List of IC@N Research Projects and Supervisors

School of Mechanical & Aerospace Engineering (MAE)

Name of Supervisor	Research Project Description
Assoc Prof Cai Yiyu myycai@ntu.edu.sg	**Tactile Suite Design** This project is interested to design an innovative suite simulating the water effect interacting with a swimmer wearing the suite. Vibration sensors will be used and integrated within the suite through possible master-slave solutions. Water splashing and wave effects will be simulated with the suite. Integrated software and hardware development will be conducted via Application Programming Interface. The project student is expected to have a strong interest, and good experience in the relevant field (mechatronics, sensors, or robots). Solid programming skill will be a bonus. This project is interested to design an innovative suite simulating the water effect interacting with a swimmer wearing the suite. Vibration sensors will be used and integrated within the suite through possible master-slave solutions. Water splashing and wave effects will be simulated with the suite. Integrated software and hardware development will be conducted via Application Programming Interface. The project student is expected to have a strong interest, and good experience in the relevant field (mechatronics, sensors, or robots). Solid programming skill will be a bonus.
Assoc Prof Chou Siaw Meng MSMCHOU@ntu.edu.sg	**Pie Crusting of Tendons and Ligaments** **(This project is not available for Summer intake)** Area of research: Biomechanics Objective: To understand how ligament/tendon biomechanical property changes with pie crusting. Scope: The scope of this project includes one of the following: 1. To understand how ligament and tendon's biology changes with pie crusting and to derive a mathematical model to determine how pie crusting affects the length (L), stress-strain curve, and load to failure of a given ligament/tendon. 2. To study the relationship between the number of stabs (n), distance between stabs (w), transverse distance between stabs (s), the length of each stab (d) and the alteration of biomechanical properties of the ligament/tendon. 3. To validate the mathematical model with biomechanical studies in the lab with standardized animal ligament/tendons. Project Duration: up to 6 months
	Determination of shoulder global range of motion

	(This project is not available for Summer intake) Area of research: Biomechanics Objective: To determine the global range of the shoulder motion in three-dimension. Scope: This project seeks to propose a cost effective and user-friendly method of measuring shoulder range of motion for clinical purposes. Existing measuring equipment are complicated, expensive and not applicable for clinical practice. A motion capture system will be utilized to capture the three-dimensional data. The data collected will be used to generate a two-dimensional map to serve as a tool to compare shoulder joint functionality between the normal population and patients (before and after treatment). Project Duration: up to 6 months
Asst Prof Hortense Le Ferrand Hortense@ntu.edu.sg	**Orientation and aggregation of anisotropic microparticles under magnetic fields** Biocomposites often display outstanding properties (mechanical, optical, functional) that result from their internal microstructures. Using synthetic chemistry, however, allows exploring a wider range of properties and functions. In particular, ferromagnetic anisotropic particles distributed in a polymer could be a means for magnetically-triggered morphing composites with superior mechanics and electrical conductivity. To this aim, one should first understand how to build hierarchical microstructures with such elements. In this project, the student will study how ferromagnetic microparticles suspended in a viscous matrix respond to magnetic fields in terms of orientation and distribution. The tools will be optical microscope, rheometer, and magnetic fields.
Asst Prof Li Hong ehongli@ntu.edu.sg	**Conversion of Carbon Dioxide to Energy Sources Catalyzed by Graphene-Like Materials** Area of research: electrochemical engineering, renewable energy. Project description: Global energy consumption increases by 15% every decade while petroleum supply is declining gradually. Traditional energy source alternative to petroleum such as coal worsens the climate change by emitting more greenhouse gases. Greenhouse gas emission consists of mainly carbon dioxide (CO2) and methane emission, where CO2 contributes to more than 55%. Greenhouse gas emission results in global warming that causes about 300,000 casualties every year. Global temperature would increase by 4 oC with current greenhouse gas emission trend, which could cause sea level rise about 10 meters. This would result in millions of people living in coastal area homeless. Carbon dioxide can be converted to energy carriers like carbon monoxide and hydrocarbons via electrochemical reactions; reducing the

	greenhouse gas emission and meanwhile producing useful energy sources. Graphene-like two-dimensional materials have great potential to act as superior catalysts for these reactions because their atomic thickness exposes most of their atoms to the environment, which could result in extraordinary chemical activity. In this proposed research, two-dimensional catalysts for conversion of CO2 to useful energy source will be investigated. Students, who would like to gain experimental experience in the areas of two-dimensional nanomaterials for environmental applications, are welcomed to apply. Methodology: Student is expected to participate in every steps of the entire project including design of catalyst, synthesis of catalyst, fabrication of testing bed, and characterization of the catalyst. Only experimental work will be involved in the project. Project Duration: Six-month internship is preferred. Preferred background: material science and engineering, chemical Engineering, electrical engineering or related engineering disciplines. It is advantageous to have knowledge of electrochemistry, physical chemistry, semiconducting, nanomaterial synthesis and characterization.
Asst Prof Li King Ho Holden HoldenLi@ntu.edu.sg	**Development of RF Communication System for Nanosatellite** Small scale satellite has been received much attention from both industrial and academia since its development in 1999. The small physical size and standardized cubic structure of the CubeSat reduce the design complexity, development cost, lead time and launch cost. Our team is currently developing a CubeSat platform and ground-based sensor terminals for space-based Internet-of-Things applications. The student will work closely with a research team on development and testing of the RF communication module for ground-based sensor terminals. The student is expected to have good understanding in RF communications, data communication protocol and programming. Project Duration: 6 months Dr Chow Chee Lap of Temasek Laboratories will be the co-supervisor.
Assoc Prof Huang Wei Min MWMHuang@ntu.edu.sg	**Shape memory polymer/alloy composite for enhanced stiffness** Shape memory alloy and shape memory polymer are two typical shape memory materials with great potential in many applications. One of the most popular stimuli to activate shape memory is heat. Both shape memory alloy and polymer change stiffness upon thermal cycling, but in an opposite way. While shape memory alloy becomes harder upon heating, shape memory polymer becomes softer upon heating. The problem in many real engineering

