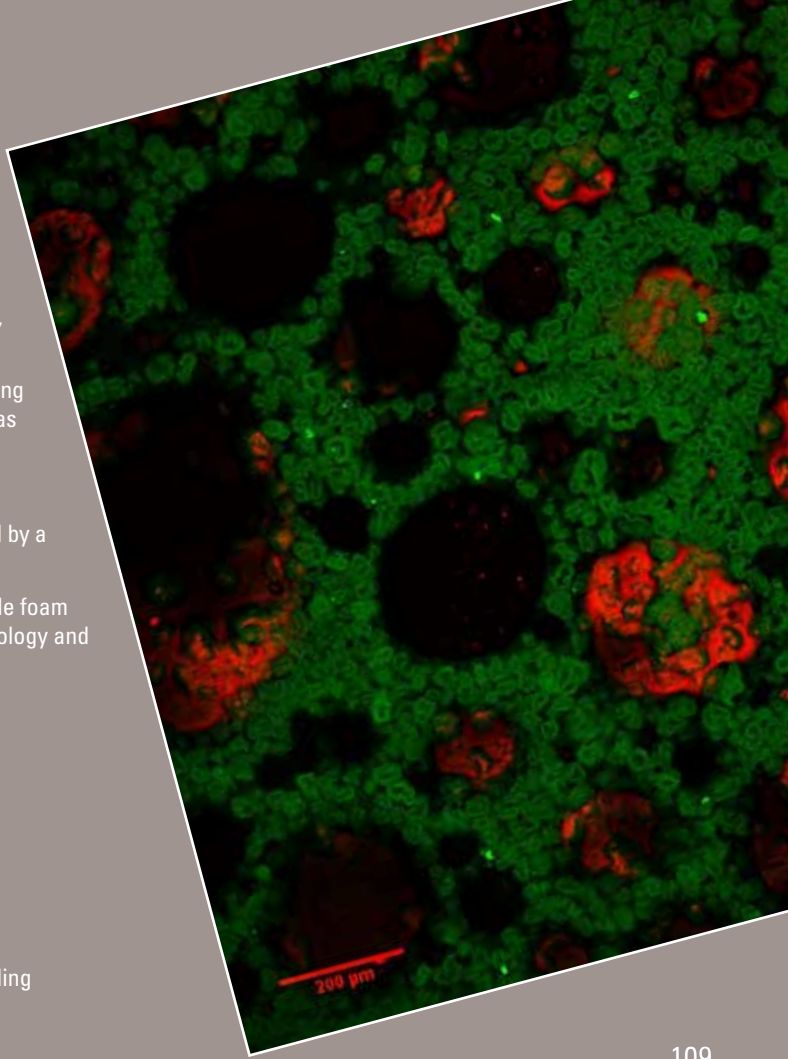
Gas Chromatography (GC) was used to determine the major fatty acid composition, High Performance Liquid Chromatography (HPLC) for tocopherol composition and triglyceride profile. The quality of the oil was also assessed with Free Fatty Acid (FFA), Peroxide Value (PV), Anisidine Value (AnV), and Rancimat analysis. A trained sensory panel was developed for assessing the attributes of New Zealand cold-pressed virgin rapeseed oil.

Fat-Free Food Foams

Many foods are aerated to create interesting textures. Examples include ice cream, meringue, cake, mousse and soufflé. The aeration of foods requires surface-acting foaming agents to stabilise air bubbles, such as egg white protein in meringue.

Previous work by Massey University students has identified a novel foaming agent with excellent foamability in very low-fat systems. The ingredient has successfully been used as a foaming agent and fat replacer in a zero-fat dessert and this project investigates other product opportunities, such as meringue and mousse. Formulation work has also been carried out in this project to improve sensory properties of the zero-fat dessert, as assessed by a consumer sensory panel.

In addition, this project researches the mechanism of foaming in a simple foam system using a range of techniques including confocal microscopy, rheology and ingredient interaction trials.



Hannah Easton

Palmerston North Girls High School
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Supervisors: Mr Allan Hardacre, A/Prof Matt Golding

Inhibition of Carbohydrate Digestion In-Vitro by Food Gum and Plant Fibre (Food Enzymes)

Consumption of foods rich in dietary fibre can reduce glycemia, which has been linked with a lowered risk of coronary heart disease and diabetes. Guar gum, a soluble fibre widely used in food products, has been shown to be effective in lowering postprandial glycaemia. At low concentrations, this has been reported to be due to non-competitive binding of α-amylase to the galactomannan present in guar gum, thereby inhibiting starch digestion. However, it is not known if this effect extends to amylases from different sources or other soluble polysaccharides with structures similar to guar. This project investigates the role of guar gum in reducing the rate of starch digestion during *in-vitro* digestion by a range of commercial amylase preparations. Spectrophotometric determination of reducing sugar concentrations was used to measure the rate of starch digestion and to determine the kinetic constants (K_m and V_{max}) for the various amylases. The effect of guar, a soluble fibre was compared to insoluble wheat fibre to determine the efficacy of regularly consumed food fibres in ameliorating the rate of starch hydrolysis in model digestion systems.

Gui Xin Goh

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Ivy Wan Ling Goh

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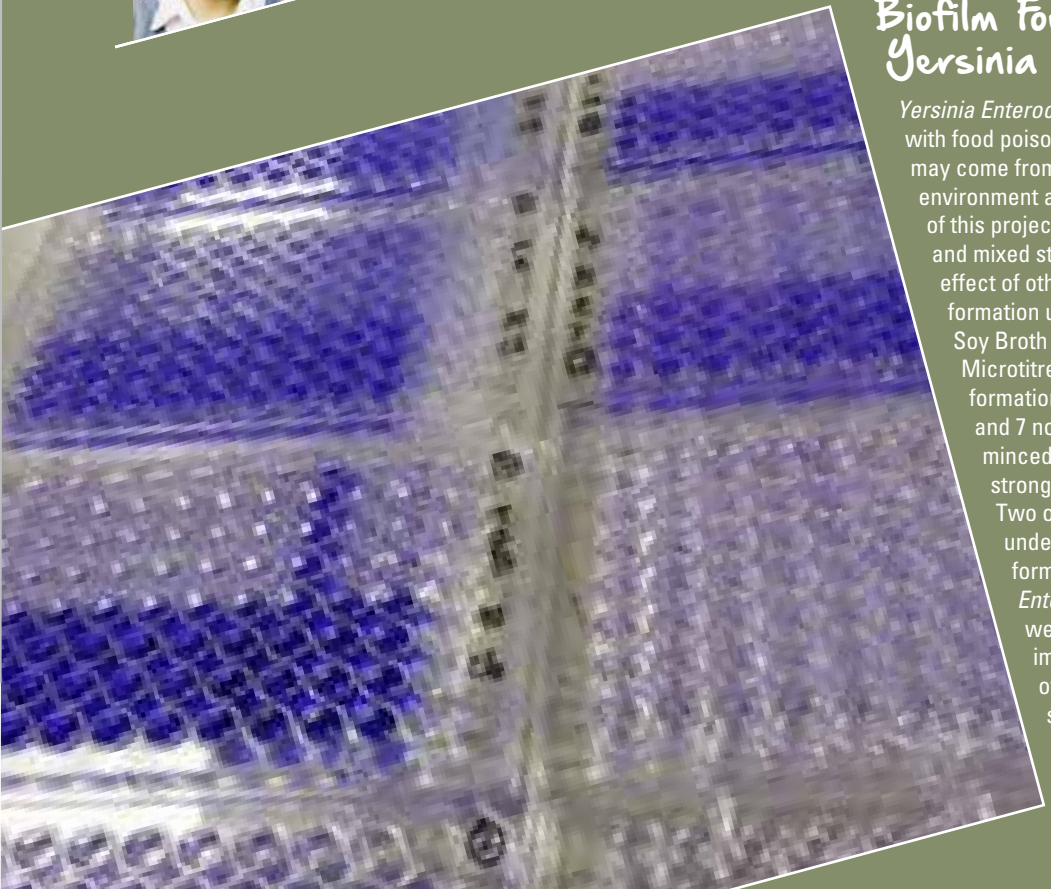

Biofilm Formation of Yersinia Enterocolitica

Yersinia Enterocolitica is a pathogenic bacterium associated with food poisoning caused by pork. The contamination of pork may come from biofilms in the slaughter or meat preparation environment although this has not been investigated. The aim of this project was to evaluate biofilm formation of single and mixed strains of *Yersinia Enterocolitica* and examine the effect of other bacteria isolated from minced pork on biofilm formation using two different growth media, namely, Tryptic Soy Broth and Meat Broth, at 10°C and room temperature. Microtitre plate assays were used to determine the biofilm formation of 16 Y. *Enterocolitica* strains (9 pathogenic and 7 non-pathogenic) and 11 bacterial isolates from minced pork. The *Y. Eterocolitica* strains formed the strongest biofilms in meat broth at room temperature. Two other bacterial isolates producing strong biofilms under the same conditions were tested for biofilm formation, in combination with 9 pathogenic *Y. Enterocolitica* strains. Enhanced biofilm formations were observed for some combinations, which may imply that pathogenic *Y. Enterocolitica* is capable of interacting with other bacteria in pork to form strong biofilms that may resist environmental stresses in a meat processing system.

