**The following are a list of projects that have been proposed by academic staff members**( note: many topics are given below, and each staff is advised to take maximum 6 students each)

**Projects supervised by Dr Frazer Noble:**

**1)Project One:**

Google’s TensorFlow (TF) is a machine learning framework, which was open-sourced late 2015. It is based on C++, but has a Python application programming interface (API), which is easy to use once familiar with it. In this project, I propose that machine learning, using TF, be used to help a robot navigate through an environment by classifying objects and its environment, determining viable paths.

A particular application could be: an autonomous robot on a farm, which needs to travel between two way points with varying terrain and path choices between the two points.

A proficiency in Python, C++, and general programming tools, e.g. Git and GitHub, would be required.

**2)Project Two:**

The Centre for Additive Manufacturing (CAM) has a range of 3D printers; in particular, the multi-material machine, which can print parts with non-homogeneous stiffness, i.e. parts that can be hard in some places and soft in others. In this project, I propose that a shoe insole, which minimises the impact of heel and toe strike, be 3D printed using the CAM’s multi-material machine.

A particular application could be: 3D printing an insole for a stiletto shoe.

A proficiency in SolidWorks and 3D printing would be required.

**3)Project Three:**

RGB-D cameras, e.g. Microsoft’s Kinect, are popular devices for getting colour and depth information in robotic applications; however, they are limited to indoor use and are susceptible to sunlight. In this project, I propose that stereo vision be used to generate a 3D model of an environment.

A particular application could be: generate a 3D model of a farm.

A proficiency in C++ and general programming tools, e.g. Git and GitHub, would be required.

**Projects supervised by Dr. Rezaul Hasan:**

1. **Design and prototype construction of an optical amplifier for fibre-optic communication**

In this project the student will design an optical trans-impedance amplifier for fibre-optic communication using discrete devices.

1. **Design and construction of a trans-impedance amplifier for visible light communication**

In this project the student will design a trans-impedance amplifier for optical wireless receiver using visible light communication.

1. **Design of an implantable microchip pressure sensor using Comsol/Solid Works**

Student will design a structure to be able to implement it on a standard CMOS silicon chip processing technology.

1. **Design of an energy harvesting electro-mechanical cantilever beam structure.**

The student will develop a miniature energy harvesting device for harvesting energy from mechanical vibration.

1. **Keyless access control system for students using smart phone technology**

The student will research and develop the necessary hardware/software enhancements to a smart phone to access buildings, laboratories, car-parks etc. through smart phone technology without requiring a separate access card for this purpose.

1. **Design and Construction of an Audio Amplifier**

The purpose of this project is to design and build your own audio amplifier from scratch. Good audio amplifiers take a small input signal (from microphone) and magnify it several times, without distorting it, so that it can be heard at the speakers. The required specifications are high input impedance, low output impedance, and a gain of about 10.

**Projects supervised by Assoc Prof Johan Potgieter :**

1. **Painting Robot**

Robot to identify colour segments of any digital image and convert to Primary and secondary colours using thresholding techniques. The robot must then replicate the digital image on a canvas using paint.

1. **Surface Hardening of printed stainless steel using SLM**

During the 3D printing of stainless steel using Selective Laser Melting (SLM) the sintering process is repeated on the final layers of the object to heat treat the surface. This is an alternative method to conventional heat treatment.

1. **PET recycled plastic for additive manufacturing**

Recycled plastic PET bottles will be used to do a full characterisation study and evaluation of PET as a recycled plastic for 3D printing. The PET plastic will also need to be converted from an amorphic to crystalline structure to 3D print.

1. **Soft Robotic Table for medical applications**

Using 3D printed multi material technology the research will focus on the development of a 3D printed flexible table able to be actuated for the movement of delicate bio material.

1. **App development and network optimisation for interrupt driven services. (George Young)**

(confidential – cannot provide any more info at this stage)

**Projects supervised by Dr. Steven Dirven :**

1. **Finite-Element methods for modeling prestress and pretorsion in elastomer composites**

“Prestressing” is a material-composite method used in the construction industry to create reinforced concrete beams. In this case, it is designed to create stiff, rigid structures. However, this manufacturing principle can also be applied in the soft robotics field to create structures that naturally deform from a flat object to some complex 3-Dimensional shape. This prestressing behavior is challenging to model for elastomer materials. The project involves development of methods to predict the extent of deformation when the structure is in static equilibrium. This project complements pioneering work in the field.