	applications is that in the soft state, the material might be not stiff enough even to support its self-weight. This project aims to experimentally investigate a simple solution by means of combining shape memory alloy and polymer together, so that the resulted composite is always able to, at least, support itself to avoid collapsing during operation upon thermal cycling. This project is under smart materials and is mainly experimental investigation. The duration of this project is up to 6 months. Good hands-on skill is required, and interest to explore new ideas is a big plus.
Assoc Prof Rajesh Piplani piplani@pmail.ntu.edu.sg	**Data Analytics for Production Scheduling** Using data on machine utilization, queue lengths and time-in-system, develop algorithms that model the relation -ship between system parameters and system performance measures, such as throughput rate. The data will be either collected from a real system, or generated using a simulation model. The student should be proficient in computing, and be either familiar with or willing to learn python and MATLAB. Duration :5-6 months
	Analysing risk in global supply chains Develop optimization model of a global supply chain, and analyse the supply chain for various scenarios of disruption. Model output would be prescriptive contingency plans that minimize the impact of disruption on the firm's chosen performance measure (such as lost demand). The project will require application of linear programming. The student should be familiar with LP and be willing to learn modelling software. Duration :6 months
Assoc Prof Xie Ming mmxie@ntu.edu.sg	**Development of Vision System Using Robotics Operating Systems** The aim of the small project is to learn how to use ROS (robotics operating systems) to implement a vision system with graphical user interface and a set of functions for image processing and vision computing.
	Development of Simulation System Using Robotics Operating Systems

	The aim of the small project is to learn how to use ROS (robotics operating systems) to implement a simulation system with graphical user interface and a set of models of industrial robots, mobile robots and intelligent vehicles.
	Development of Speech System Using Robotics Operating Systems The aim of the small project is to learn how to use ROS (robotics operating systems) to implement a speech system with graphical user interface and a set of functions for speech recognition and voice activated control of robot systems or intelligent machines.
Assoc Prof Huang Wei Min mwmhuang@ntu.edu.sg	**Rubber-like Shape Memory Hybrid for Comfort Fitting** This project aims to develop a new shape memory material for comfort fitting, such as shoes and insoles. This shape memory material should have a couple of unique features, which cannot be spotted in conventional shape memory polymers either individually or in a combined manner, namely highly elastic (as silicone rubber) at around body temperature, and fixing of the temporary at around body temperature.
	Self-Healing in a Novel Electrically Conductive Shape Memory Polymeric Composite This project aims to develop a novel electrical conductive shape memory polymeric composite, which can be activated for shape recovery via joule heating, while the built-in conductive network can be repaired easily for cyclic operation. The scope of this project includes two parts, fabrication of the polymeric composite, and characterization of its performance, namely the shape memory effect and healing effect of the conductive network for joule heating.
Ast/P Li King Ho Holden holdenli@ntu.edu.sg	**RF Communication Design for CubeSat** In this project, a Cube Satellite (CubeSat) will be developed and launch into orbit for experimental study of cosmic effect on timing device. The CubeSat will continuously transmit useful information to ground station throughout its flight mission. The candidate will help in the design and development of the UHF transceiver module for data communication between the CubeSat and ground station. The candidate is expected to have strong understanding on RF communications system principles, especially Satellite communication.
Prof Lye Sun Woh MSWLYE@ntu.edu.sg	**Intern for Human Computer Interaction (HCI) applications programmer in the field of Air Traffic Control (ATC)** Intern will be playing a key role in developing key applications for HCI in ATC. This is achieved by implementing the computation of monitoring behaviour from the captured eye tracking data, in the

	already available real time post-processing tool (Java) Intern will also be able to perform trial tests to test the feasibility of the improved system in ATC.
Assoc Prof A. I Sivakumar msiva@ntu.edu.sg	**Application of learning algorithm for dynamic scheduling of single machine** Study single machine scheduling methods; understand the nature of N-P hard optimization problem. Study dynamic scheduling methodologies Develop simple scheduling algorithm for multiple dissimilar jobs on a single machine Review how to apply a simple concept of learning algorithm to dynamic scheduling Apply discrete event simulation to validate results. Duration: 3 months
Assoc Prof Shu Dong Wei mdshu@ntu.edu.sg	**FEM investigation of Split Hopkinsin Pressure Bar** Split Hopkinson Pressure Bar requires high precision of the specimen, precise alignment of the bars, and strain gage positioning. This project investigate such influence with the help of ANASYS/LSDYNA licensed in the CAD laboratory in the school of MAE of NTU. The project students will interact with a group of Students comprising NTU undergraduate students and PhD students. Duration: 2 to 6 months
Assoc Prof Shu Jian-Jun mjjshu@ntu.edu.sg	**Riemann zeta function** The Riemann zeta function is central to number theory and also plays an important role in physics and engineering. The scope of this project is to investigate some important properties and applications of the Riemann zeta function, and to write a project report. Duration: 6 months
	Quantum entropy The concept of entropy plays a central role in classical information theory. The scope of this project is to develop an entropic measure of quantum information, and to write a project report. Duration: 6 months