Esther Gusti

Singapore Polytechnic
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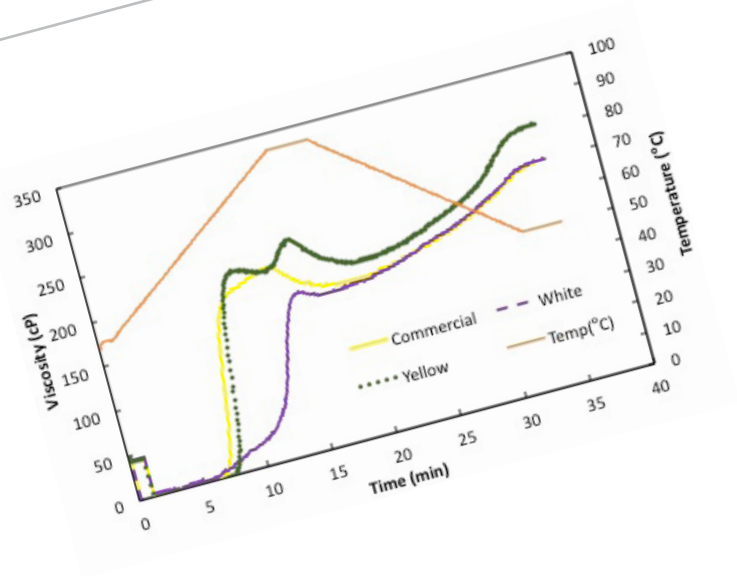
Supervisors: Dr Oni Yuliarti

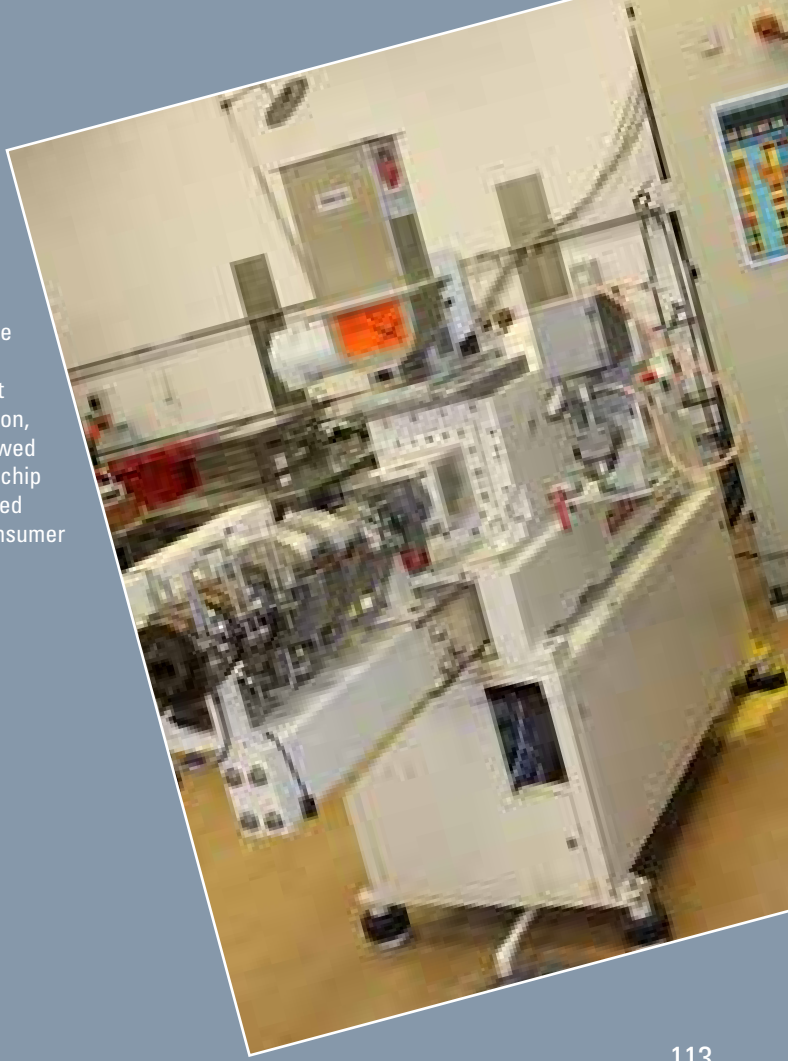
Physicochemical Characterization of Isolated Cassava Starches



The demand for starch is increasing and cassava is considered as a potential source of starch. Starch contributes to textural properties of many foods and is widely used in food and industrial application. The physicochemical properties of cassava starch depends largely on the variety, and environmental factors, whereas, the isolation method of cassava starch determines the quality and the functional properties. In this study, the physicochemical properties of water which extracted cassava starch isolated from two varieties of cassava (white and yellow) were investigated. The chemical properties such as total starch and amylose/amylopectin content were studied. In addition, the physical properties such as swelling, molecular profiles and morphological characteristics, were also investigated. These properties were further related to the functional properties namely pasting and gelation properties. This study showed that the starch swelling and breakdown viscosity properties were influenced significantly by starch amylose content and particle size. Furthermore, the starch extracted from yellow tuber was shown to exhibit higher peak viscosity compared to commercial starch available in the market, suggesting that the cassava from Lombok, Indonesia could be a promising source of starch.

Organic and Gluten Free Ready-to-Eat Snack Food

Kiwi Organics is a small, family owned New Zealand company that produces bulk organic corn grit and flour. They currently see a gap in the market for a healthy plain corn based product that is both organic and gluten free especially in the New Zealand market. Research into current products available on the market was conducted and with this information, various product concepts were developed. These concepts were narrowed down into a final product concept, which will be a natural organic corn-chip like product. Various formulations for this final product concept were tried and tested using bench top methods and evaluated through use of a consumer sensory panel. An optimal formulation was developed with shelf life and nutritional testing conducted, leading to a final product.



Nicholas Hanly

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Kaylee Ironside

Palmerston North Girls High School
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Supervisor: Dr Jason Hindmarsh

'Just Add Water' Cereal

The aim of my project was to develop a premium 'just add water' fruit juice cereal for Food Locomotive Ltd in Hawkes Bay. The cereal has been designed to only need the addition of water to hydrate a dried apple juice within the cereal. The most challenging aspect of this project was to develop a dried apple juice powder that could be incorporated in to the cereal. It was found that due to the high sugar content of apple juice, drying methods such as freeze drying and spray drying cannot be used to dry apple juice into a powder without the need of additives. To overcome this problem, experimental trials were carried out to develop a dried mix of ingredients that mimic the taste of apple juice when rehydrated. After formulation trials, the dried apple juice mix was added to the cereal developed, creating the final 'just add water' cereal product. Sensory analysis was then carried out to obtain a consumer evaluation of the final cereal product.

Biofilm Formation of Thermophilic Bacteria from Whey

The aim of the project was to study biofilm formation of thermophilic bacteria isolated from whey powder, to assess the importance of biofilm in contamination of whey products. 14 isolates were provided, three were identified using Polymerase Chain Reaction (PCR) as *Bacillus cereus* while 11 were *Streptococcus thermophilus*. These were tested for their ability to form biofilm using the microtitre plate assay using single and mixed cultures in different media. Indicator of good biofilm growth was an optical density (OD at 570nm) of 0.5 and above. Nine single cultures, all *S.thermophilus*, achieved that OD. More biofilm was produced in M17 medium compared to tryptic soy broth and whey. To mimic industrial processing, a laboratory biofilm reactor (CDC reactor) was used with new PVDF (polyvinylidene fluoride) membranes to determine if the strains forming best biofilm from the plate assay would colonise membrane surfaces. After 24 hours of incubation, results showed growth on the membrane. Hence these thermophilic bacteria do have potential to form biofilm on membrane surfaces and this is therefore a potential source of contamination for whey powder.

Nur Hanizah Binte Kamsani

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Development of a Fermented Hard Ginger Beer (4%)

Bundaberg Ginger beer is well renowned for its ginger flavour profile in the U.S, Australia and in New Zealand and continues to be one of the leading non-alcoholic ginger beverages on the market today. There is a gap in the market for an alcoholic ginger beer that has a flavour profile similar to Bundaberg non-alcoholic ginger beer. The aim of my project was thus to produce a fermented hard ginger beer with a 4% level of alcohol (by volume) based on the flavour of Bundaberg non-alcoholic ginger beer. My ginger beer was produced by fermentation using similar ingredients to Bundaberg, and the overall ginger flavour and pungency was enhanced by adding concentrated extracted oleoresins from ginger (via CO_2 extraction) which makes my ginger beer unique to other ginger beers currently on the market. To compare my ginger beer with Bundaberg a tasting panel was trained and used to rate the various flavour attributes of both ginger beers. Finally, consumer testing would be carried out to allow feedback on my final ginger beer product to assess its likeability.

Lachlan Kendrick

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Benjamin King

Rangitoto College
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Investigation into Methods to Reduce Chicken Product Freezing Time

The freezing of poultry products is common practice to extend the product's shelf life. On the industrial scale where boxes of product can weigh up to 15kg, reducing the core temperature of these products can consume significant amounts of time and energy. Reducing this time will allow for increased production, reduced energy costs and may help prevent product pile ups in the event of a breakdown. This project aims to find cost effective methods of reducing the freezing time of poultry products without significantly altering current production methods.

Joanna Koat

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Development of a Food Product from Red Grape Pomace

Grape pomace is a by-product of the wine making process, which consists of grape stems, seeds, skins and pulp (Farkas 1988). The New Zealand wine industry produces on average, around 40,000 tonnes of grape pomace per year. Some grape pomace gets recycled as compost but the collective cost of disposal is still more than half a million dollars each year for the eight major wineries of Marlborough so investigation into value added products is desired (Bell 2013). This project investigates the potential food applications that can be developed to obtain more value from this waste product.