1. **Soft robotic fruit gripper**

Gripping of soft goods, such as fruit, with conventional robotic grippers can lead to bruising or blemishing. In order to selectively pick and move fruit from one location to another, more compliant grippers are required. One avenue is to produce a large contact gripping surface, to spread the load. This could be pneumatically or hydraulically actuated. The project involves exploration of design methodologies, fabrication, and subsequent validation of the results. The solution may potentially be printed on the multi-material 3D printer.

1. **Pressure / Vacuum molding for Soft Robotics**

The emerging field of soft robotics utilizes materials in new and interesting ways, which provides an opportunity to revisit manufacturing processes and adapt them for this niche. Soft robots can be created under pressure or vacuum conditions, which may enable unique geometries to be achieved. Demolding of thin features needs to be considered. Applications such as modeling soft human organs, biological organisms, or animals are considered as target fields. This project will involve elements of background research, design, fabrication with 2-part Room Temperature Vulcanisation (RTV) silicone rubber, and testing of the manufacturing process.

1. **Pressure sensor array**

Pressure sensors arrays can be used to measure interaction between objects. Using passive electronic methods (Eg. resistance/capacitance) pressure sensors can be designed and deployed in many applications. The project involves the optimisation of design variables for production of a pressure sensitive array followed by the exploration of data aggregation algorithms. As the array is 2D, the solution technique will be based on image processing methods.

1. **Artificial Muscles : Actuation and control**

Artificial muscles have been applied in many fields; however, they have not had a large uptake in industry. In order to make these actuators more attractive to applications in industrial environments they need to provide fast, reliable, actuation. Methods are required to increase the bandwidth of these systems, as well as control their static elastic compliance. This can be achieved at both the physical and control levels. The project will involve a linear or rotational antagonistic apparatus for testing the muscles and actuation scheme. There will be elements of experimentation and data analysis.

**Projects supervised by Moil Tin Chew:**

1. **Fault-Tolerant Control in Digital Electronic Processing Systems**

This is an engineering research-type project where the theory and principles of the fault detection and fault-tolerant design are to be studies and implemented. The goal is to develop a digital data processing system that would be able to perform its functions even if some of its components (logic, memory, ALU, etc.) and/or communication resources are malfunctioned. The system recovery could be considered on the software level (i.e., by using special software algorithms), or by introducing an additional hardware means. It is planned that the experimental research, prototyping and proof-of-concept processing system development will be done based on the Altera FPGA training board (as it is known to the students from the 2nd and 3rd year courses), with a possibility to employ discrete components and microcontrollers.

1. **Application of Internet of things on smart agriculture**

The project focuses on the Internet of Thing (IoT) devices/sensors to collect the various data on soil nutrients, moisture, temperature and humidity, and communicate that data over a wireless network to a computer to analyze and help determine action steps. Each sensor can monitor a specific condition or set of conditions. Thus water, fertilizer and pesticides can be dispensed in more precise quantities and with better timing which will increase yields of the crops.

1. **Low cost eye gaze gesture communication for people with motor disabilities**

The Eye Gaze system is a communication system for people of complex physical disabilities. The system allows user to operate with an eye (or both eyes) by looking at control keys displayed on the screen. With this system, a person can synthesize speech, control his movement, switch on light, turn on bell to alert help, operate telephone, and even access internet and operate computer software.

1. **Design of low cost embedded system for tracking the dementia patient**

A GPS based tacking system provides information about the real time location of the patient and sends the coordinate to the GSM modem through the microcontroller. Microcontroller used as the interface between GPS receiver and GSM modem. After receiving the location data, the data is sent to GSM modem through Short Message Service.

**Projects supervised by Dr Mathew Legg:**

1. **Measuring the Properties of Objects using Ultrasonic Non-Destructive Testing**

Non-destructive testing of the properties of structures is important for industry. This may be to detect defects in objects. An example is detection of corrosion in pipes for the oil and gas industry. Alternatively, non-destructive techniques may be used to measure the mechanical properties of materials. This may include the stiffness of wood or the grading of metal. Ultrasonic techniques are one of the most commonly used non-destructive technique. This research project would investigate ultrasonic non-destructive testing of objects. This work may include some hardware development, experimental setup, data acquisition, and signal processing.

**Projects supervised by Dr Sanjay Mathrani :**

1. Identification of key Lean and/or Agile manufacturing strategies deployed for organizational effectiveness. Evaluate solutions to critical operational issues in New Zealand organizations that have implemented lean or agile strategies for transformational effectiveness using a suitable research methodology.
2. Evaluation of strategies and success factors in new product development. The project focuses on the product development operations of manufacturing organizations for achieving effectiveness in the new product introduction process. Using appropriate research methods, find solutions to complex issues in new product development. The research area could be narrowed down to a specific development aspect.
3. Recommendations for novel knowledge-based productivity management processes in New Zealand manufacturing companies. Investigate the current productivity management processes in New Zealand SMEs to identify current strategies and drivers for organizational success.
4. Any specific areas of interest within product development and/or manufacturing can be discussed individually with students e.g., Six Sigma based improvement project.

**Projects supervised by Prof Serge Demidenko:**

1. **Spectral Warping and its Application to Signal Generation and Analysis**

Spectral warping is a time domain to time domain transformation on a signal that effectively warps the frequency content of the original signal. It has been first developed and applied for the voice correction in communications with deep underwater divers who used a special breezing gas mixture that led to the voice distortion. The spectral warping network can be implemented as a cascade of first order IIR filter sections. The continuous input signal is sampled, and split into a series of frames of N samples each. The spectral warping transform is applied to each frame by time reversing the samples within a frame and passing them into the filter network. After final sample has been entered, the outputs of each of the first order filter stages provide the samples of the warped signal. Because of the frequency warping, there will generally be more output samples than input. The goal of the project is to develop an FPGA-based implementation for the spectral warping processor and investigate then possible implementations of it in a variety of fields.

1. **LabView Based Desktop OpAmp Tester for Education and Training**

The goal of this project is to develop a simple desktop system for parametric testing of low-to mid-range Operational Amplifiers for several major parameters (such as CMRR, PSRR, bias, offset, etc.). The system is to be based on the use of the National Instruments (NI) LabView software, NI ELVIS prototyping system, custom-made load board with the component under test socket and required signal interface components, and PC.

1. **Low Cost Digital Interface for Stethoscopes**

This project proposal is industry inspired – one of the global pharmaceutical companies, wanted to get an inexpensive microphone device or stethoscope attachment that converts analogue sound to digital signal and transfers the signal to a mobile device or computer via a wired or wireless connection. The ultimate aim is to assist diagnosis or screening of cardiac and lung diseases by employing digital signal processing and pattern recognition. The existing digital stethoscopes are expensive and designed for specific medical applications, thus limiting their usage and access for the medical community.

The solution should have the following features:

1. Be either a dedicated auscultation device or an add-in to a standard analog stethoscope;
2. Allow sounds from patient’s auscultation to be transferred to any standard digital device (e.g., Mobile phones, tablets or desktop computers);
3. Be reliable and maintain quality during operation;
4. Technical Specifications:   
   - Frequency Response: 20-5000 Hz;  
   - Sampling Frequency: min 11000 Hz;  
   - Signal to Noise Ratio: min 65dB;  
   - Digital Data Representation: min 24 bits;  
   - Audio delay: max 50 ms;  
   - Operate for at least 5 days without the need to recharge.
5. **Object Geolocation for Critical Assets Management**

This project will require study and development of a technology and implementation of a system to report the location of objects in space. The aim is to assist with management of critical assets. For example, the system could include tags and readers to identify those tags, enabling to report the location of objects in relation to a map, to a floor plan, and to an elevation or depth. Objects may be stationary or mobile. Ideally, the object locations are to be reported via smart phone interface or other portable handheld device and be available through the Internet.

1. **Real-time Sensing of User Location, Orientation, and Velocity**

This project is a part of an autonomous mobile robot that is a free moving companion/ assistant of a walking user (e.g., a kind of a “robotic guide dog”). The goal is to develop a technology for recognising a particular user within a specified distance range and sensing, in real-time, a user’s location, orientation, and velocity. The robot will be travelling in front or at the side of the walking user. As an additional task the robot might be tasked to recognise the user’s movements and understand the user’s intent. It is preferred that no placement of additional devices be required on the user. Use of a wearable device, e.g., a watch- or smartphone – type, is acceptable if it is not bothersome to the user.