Uneven Colour of French Fries after Frying

Frozen French fries is a popular frozen processed foods in New Zealand and the quality of the products depends on the quality of the raw potatoes and process. Potato contains reducing sugars, such as glucose and fructose. These sugars are important for determining the colour of French fries as they are the reactants of Maillard browning, which is the key reaction responsible for browning of French fries. If the distribution of sugars is uneven after freezing, an uneven colour will result after frying. The aim of this project was to investigate the cause of this quality fault and to propose a solution to the problem.

Namki Kwon

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Yishi Lam

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Dr Sung Je Lee, A/Prof Kelvin Goh, Miss Anges Teo

Spray Dried Nanoemulsions

Recent studies have shown that protein-stabilised nanoemulsions with small droplet sizes can be prepared by combining high pressure homogenisation and solvent displacement-evaporation. However, no studies have been reported on the conversion of liquid nanoemulsions into dried powders for food applications. Therefore, this project has been initiated to explore the feasibility of spray drying nanoemulsions to use their powders as food ingredients. In addition, spray drying for microencapsulation is gaining popularity in the food and pharmaceutical industries as spray dried particles can potentially improve protection, delivery efficiency and bioavailability of bioactive compounds. The aim of this project was to prepare dried emulsion powders by selecting suitable encapsulating wall materials for spray drying nanoemulsions and to compare different drying methods (spray-drying and freeze-drying). The spray dried powders prepared from conventional emulsions or nanoemulsions were characterised. They were also analysed for after reconstitution by comparing with the corresponding original conventional or nanoemulsions.

Management of Goaty Flavour in Goats Milk

Goats milk and derived milk products are increasingly becoming important food source due to its higher digestibility and low allergic content. However, unlike the consumer acceptance of goat milk cheese, the development of this highly beneficial milk product has been held back by its unpleasant goaty flavour. The aim of this project was to:

1) investigate the development of the 'goaty' flavours in goats milk;
2) identify the compounds responsible for the off flavours as well as the factors known to influence their development.

The conclusion of this project offers recommendation of milk handling techniques that could improve goats milk overall acceptability when processed into long shelf life milk products (UHT milk and whole milk powder), and short shelf life milk product (pasteurized fluid milk).

Xiaoqi Li

Universal College of Learning
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Applying Predictive Microbiology to Fish Spoilage

The production and marketing of fresh fish is popular worldwide. Fresh fish is however susceptible to spoilage due to the presence of high water activity. It is therefore important to store fresh fish under chilled conditions from harvest to the consumer. In New Zealand, the average shelf life of fresh fish is ten days when stored 4°C. To protect public health, NZ regulations stipulate that fresh fish should not contain more than a million aerobic microbial plate counts per 25g sample. Thus, it is important to optimize the storage temperature of fresh fish to minimize the spoilage. Predictive microbiology offers an alternative to traditional microbiological evaluation of food spoilage. Therefore, this study aims to develop suitable predictive microbiology models to model the spoilage of fresh fish during handling and storage at selected temperatures.

Dake Liu

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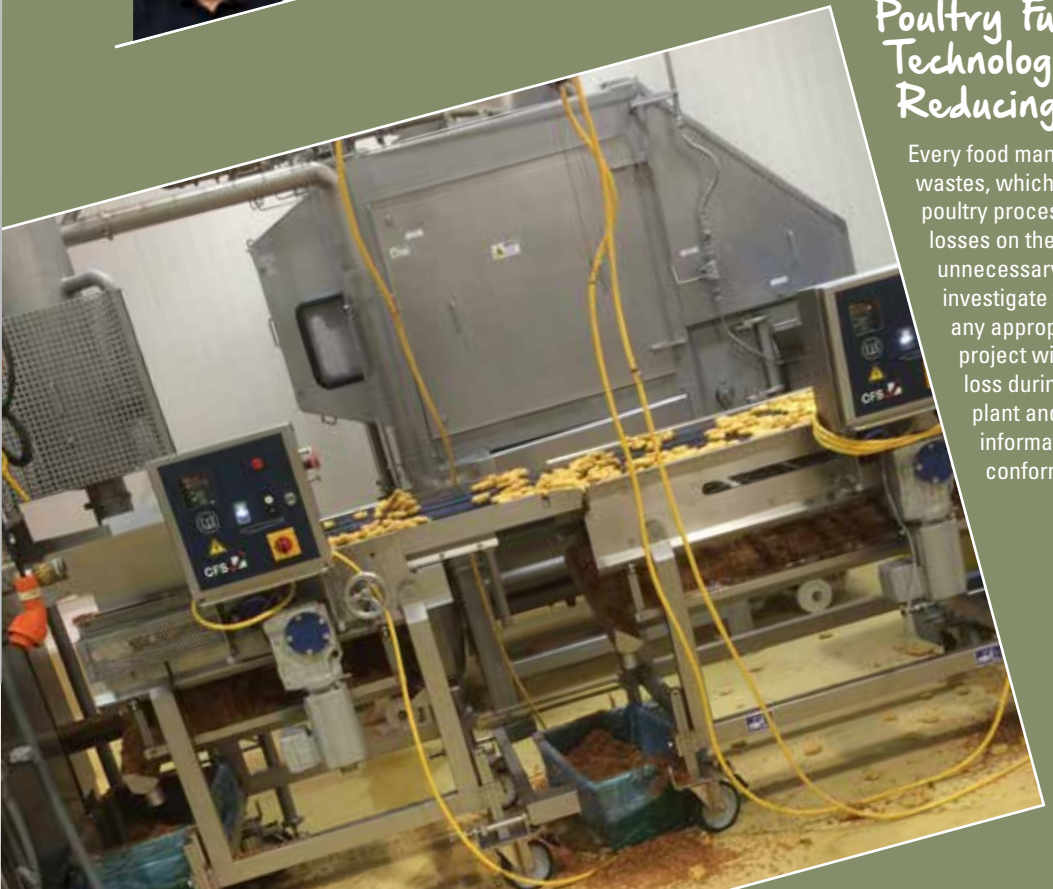
Hanliang Liu

Westlake Boys High School
Major: Food Product Technology
Supervisor: Dr Eustina Fraser



Poultry Further Processing Technologies; Measuring & Reducing Loss

Every food manufacturing process line includes losses and wastes, which can lead to huge costs if managed poorly. A poultry processing plant has recently observed excessive losses on their further processing lines, which results in large unnecessary costs for the company. This project aims to investigate the possible reasons for, as well as determining any appropriate changes to manage these losses. This project will lead to an understanding of the causes of loss during further processing at the poultry processing plant and provide the business with the appropriate information in order to establish relevant and up-to-date conformance benchmarks.

Chia Mint Loo

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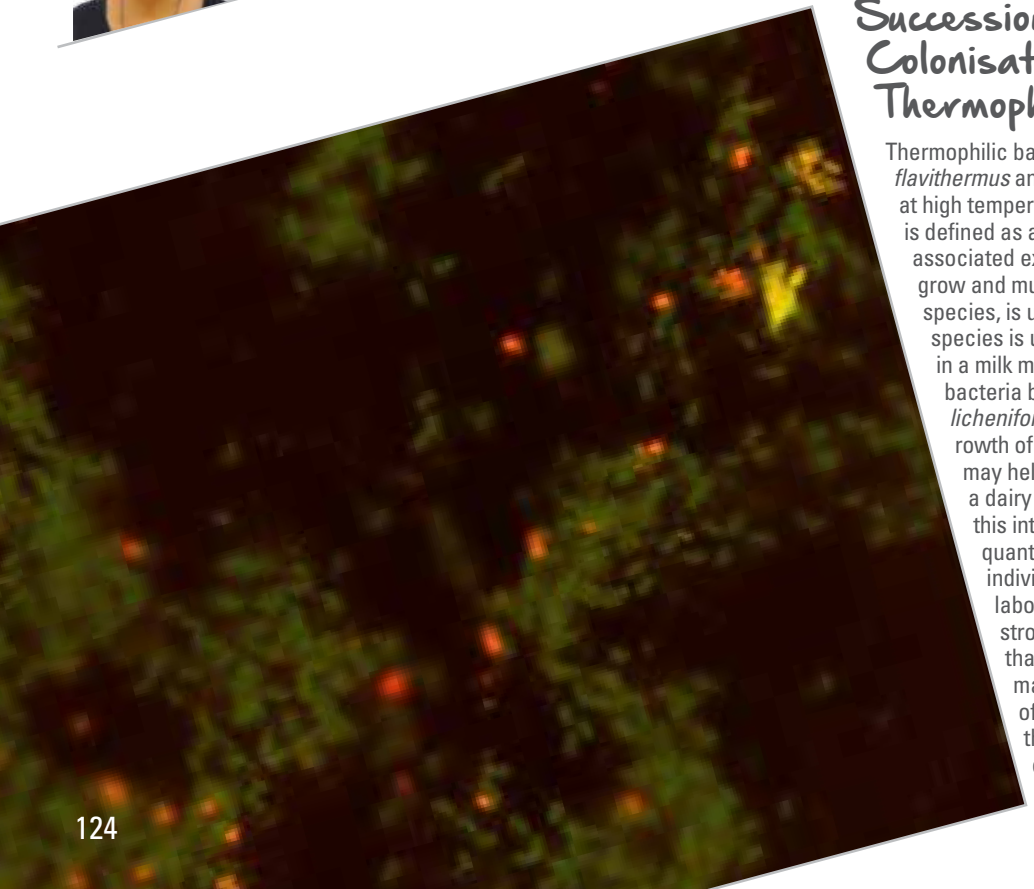

Succession of Surfaces Colonisation with Thermophilic bacilli

Thermophilic bacilli, *Bacillus lichenformis, Anoxybacillus flavithermus* and *Geobacillus stearothermophilus* thrive at high temperatures with ability to form biofilm. Biofilm is defined as an aggregation of microbial cells and their associated extracellular polymeric substances that attach, grow and multiply on surfaces. The growth of single species, is understood but interaction between different species is unknown. *B. licheniformis* often appears early in a milk manufacturing plant while other thermophilic bacteria being detected later. This suggests that *B. licheniformis* may generate conditions that support g rowth of other species. Understanding this interaction may help in controlling thermophilic bacilli growth in a dairy manufacturing plant. This study investigated this interaction using a microtiter plate assay to quantify biofilm formation of the different species, individually, in combination and sequentially. A laboratory reactor was used to investigate the strongest biofilm combination in an environment that more closely represented a dairy manufacturing plant. There was no evidence of *B. licheniformis* conditioning surface for the growth of other species but there was evidence of interactions between some strains of thermophilic bacteria producing stronger biofilms than the individual strains.