1. **Digital/Mobile Solution to Record Inhaler Cartridge Use**

This is a project combining the electronics and product design. It is aiming at developing digital/mobile solutions to record the number cartridges used in a multi-dose inhaler, reminding patients to order new cartridges and inhalers, as well as reminding them to replace the inhaler after using N cartridges. For example, the inhaler is used with cartridges that contain each enough medication for X days of treatment. When the allocated doses are dispensed, the cartridge will lock. The patient can replace the cartridge and reuse the inhaler. The inhaler can be used with up to N times (thus using N cartridges). After that the inhaler should be discarded and replaced with a new one. Patients need to keep a record of the number of cartridges they have used in an inhaler and remember to replace the inhaler at the appropriate time. Thus, in general terms, the proposed device is to be able to: record (count) cartridges used, record when cartridges are changed; remind the patient to change cartridges and to reorder prescriptions for new cartridges/inhaler when required, provide a daily reminder to the patients take their medication. It is important that the solution is to be appealing and can be used intuitively by patients (including elderly patients aged 65+) and/or the pharmacist, nurse doctor or caregiver.

**Projects supervised by Dr Xiaowen Yuan :**

1. **3D printing of fibre reinforced honeycomb structured composite materials**

Fibre reinforced composite materials have wide applications in industry including the automotive and aerospace industries. However, the conventional fabrication methods require expensive facilities and equipment, such as autoclaves and complex rigid moulds, hindering the wide use of composites. Three-dimensional (3D) printing or additive manufacturing enables the fabrication of near-net-shaped complex 3D parts without expensive moulds or tools in short periods of time, based on 3D computer-aided design (CAD) data. Currently, 3D printing of light weight and high strength fibre reinforced composite materials represents a challenge in the composite field.

This project focuses on 3D printing of fibre reinforced honeycomb structured composite materials, and characterisation of mechanical performance. A prototype product is expected to be developed by the end of this project.

1. **Device design and characterisation of carbon fibre composite materials**

Carbon fibre composites have excellent mechanical performance due to the high strength and stiffness of carbon fibres. In areas where high quality composite materials are required, prepreg materials, where the fibres are preimpregnated with resin, are generally used. This allows high quality composite parts to be produced with a low void content, high volume fraction, controlled laminate thickness and the desired volume fraction. This research is to design and implement a process for creating carbon fibre composite materials for additive manufacturing. Mechanical performance of the composites materials, interface adhesion, and microstructure of the composite materials will be characterised.

1. **Natural fibre composites imaging and processing**

Natural fibres and natural fibre composite materials have attracted great attention worldwide. Natural fibre composites have the potential to replace synthetic fibre composites in a wide number of applications. The mechanical properties of fibres, fibre structure, pore structure and fibre composition will be characterised. In addition, correlation of the content and structure of fibres to their mechanical properties will be investigated. Understanding the over-arching relationship between content/structure and mechanical properties of plant fibres will lead to better utilisation of these fibres. This project will focus on local NZ flax fibre, i.e. harakeke (in Maori) fibre. Local industry will be involved.

1. **3D print media development for energy storage devices**

Devices for energy storage (such as supercapacitors) have attracted huge interest globally in recent years. We propose to develop an advanced nanostructured material for supercapacitors using 3D printing technology. This research consists of two phases: one is to prepare a mixture of nanomaterials consisting of graphene in which the viscosity is controlled for printing. The other is to develop a micronozzle to extrude the solution in a 3D printer at room temperature. This project requires two students working together to develop complementary solutions.

1. **Manufacturing biomedical devices through additive manufacturing**

A stent is a small mesh tube that's used to treat narrow or weak arteries. Arteries are blood vessels that carry blood away from the heart to other parts of the body. Doctors may need to place stents in weak arteries to improve blood flow and help prevent the arteries from bursting. Stents are usually made of metal mesh at high cost, and has the need to be removed when no longer needed. This project takes the challenge to develop a bio-thermoplastic stent using 3D printing technology. Such stents have the advantages of dissolving in-situ after their service life, and at lower cost than their metal equivalents.

1. **Thermal interface materials for microdevices**

A thermal interface material (TIM) is used to fill the gaps between thermal transfer surfaces, such as between microprocessors and heatsinks, in order to increase thermal transfer efficiency. These gaps are normally filled with air which is a very poor conductor. TIMs address a crucial problem with today's low-power electronic devices – the need to dissipate the sizable amounts of heat being generated. This project involves developing a compound of graphene and conducting polymer, testing of conductivity and strength, data analysis, and application in a prototype device.

1. **3D printing bio-ceramics for medical applications**

Calcium phosphates have been widely used for biomedical purposes. A solution of monocalcium phosphate monohydrate (MCPM) and sodium hydroxide (NaOH) has been developed previously. The results show that with a relatively low melting point at 109oC, MCPM could serve as a potential 3D printing ink to produce a scaffold. Based on this finding, this project focuses on developing this printing ink and using a 3D printing technique to manufacture the scaffold which can be used in bone replacements.

**Projects supervised by Dr. M. A. Rashid:**

1. Security Frameworks in Emerging IoT Platforms
2. Design of a Communication Gateway for WSN and the Internet.
3. Web Enabled Green House Monitoring and Control System
4. Networked IOT using ultra-low power wireless MCU
5. Visible Light Communication in the Smart Home
6. Secured Gesture Control of Internet of Things (IoT)
7. Study of Interference Performance of hybrid WDM-OCDMA system (Optical Communication Networks)

**Projects supervised by Dr. Fakhrul Alam:**

1. **Implementation challenges of RSSI based wireless localization systems**

A large number of the indoor localization methods based on wireless technology rely on Received Signal Strength Indicator (RSSI). WiFi and Zigbee are the most common wireless technology proposed in the literature for localization. However both of these suffer from various real-world problems and require extensive calibration. This project requires the student to identify and characterize the following problems through practical measurements (there is a working testbed available for the student)

* Inaccurate mapping of W-FI RSSI due to hardware nonlinearity
* Impact of ground reflection on RSSI values of Zigbee and WiFi
* Impact of power supply on RSSI reporting of ZigBee

1. **Device Free wireless localization**

An indoor localization system can be implemented through either Device-free Localization (DfL) (Passive localization)] or Active localization. DfL is an emerging technology that can locate moving objects within an area surrounded by wireless nodes or radios. DfL works by creating a dense network of “linked pairs” as each radio surrounding the area of interest can transmit and receive wireless signals. When an object passes through the links, some of the signal is either absorbed or reflected by the object, thus resulting in less signal power (Received Signal Strength) reaching the destination node (radio). An image of where the power is being absorbed can be formed by analysing the loss along the TX-RX links, and thus a moving object’s location can be detected. This project requires the student to use Massey University’s functional testbed using ZigBee and compare the performance of popular algorithms.

**Projects supervised by Dr. Khalid Arif :**

**Keywords:**

**3D/4D printing (Additive Manufacturing); Robotics; Sensors/Biosensors; Bioinstrumentation**

1. **4D printing**

To be decided in person (or via email).

1. **Robotic 3D printing around a pipe**

To be decided in person (or via email).

1. **Collaborative printing with micro/mini mobile robots**

To be decided in person (or via email).

1. **Investigation of 3D circuit device fabrication process using Stereolithography (or FDM):** The use of advanced 3D printing technology enhanced with component placement and electrical interconnect deposition can provide electronic prototypes that can be rapidly fabricated in comparable time frames as traditional 2D bread-boarded prototypes; however, these 3D prototypes include the advantage of being embedded within more appropriate shapes in order to authentically prototype products earlier in the development cycle. The fabrication freedom offered by 3D printing techniques, such as stereolithography (SLA) and fused deposition modelling (FDM) have recently been explored in the context of 3D electronics integration referred to as 3D structural electronics or 3D printed electronics. Enhanced 3D printing may eventually be employed to manufacture end-use parts and thus offer unit-level customization with local manufacturing.

This fundamental research project will explore methods of combining SLA and/or FDM with circuit board printing techniques. The research will include literature review of the existing techniques, design of experiments to print 3D PCBs, testing and validation.

1. **Microfluidics for biosensing using Stereolithography (or FDM/SLS/PDMS):** This research is similar to #1 but the objective is printing of micro channels (few hundred micrometers wide), chambers, and functional parts (e.g. pump, valve) integrated into the printed part. Based on extensive literature review, experiments will be designed to print complicated parts with microfluidic features. The fabricated parts will be tested using lab size pump and valves for functionality and fulfillment of the design objective. In addition to 3D printing techniques, PDMS fabrication methods will also be explored.
2. **Full field displacement measurement for 3D printed parts using digital image correlation**

3D printing (or additive manufacturing) was invented in 1980s and until recently has been used for rapid prototyping. In the last few years however, it started to evolve into next-generation manufacturing. Due to the lack of consistent engineering data or design literature on 3D printed parts, it is imperative to understand and extend advanced optical measuring techniques to 3D printed parts.