Acid-induced Gelation of *Cyclea barbata* Miers Pectin

Pectin extracted from *Cyclea barbata* Miers leaf forms a gel at a low pH in the absence of co-solutes and divalent ions at room temperature. These gelling properties are important and particularly useful in the development of low-sugar food systems. The pectic polysaccharide extracted from the leaves was identified as low-methoxyl pectin with zero degree of esterification. In this study, rheological measurements were employed to determine the effect of varying different levels of pH, urea, pectin and divalent ions (Ca^{2}+) concentration towards the gelation properties of the isolated pectin. The gelation time and gel physical properties were investigated by determining the gel-sol transition time and the mechanical spectra (G′ and G″) using oscillatory measurements. This study showed that acid-induced gelation of the extracted pectin was mediated by hydrogen bonding and gelation only occurred at pH ≤3. The results obtained from oscillatory measurements showed that gel strength was affected by varying pectin concentration and Ca^{2}+ levels. Gel strength increased with increasing pectin concentration, and a similar pattern was observed with increasing Ca^{2}+ levels, however only up to a critical limit of 7.5mM Ca^{2}+.

Amanda Sok Hoon Low

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Supervisor: Dr Oni Yuliarti

Tongxin Ma

Hamilton Girls' High School
Major: Food Product Technology
Supervisor: Dr Eustina Fraser

High-Calcium Milk Beverage

Calcium is the most abundant mineral in the body. It helps to maintain healthy and strong bones; it also has critical functions including muscle contractions and nerve impulses. The recommended daily intake of calcium is 800mg per day for adults. This project is aimed to develop a stable high-calcium (50% RDI) milk beverage. The challenge is to optimise the formulation of high-calcium milk so that it looks and tastes the same as regular milk.

Extruded Meat Analogue and Extended Meat

During this project a tasty extruded meat analogue was developed from soy protein. The product was similar to chicken meat in terms of appearance, texture and nutritional properties. Mechanically reclaimed meat was used in some of the products developed to improve taste, the soy providing meat like texture. The primary application was as an infant food but the excellent texture may extend its application to stir-fried foods, casserole, stew and sandwich or pie fillings. Plant protein production is 5-10 times more efficient than that from animals in terms of land area and uses much less water and other resources, the development of high quality products from plant proteins an essential component for feeding the rapidly expanding world population.

Jane McBreen

Gisborne Girls' High School
Major: Food Product Technology
Supervisor: Mr Allan Hardacre

Development of Natural Concentrated Cocktail Mixers

The cocktail mixers generally found on the shelves of supermarkets or liquor stores tend to be packed full of additives and excess calories, which leads to Roseville Consulting, Primal Essences and I working together with the aim of providing consumers with the best possible ingredients to make cocktails that are natural, delicious and low in calorific value.

Primal Essence is an ingredients company who use super critical fluid extraction CO_2 methods to render extracted oils or oleoresins from pure spice or herb raw materials completely water-soluble in a clean, natural and gentle process.

The aim of this project is to develop and evaluate at least three prototype mixers, using Primal Essence flavouring ingredients, which have a flavour profile that is perceived by consumers to be authentic, have minimal additives and are low in calories.

These cocktail mixers will be concentrated, such that the consumer need only add a few drops of the mixer to their alcohol of choice and water or soda to experience the full taste of the cocktail flavour.

Hayley McIvor

Feilding High School
Major: Food Product Technology
Supervisor: Dr Richard Love

Nur Hidayah Liyana Mohd Nasir

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Allan Hardacre, Jane Coad

Soy-based Meat Analogues with Nutritional Properties

The aim of this project was to develop High Moisture Meat Analogues (HMMA) with enhanced nutritional properties. Meat analogues are designed to mimic real meat in terms of its appearance, flavour, nutritional value and texture. The meat-like structure was developed by processing soy and wheat proteins at high temperatures and at moisture contents above 60% using a twin screw extruder.

This project has successfully produced HMMA's that imitated chicken meat in terms of texture and flavour with the addition of appropriate additives. The resulting product was meat free and contained a chicken flavouring derived from yeast extract. In addition, a vitamin premix was incorporated to enhance the nutritional value. Sensory evaluation by panellists indicated that the analogues were acceptable to consumers. HMMA's can be formed into a variety of shapes for a wide range of applications.

Kate Morris

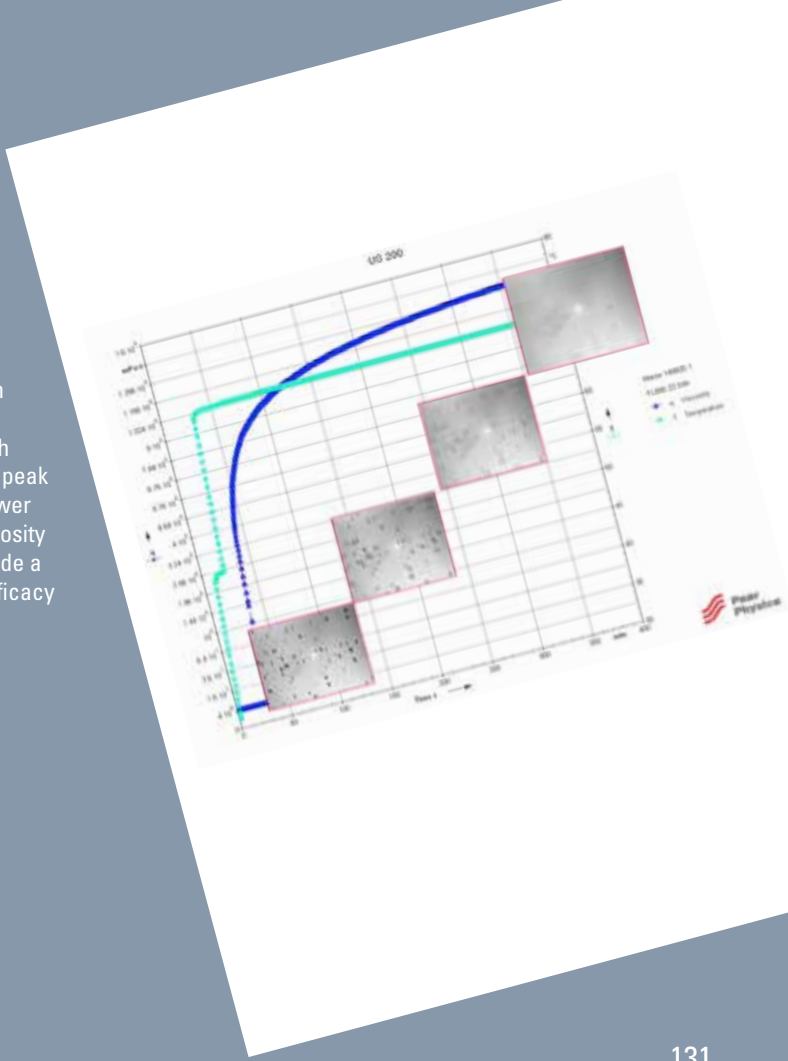
Saint Kentigern College
Major: Food Product Technology
Supervisor: A/Prof Brian Wilkinson

Development of a High Pressure Processed Dressing

As New Zealand becomes an increasingly multicultural country, international cuisines are now becoming increasingly influential in the eating experience of New Zealanders. This is reflected in a growing number of international products, both in supermarkets and in restaurants. The aim of this project was to develop a shelf stable Thai style dressing suitable for use in salads and marinades through the use of high pressure processing. High pressure processing is a method of preserving and sterilising food products. The high pressure helps to inactivate microorganisms and enzymes present, thus helping to prevent the deterioration of the quality of foods. This ability of the process to preserve the quality e.g. flavours and freshness will be investigated to see whether a shelf stable, high quality Thai dressing can be produced for the client. This involved researching Thai cuisine, conducting market and consumer reviews, optimising the processing conditions in the high pressure processor to achieve the highest quality product and conducting a sensory analysis on the final product.

Rheological Properties of Starch Gelatinisation

The rheological behaviours of native and modified starches were investigated. Viscosity changes under constant and stepwise heating were measured using rotational rheology. The viscosity of 10% dwt/vol maize (corn) starch suspensions was found to increase with suspension temperature. This could be due to the starch granules absorbing more water and increased rigidity due to the expanded granules. Maize starch exhibited two peaks at >82°C while tapioca starch showed only a single peak at 72°C. Hydroxypropyl distarch phosphate modified starch produced lower viscosity as compared with native starches which produced higher viscosity over the same temperature range of 68 – 95°C. This work serves to provide a fundamental knowledge regarding the gelatinization of starch and its efficacy when used to thicken foods.