This project will study the application of 2-Dimensional Digital Image Correlation (DIC) technique to 3D printed parts produced using a SLS/FDM/SLM printer. DIC tracks the movement of applied surface pattern during the test of experiment. It is achieved by analysing the displacement of the pattern within subsets or sub-windows of the full image. Open source project Ncorr will be used for execution of algorithms and to calculate displacements and strains with sub-pixel resolution.

1. **Non-contact (video or laser) extensometer for tensile testing of material**

Strain measurement in materials testing is traditionally carried out using some form of contacting extensometer. A typical clip-on extensometer, for example, attaches to the specimen with clips or elastic bands and uses knife-edges to accurately track deformation in a specimen during testing. While providing accurate strain measurement in numerous applications, contact extensometers have a number of disadvantages.These extensometers are not suitable for elevated temperature or delicate specimen testing e.g. fine wires and thin foils. Further, the process of attaching a clip-on type of contacting extensometer, in a repeatable fashion, requires a level of operator skill.

The main objective of this project is research into techniques of non-contact strain measurement during elevated temperature testing using low cost video or laser system. Based on the literature review, a design for the extensometer will be conceived, developed and integrated with Instron Testing Machine (5967). The outcomes of this research are expected to be of high value and will be published in a conference and/or journal of repute.

1. **Investigation of methods for wireless communication with an underwater robot**

Currently an underwater robot or unmanned vehicle would need to be tethered such that it is hard-wired to the controller to enable the communication of instructions. The purpose of this research would be to find a way to control a robot in water without the use of a fixed tether or control cable.

1. **Indoor localization of a mobile robot using visual light communication**

Indoor robot positioning has become an attractive research topic within the past two decades. However, no satisfying solution has been found with consideration of both accuracy and system complexity. Recently, research on visible light communications (VLC) offers new opportunities in realizing accurate indoor positioning with relatively simple system configuration. An indoor positioning system based on VLC technology will be investigated in this research, with no synchronization requirement on the transmitters. The model developed of localization will be implemented on an already existing mobile robot to validate and test the accuracy of the system.

1. **Amphibious robot leg mechanism design and development**

Robot grasping is generally inspired by human hand due to its dexterity and large degrees of freedom. However, some tasks do not require robot with a human-like hand either due to simplicity of the task or another possible use the hand e.g. for walking or swimming. Gulls for example, can walk, swim and grasp objects with their toes. Yet, a gull’s foot is not as complicated as human hand. Bird foot motion is a natural example of a simpler design which has not been investigated in detail before, and has some advantages over the human hand. In this research a robot model which is based on the foot of a bird will be explored. The resulting design will be tested for grasping, walking and (possibly) swimming, particularly from shore against the waves.

1. **Bio inspired hybrid locomotion in flying robots**

Hybrid motion strategies, e.g. combining jumping or running with flying and gliding, are used in nature by numerous animals and birds for effective movement in their natural habitat. However, only recently its importance is realized as a valuable locomotion strategy for small robots, navigating in rough terrain.

The aim of this research is to study existing developments in robots capable of hybrid locomotion and investigate the fundamentals principles like release velocity, height and control issues that allow birds to jump and fly. Based on the theoretical findings, energy storage and release mechanisms will be designed to experiment with commercially available “ornithopters”, artificial bird like flying robots.

1. **A geometric approach to robotic soft textile folding**

Few tedious tasks are as universal to the human experience as household chores. No utopian future would be complete, then, without household robots relieving humans of these tasks: doing the dishes, sweeping the floors, setting the table, and doing the laundry. This research explores the latter challenge. Washing machines and dryers have automated much of the process, but one clear bottleneck remains: autonomous soft textile folding.

This research will investigate solutions to the perception and manipulation challenges inherent to the task. A simple geometry based model of the textile will be used to neglect the complex dynamics and algorithms and methods will be developed for desired sequence of folds. The models will be implemented on a custom designed folding system.

1. **Rapid detection of soil surface contaminants using a quad copter**

This project will investigate the use of a quadcopter for rapid detection of substances within the surface of soil through imaging and direct contact sample collection and detection sensing methods. One of the target contaminant is urea that is found in the form of patches in cattle grazing pastures.

This project will require control design for very low altitude stable flight of the quad-copter, study and selection of imaging system (e.g. thermal camera) and sample collection and processing biosensors.

Initially samples of urine patches will be collected and brought to lab for testing with the selected biosensor. Extensive field experimentation will be needed to complete this research project.

1. **Quadruped walking**

To be decided in person (or via email).

1. Student proposed topics are also welcome.