Xiao Hui Ng

Nanyang Polytechnic
Major: Food Product Technology
Supervisors: Mr Allan Hardacre, Dr Tuoc Trinh, A/Prof Kelvin Goh

Kristi Ngan

Onslow College
Major: Food Product Technology
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Development of a Premium Health Smoothie

The aim of this project was to develop a premium health smoothie for a start-up company. This product idea was generated in 2012 when 100 tonnes of pears suffered internal browning due to frost damage. The smoothie will contain New Zealand grown fruit, a pear base and superfoods.

When developing the product it was necessary to understand the manufacturing process of smoothies on a commercial scale. This involved optimising the conditions when freezing the pears to minimise the browning, so that a year round product can be manufactured, and investigating how the properties of pear juices differed depending on the method used to obtain the juice.

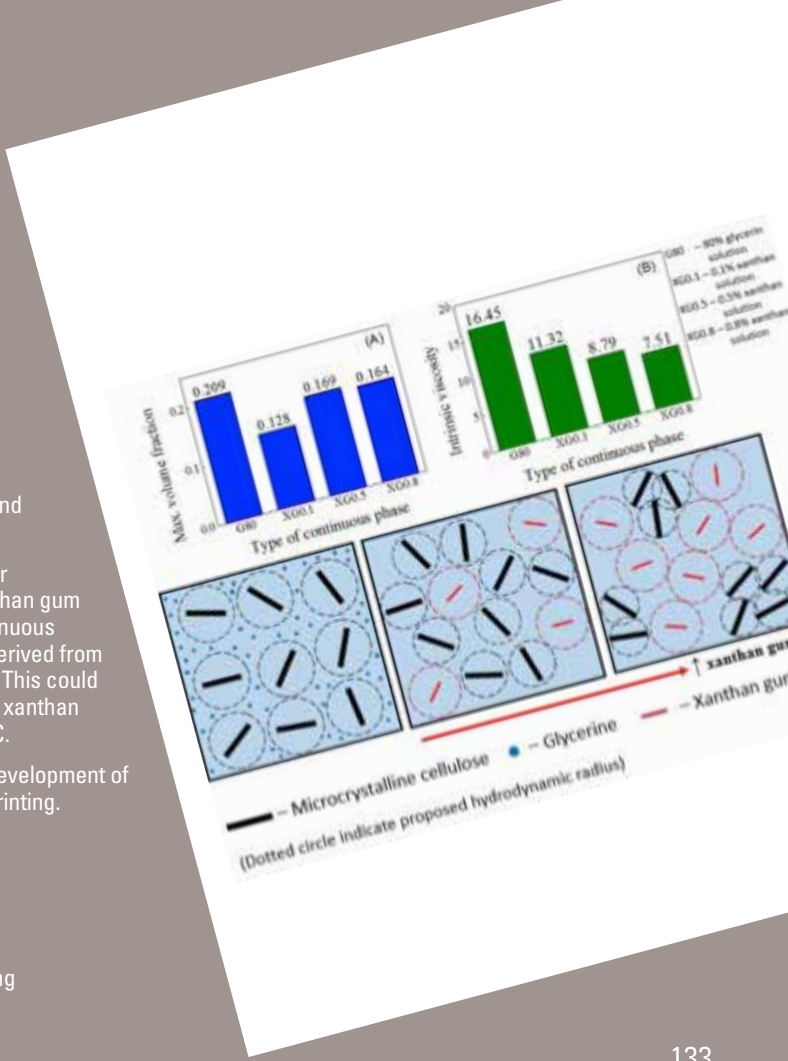
The project also investigated the heat treatment of the formulated smoothie to ensure that the product is safe to consume and has an appropriate shelf life.

Effect of Insoluble Volume Fraction on Rheological Properties of Mixed Colloidal Suspensions

Food products such as purees and sauces are examples of particle-filled suspensions. In this research, the effect of particle volume fractions and flow behaviours of the continuous phase on the rheological properties of suspensions were studied. Microcrystalline cellulose (MCC) at different volume fractions (0.01, 0.025, 0.05, 0.075, 0.1 and 0.11) were dispersed in different continuous phase (80% glycerine, 0.1, 0.5 and 0.8% w/w xanthan gum solutions). All the suspensions were characterized using rotational and oscillatory measurements.

With increasing particle volume fraction, the suspensions exhibited higher relative viscosity and elastic modulus as expected. Interestingly, in a xanthan gum continuous phase, the elastic moduli were lower than in a glycerine continuous phase. The maximum particle volume fractions and intrinsic viscosities derived from Krieger-Dougherty equation decreased in the presence of xanthan gum. This could suggest possible retardation of particle dispersion due to the presence of xanthan gum molecules and probably better efficiency for binding water than MCC.

Information obtained in this study provides better understanding for the development of food formulation for dispensing of particle-filled suspensions in 3D food printing.



Teck Ann Ong

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The Business of Reducing Calories

The recent rise in the worlds diabetic population has seen governments and health organisations regulate the availability of sugar based beverages. This is seen by the introduction of taxes on high sugar containing beverages, as enforced in Mexico in 2014. Thus, research and development of sugar substitutes has become increasingly important to beverage companies.

This project looks into the use of natural sweeteners in juice type beverages, with particular detail on the taste, textural and stability in relation to processing properties of the natural sweeteners. Sensory evaluation through a dynamic evaluation process known as temporal dominance of sensations is utilised to understand the properties of the natural sweeteners investigated.

Janith Palpagama

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Supervisors: Dr John Grigor, Dr Kylie Foster

Young-Ju Park

Rotorua Lakes High School
Major: Food Product Technology
Supervisor: Dr Sung Je lee

Effect of Emulsifiers on the Properties of Vegetable Fat Based Ice Cream

Emulsifiers are widely used in various food systems. The effect of several different types of emulsifiers at various concentrations on a vegetable fat based ice cream was investigated. The project was aimed at producing an ice cream that has a high overrun with the desired organoleptic properties.

Michael Ryder

Nelson College
Major: Food Product Technology
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Ms Michelle Tamehana, Mr Michael Parker

Effect of Yeast Strain on Esters in Beer

Esters are important aroma and flavour compounds in beer and result from the fermentation of raw materials by the yeast. Different yeasts produce different ester profiles and contribute to the distinctive characteristics of different products. In this investigation 5 different beer yeasts are used to ferment a range of 'null' beers under near identical conditions. The beers are evaluated for the detection and quantification of six significant beer ester aromas on a 0-9 scale. The evaluated samples are compared and contrasted to profiles of different styles of beer. This work enables the categorisation of collected beer and wild yeasts that can be added to yeast libraries for use in the brewing industry.

Tracking Campylobacter spp. Through Primary Poultry

New Zealand still has one of the highest rates of campylobacteriosis in the developed world. In 2013 there were 152.9 cases per 100,000 people reported (in 2006 it was 380), a decrease on the previous year where there was 158.6 cases per 100,000 people reported. The link between campylobacteriosis and the consumption of poultry meat has long been established. This link means it is essential that the *Campylobacter spp.* levels are monitored throughout the processing of chicken. This project aimed to identify the levels of *Campylobacter spp.* at eight different points in the primary processing of the Tegel Foods Ltd Christchurch plant. This data was used to develop a benchmark for the Christchurch site, to help target control in the future, when they reach the limit of 3.78 $\log_{10}$/carcass. This study was also compared to similar studies performed at the other plants to identify key significant differences across the three plants. .

Hannah Schreurs

Cashmere High School
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Supervisor: Prof Steve Flint

Justin Sim

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Dr Jon Palmer

Sensitivity of Alkaline Phosphatase to HPP

High Pressure Process (HPP) subjects packaged food to pressures up to 7000 times that of atmospheric pressure. Exposure to high pressure changes proteins structures of bacterial enzymes, DNA and membranes. This has the capacity to impair the biological functions of bacteria and may result in cell death. Pressure sensitivity of micro-organisms can change in the presence of fats, acids and other compounds. Hence it is critical to develop process markers for each type of food to ensure an accurate model of pathogen reduction. The aim of the project was to determine if Alkaline Phosphatase (ALP), an intrinsic milk enzyme, can be used as a pasteurization indicator for HPP milk. Studies have concluded that total inactivation of ALP (at above 6000 MPa) would result in over pasteurisation as the pressure resistance of the enzyme is greater than *Escherichia coli* and *Staphylococcus aureus*. However, sub-lethally damaged bacteria could recover in the neutral and nutrient rich milk. Hence, it is crucial to correlate ALP inactivation and pathogen death and survival rates to determine the suitability of the ALP as a process marker.

Friction Losses of Non-Newtonian Fluids in Pipe Flow

Fluid transportation is a common and essential operation in the food industry. In order for fluids to flow, they must overcome the resistance to motion which result in friction losses. These friction losses are known to depend on the fluid rheological properties as well as the design of the flow system, including the selection of a suitable pump. Correlations have been developed to estimate the friction factor to the Reynolds number, a dimensionless flow rate. Most friction factor correlations are meant for Newtonian fluids where the viscosity is a constant parameter not affected by the flow rate. Correlations for non-Newtonian fluids are less well established but are more important for food engineering, since most food products are non-Newtonian. The aim of this project is to obtain experimental measurements of friction factors and Reynolds numbers to pipe flow for non-Newtonian fluids and compare them to the predictions from a selected number of the most prominent correlations. Recommendations can then be made about the accuracy, ease of use and practical application of these correlations.

Yi Ming Sor

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Dr Tuoc Trinh, Dr Michael Parker

Development of Convenient Bakery Product for Breakfast

The aim of this project is to develop a shelf stable, convenient bakery product for breakfast category. This breakfast product is to be consumed on-the-run and with the aim of being a more convenient alternative to traditional breakfast items which are currently on the market. To achieve this, a muffin with yoghurt-flavoured filling will be developed. The challenge was to make the product shelf stable as this is majorly affected by water migration. This required understanding of water activity and research and application into suitable formulation that could minimise the effects of water migration between filling and the muffin.

Nur Fatimah Zaharah Sukri

International Education Centre, Malaysia
Major: Food Product Technology
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Tsun Hei Tai

Birkenhead College
Major: Food Product Technology
Supervisor: Dr Rothman Kam

Effect Of Different Types of Sugar Extracts on the Taste of Rum During the Fermentation Stage

The aim of this project is to develop a "rum base pack" which allows home brewers to easily create top quality white rum at home. The taste and flavour of the home brewed rum should be similar in taste and flavour to commercial rums (e.g. Bacardi White Rum). The challenge was to find which temperature and sugar combination could create this top quality white rum. To do this, different concentration of molasses was used during the fermentation process of rum production. The temperature was also varied during fermentation to see which combination would create the best tasting rum.

Mei Hui Tan

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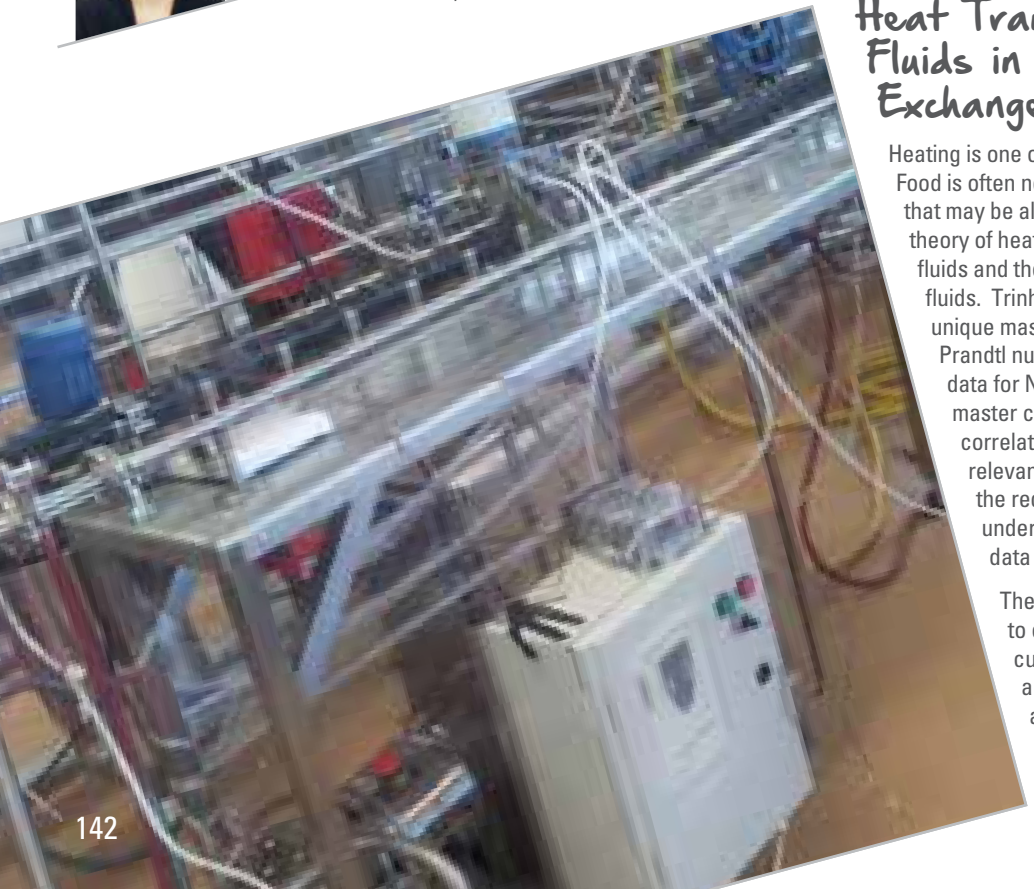
Dr Michael Parker, Dr Jason Hindmarsh



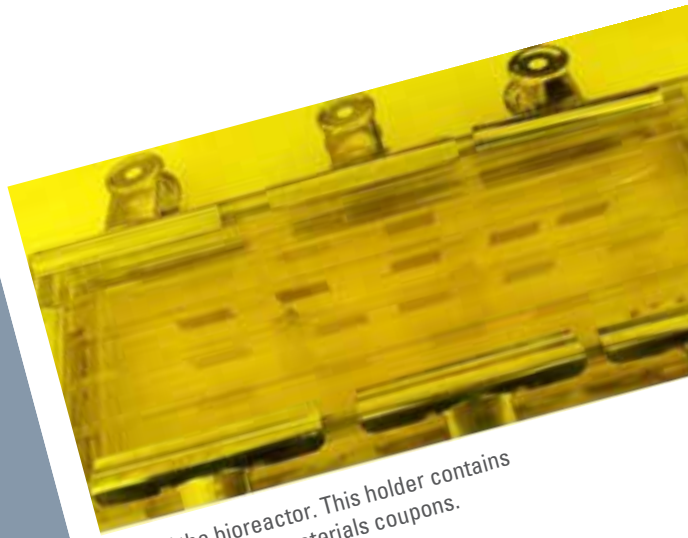
Heat Transfer of Non Newtonian Fluids in Tubular Heat Exchanger (THE)

Heating is one of the major operations in food processing. Food is often non newtonian and has physical properties that may be altered during heat processing. Currently, the theory of heat transfer processes is focused on Newtonian fluids and there is little published data on non-newtonian fluids. Trinh (2009) developed a method to compile a unique master curve relating the Nusselt, Reynolds and Prandtl number that collapsed published heat transfer data for Newtonian and non-Newtonian fluids. The master curve is easy to apply as no mathematical correlations are needed. The user can simply read the relevant normalised parameters and back calculate the required design parameters for the fluid and THE under consideration. Unfortunately the published data on non-Newtonian fluids are still quite scarce.

The aim of this project was to provide quality data to complement the existing heat transfer master curve focusing particularly on non-newtonian and food products fluid in laminar, transition and turbulent flow regimes in a THE.

Characterisation of Cow Water Biofilm

Biofilms in the irrigation systems are used to treat dairy effluent limit treatment capacity. This study investigated biofilm development from microorganisms found in cow water (milk powder condensate), an important waste stream in dairy industry. The microflora in biofilm taken from the cow water treatment system were identified by 16s rDNA sequencing and their ability to form biofilm under different conditions (temperature, pH and medium concentration) were determined using a microtiter plate assay. Biofilm development on different surfaces (stainless steel and plastic) were determined using a continuously flow bioreactor. *Pseudomonas spp.* formed the most biofilm from a single isolate and a combination of *Pseudomonas spp* and *Aeromonas* formed the most biofilm in the microtiter plate assay. There was no difference in biofilm formation of the different surfaces.



Part of the bioreactor. This holder contains different types of materials coupons.

Sze Ling Janice Tan

Temasek Polytechnic
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Supervisors: Prof Steve Flint, Michael Dixon

Wei Ying Tan

Singapore Polytechnic
Major: Food Product Technology
Supervisors: A/Prof Kelvin Goh, Mr Allan Hardacre

Effects of Non-Starch Polysaccharides on Digestibility of Starch Suspensions

The objective of this study was to evaluate the effects of non-starch polysaccharides (NSPs) on the *in-vitro* digestibility of gelatinised corn starch (CS) suspensions. Pasting and viscosity curves were obtained using a rheometer attached with a vane geometry. Guar, xanthan and CMC raised the peak and final viscosities of the starch suspensions while gum arabic did not show an increase in the viscosities. Guar, xanthan and CMC also showed increased setback values. Reducing sugar monitored during *in-vitro* digestion CS-Guar blend had a lower amount of digested starch than the CS control at the end of digestion. However, this trend was not observed with CS-xanthan, CS-gum arabic and CS-CMC, suggesting that guar gum could reduce the extent of starch hydrolysis possibly by retarding the activity of alpha-amylase.

Effect of Airflow Rate in Horticultural Produce

Achieving uniform and efficient cooling of horticultural produce is essential to ensure maximum storage potential. On the reverse side, non-uniformed and inefficient cooling can lead to cold or hot spots, causing excessive drying or condensation during storage, which may result in loss of quality and storage potential in produce due to heterogeneous and inefficient cooling. However in real life context, uniform and efficient cooling is hindered by several factors. One of the main factors that hinder uniform and efficient cooling would be the airflow rate during the pre-cooling process.

The aim of this project was to provide information on the effect of airflow rate on the cooling rate and uniformity of Modular Bulk Packs (MB's) of polylined horticultural produce (kiwifruit).

Cooling efficiency and uniformity (heterogeneity of cooling) during the precooling process at various airflow rate will be investigated. A recommendation on energy and cost efficient airflow rate was made.

Ying Thong Tan

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Identification and Elimination of Bacillus in Vanilla

My 4th year project involves the preservation of vanilla powder and the product is produced by Heilala® Vanilla who sponsor the research. Vanilla powder is made from the vanilla beans grown in Tonga by Heilala. Vanilla beans, being an agro-product, are susceptible to contamination by soil microorganisms. To maintain consistent quality of the vanilla powder, the project investigates the potential of using heat-treatment and UV light to reduce contaminating microorganisms to safe levels.

Mitchell Thompson

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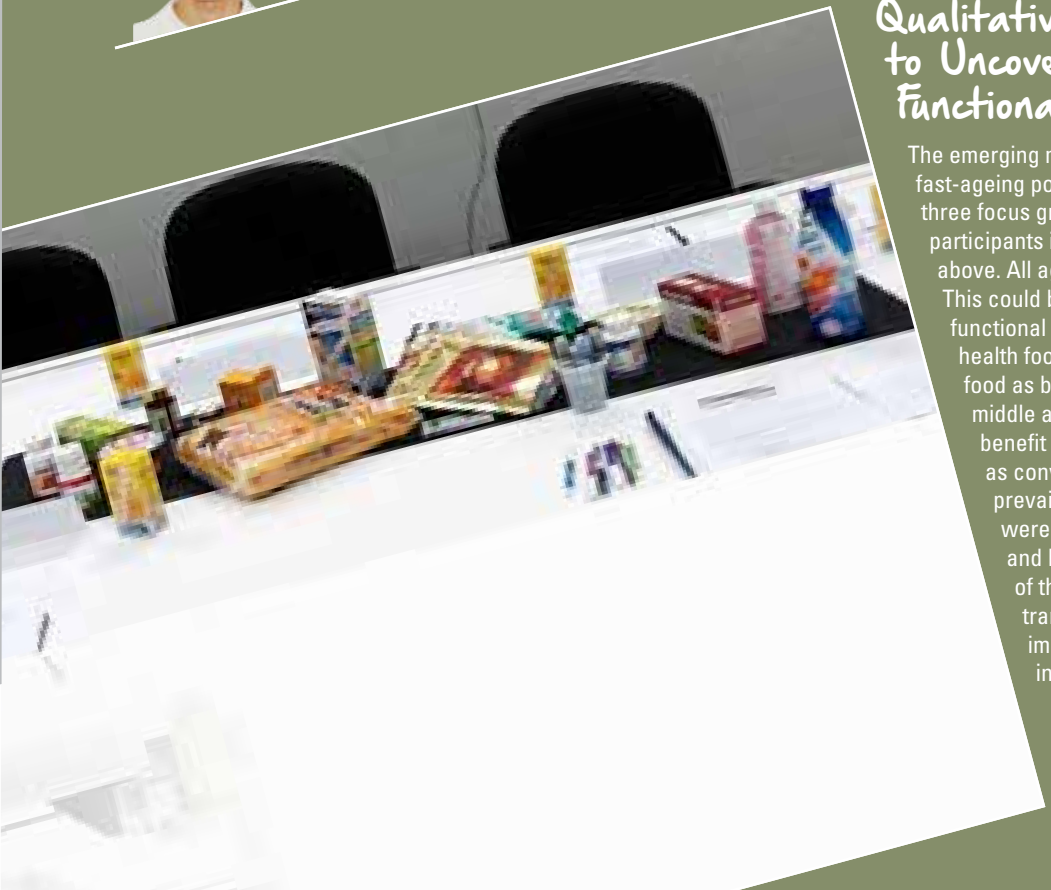
Zhi Yong Toh

Singapore Polytechnic
Major: Food Product Technology
Supervisors: Dr John Grigor, Dr Jasmine Leong



Qualitative Research Technique to Uncover the Understanding of Functional Foods in Singapore

The emerging market of functional foods and growth of a fast-ageing population in Singapore has driven the use of three focus groups to gain insights from Chinese Singaporean participants in the age group of 20 to 29, 30 to 44, and 45 and above. All age groups had low adoption of functional foods. This could be due to low awareness and the perception of functional foods in terms of food groups, everyday foods and health food or drink. Youngest age group defined functional food as bioactive or nutrients like fibre and probiotics, middle age group defined as food with general health benefit and nutrition, and matured age group defined as convenience food and not totally healthy foods. The prevailing reasons for purchase of functional foods were benefits and functions such as aid in digestion and building of strong bones. Raising awareness of the benefits through education and provision of transparency on its safety and efficacy were seen as important for higher acceptance of functional foods in Chinese Singaporeans.

Akshay Trivedi

The Scindia School, Gwalior, India
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Supervisor: A/Prof Marie Wong

Shelf Life Extension of Salmon Caviar

Uncle Delicious Ltd. processes fresh salmon caviar, which have a shelf life of 1 week. The spawning season for salmon is very short and lasts from February to March, due to the short shelf life and short spawning season fresh salmon caviar is only available for a very short period each year. The aim of this project was to develop a treatment to extend the shelf life of salmon caviar in terms of microbial safety by evaluating different treatments. The change in microbial growth, organoleptic quality, pH, water activity, colour and appearance was recorded and analysed during storage of treated samples stored at 4°C .

Ingredient Developed using White Grape Pomace Ingredient

Each year the New Zealand wine industry produces very large quantities of white grape pomace, which is the skins and seeds left after pressing the grape juice prior to the juice being fermented into wine. This usually has to be disposed of, often at some expense to the wine grower. However, it was proposed that the grape pomace waste stream could instead be utilised by creating an ingredient for use in food products. The purpose of this project was to develop such an ingredient using appropriate processing methods, and estimate its commercial potential.

Anna van Ameringen

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Supervisors: Dr Abby Thompson, Dr Derek Haisman

Zhiwen Zachary Wong

Singapore Polytechnic
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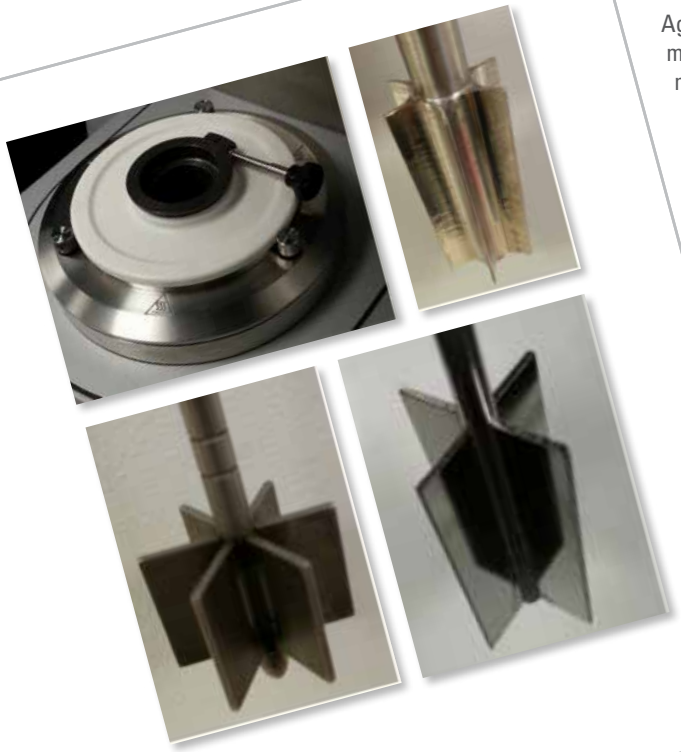
Supervisors: Dr Michael Parker, Dr Jason Hindmarsh



Agitation of Non-Newtonian Fluids

Agitation is commonly used in processing industries as a means of blending, dissolving and dispersing fluids in two or more separate phases. To design an agitator, a Power-Reynolds number curve is used to estimate the motor size and impeller dimensions required for an agitation process. The power number is a form of friction factor which measures the ratio of viscous to inertial force. Food industries often deal with non-Newtonian fluids which are viscous and shear dependent. In the agitation of non-Newtonian fluids, viscosity is an important quantity used in the selection of mixing equipment. However as viscosity is a function of fluid properties and is shear rate dependent in non-Newtonian fluids, estimating fluid viscosity becomes an issue as existing formulas used to calculate the Reynolds number only exists for Newtonian fluids. The aim of the project was to collect data on agitation of non-Newtonian fluids to compare with predictions from existing theories to decide which best describes this operation. Also, new data for different impellers will be obtained to study the effects of impeller geometry on the Power-Reynolds number curve.

Variations on Cow's Milk Components

In New Zealand, the composition of bovine milk varies with the seasons as the dairy cows are fed on pastures throughout the year. Therefore, the compositional variation of the milk can impact on the quality of processed milk products including yogurt. Sensory properties directly affect the popularity of yogurt among consumers which include texture. However, the textural defect can impair the physical characteristics of yogurt. The causes of graininess and the unacceptable viscosity in yogurt are not clear, but gross composition of milk is presumed to be an significant factor.

Therefore, the main objective of the project is to analyze key milk compositions presumed to contribute towards graininess as well as undesirable viscosity of yogurt.

Yushan Zhang

ACG College
Major: Food Product Technology
Supervisor: Dr Tony Mutukumira

Development of Dry Weight Kiwi Fruit Analogue

The constantly changing dry matter of a real kiwi fruit makes the optimization of analytical methods difficult. Therefore, the objective of this project is to develop constant dry matter kiwi fruit analogues covering a range of natural dry matter of kiwi fruit.

Chin Ean Ang

INTEC UITM
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Supervisors: Dr Jason Hindmarsh

David Brown

Palmerston North Boys' High School
Major: Food Process Engineering
Supervisors: Prof John Bronlund

Autonomous Atto-Brewery: Fermenter Development

A 2013 project designed and fabricated a 5L scale fully automated brewing system to produce wort ready for fermentation. This device allows the brewer to specify mashing profiles, timing, mashing method etc. and the brewery will follow these autonomously. The device is controlled through LabView, allowing flexibility in brewing processing. The system is intended for use by craft brewers for experimenting and developing new recipes. Craft breweries will prefer this system as it is 'set and forget', meaning that they can go about their daily duties without have to worry about the extra task of brewing a small batch of beer. This development based project is aimed at the design, fabrication and implementation of a 5L scale fermentation system to accompany the brewhouse system. This includes a wort cooling system, a fermenter, fermentation temperature control, carbonation and dispensing of the finished beer.

Hayley Browne

Westlake Girls High School
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Characterisation of a Scraped Surface Evaporator

Scraped surface evaporators are beginning to be used in a wide range of applications in industry including: the processing of fruit pulps, purees, pastes and juice; the concentration of liquids such as gelatine and antibiotics; the mixing of emulsions and the caramelisation of sugars.

Massey University has identified the growing demand and use of scraped surface evaporators in industry. The IFNHH has recently purchased a new Scrapped Surface Evaporator for the Pilot Plant at the Manawatu campus. This will expand Massey's capability to concentrate and process foods, such as viscous liquids, for research and development and industrial service.

Preliminary experiments with the new evaporator showed that it was not processing materials as effectively as it its operating parameters indicated. This meant that there may be a problem with the evaporator operation and/or the conditions for evaporation were not properly optimised. Hence, this project was created to characterise the operation of the evaporator and make recommendations where necessary to improve its usability and effectiveness. This will allow it to be used for future research and development and industrial projects.

Spray Dryer Commissioning

Milk can be spray dried into milk powder to preserve its quality and for economy purpose by reducing its bulk density. However, whole milk powder has poor instant properties due to the presence of high fat content. Hence, emphasis has been placed on the techniques of manufacturing a satisfactory instant whole milk powder.

This project was aimed to produce instant whole milk powder with functional properties similar to commercial product. An attempt can be made is through spray dryer commissioning to induce agglomeration as it is critical for reconstitution performance. This project involved analysing the functional properties (particle size, moisture content, wettability, dispersibility and bulk density) of commercial product, optimizing atomisation process and comparing the functional properties of spray dried powder to the commercial product.

Lay Hsin Chan

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Rajinder (Jini) Kalkat

Tauranga Girls' College
Major: Food Process Engineering
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Preliminary Rheological Modelling of Tomato Paste

The tomato paste industry is huge globally, and provides a good base for further processed products. For good quality tomato paste, the parameters are colour, consistency and flavour. Consistency, a rheological parameter, is known to depend on the composition and quality of the tomatoes which vary daily, as well as processing parameters, temperature and residence time.

A mathematical model that can predict consistency from the raw materials composition will be a useful processing tool, especially after it is computerised.

This project involves identifying key contributors to the rheological behaviour of tomato paste, and significant interactions between these contributors to provide key building blocks for such a model.

Falling Film Evaporator Commissioning

There are two parts of this project, the main aim of this project is to generate a milk concentrate similar to commercial product and suitable for feeding to the spray dryer. The falling film evaporator will need commissioning in a mode that best simulates commercial evaporators and the product can then be fed to the dryer and the functional properties of the powder determined. Before this, there are some problems of the falling film evaporator that should be fixed to make sure it is available to operate. In addition, water and sugar water are condensed before milk for building a standard about running this evaporator.

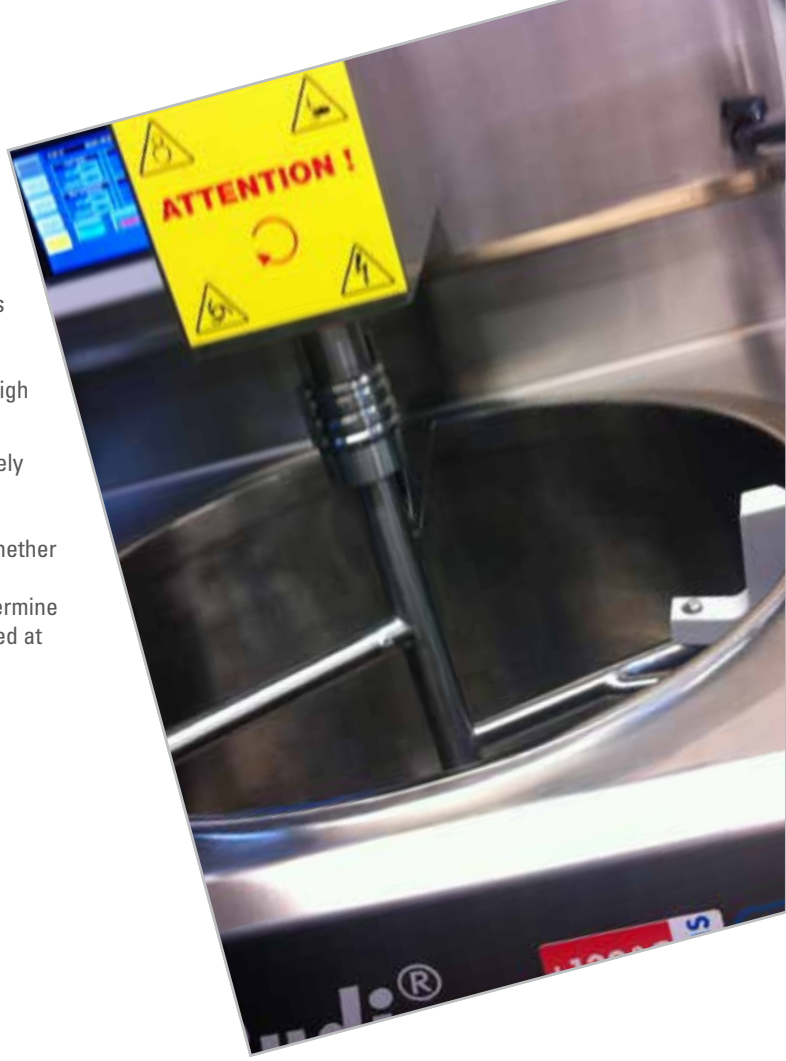
Jianan Liu

Opunake High School
Major: Food Process Engineering
Supervisor: Dr Patrick Janssen

Batch Pasteurization of Organic Liquid Eggs

Delicato Ltd is a new company in Levin which produces novel food products made from free range and organic eggs. Several interested commercial parties from the NZ food industry have approached Delicato for pasteurized organic liquid eggs (liquid whole egg, egg white and egg yolk) due to their high nutritional value and convenience for consumers.

Adequate pasteurization of liquid eggs can increase its shelf life by effectively eliminating the potential spoilage by microorganisms bacteria (S*almonella enteritidis*, etc) and fungi. However, some protein in liquid eggs can also be denatured and coagulated at high temperature. This project investigated whether it is feasible to maintain both food safety and quality of liquid eggs via batch pasteurization. Small scale (500mL-1L) trials were initially conducted to determine the optimal conditions (i.e. temperature, time, etc), which were then validated at commercial scale at the Delicato plant.



Tong Ren

Palmerston North Boys' High School
Major: Food Process Engineering
Supervisor: Dr Jason Hindmarsh

Camilla Peta Frances Riddiford

Samuel Marsden Collegiate School
Major: Food Process Engineering
Supervisors: Dr Richard Love

Vanilla Seed/ Water Slurry Separation

A vanilla paste product has been created to add value to spent vanilla beans used to make vanilla extract. This involves separating the seeds from the pods and adding them to vanilla extract, sugar and a thickener. A water/seed slurry is generated when the seeds are removed from their pods. A settling tank is then used to separate the seeds from the slurry. This is effective for 90% of the seeds; however 10% of the seeds float on the slurry surface in an oil layer. Currently, these remaining 10% of seeds are removed by using a gravity driven filter sock. This process is cumbersome and this project looks at improving this unit operation and making the overall seed extraction process more convenient. Following initial particle characterisation experiments, various solutions have been considered. One set of solutions involves improving the settling tank process by using mechanical and chemical methods to encourage the 10% of surface seeds to sink. Another set of solutions involves replacing the filter sock with a mechanised separation unit operation.

Angela Yang

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Supervisors: Prof Tony Paterson

Spray Drying of Apple Juice Concentrate

There has been developing interest in the fruit industry to spray dry apple juices. However, apple juice powders have problems of stickiness. This is caused by the sugars and acids present in apple juice, resulting in a low glass transition temperature for the apple juice powder. To overcome this problem, high molecular weight drying aids such as maltodextrin have traditionally been added to increase the glass transition temperature. However, this is undesirable as it lowers the fruit content of the powder and increases costs. Pectin is a naturally-occurring polysaccharide in apples.

This project investigates the use of pectin as a drying aid for the spray drying of apple juice. It was found that pectin alone cannot overcome the glass transition temperature problem; however, in combination with limited amount of maltodextrin, pectin can aid the formation of spherical agglomerates.

Protein Separation by Foam Fractionation

Process streams found in many food industries often contain small amounts of valuable fractions such as proteins. Direct discharge of wastewater could cause loss of abundant and functional organic substances and could also damage the environment. Foam fractionation is an adsorptive bubble separation method, which can be used for enriching and partially separating solutions of surface active species. The separation is achieved because some substances adhere to the surface of bubbles and can thus be removed from a solution by skimming off the foam. The foam fractionation technique is of interest as it has simple equipment, low investment, low energy consumption and environmental compatibility.

The focus of this project was to establish a methodology for medium scale foam fractionation apparatus and testing procedures. This allowed the efficacy of foam fractionation as a separation technique of proteins from a model dairy processing stream to be evaluated. Whether or not the quality of the model stream had actually been improved after foam fractionation processing was also investigated.

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By Majors

By Student Name

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