<table>
<thead>
<tr>
<th>Project Code</th>
<th>Project Title</th>
<th>Group</th>
<th>Project Supervisor</th>
<th>Co-Supervisor</th>
<th>Project Description</th>
<th>Specialisation</th>
<th>Project Description</th>
<th>Category of this project</th>
<th>The minimum requirement or knowledge needed to embark on this project</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM10</td>
<td>Development of an artificial skin</td>
<td>AM</td>
<td>Assoc Prof Zhu Jian</td>
<td></td>
<td>An artificial skin has extensive applications in autonomous artificial intelligence, medical diagnostics, replacement prosthetic devices, etc. In this project, the student will develop an artificial skin—a soft sensor using soft active materials—dielectric elastomers. When a membrane of a dielectric elastomer is mechanically deformed, both the capacitance of the membrane and the dielectric resistance change. By measuring the capacitance and resistance, one can measure the deformation of the membrane. Dielectric elastomers sensors offer several potential advantages over traditional ones including operation over large strain ranges, ease of patterning for distinctive sensing capabilities, flexibility to allow unique integration into components; stable performance over a wide temperature range and low power consumption. How to improve the accuracy of this soft sensor will be explored.</td>
<td>None</td>
<td>No</td>
<td>Laboratory Investigation i.e. mixture of experiment and numerical/software</td>
<td>Mechanical design and control</td>
</tr>
<tr>
<td>AM11</td>
<td>Micromechanics investigation of ductile failure in metals</td>
<td>AM</td>
<td>Assoc Prof Shailendra P. Joshi</td>
<td></td>
<td>Finite element modeling of failure evolution under various controlled loading conditions. Effect of crystal orientations will be studied.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis, Software Development</td>
<td>Good background of solid mechanics, FEM is desirable, some coding experience will be useful</td>
</tr>
<tr>
<td>AM12</td>
<td>Discrete Network Finite Element Modeling of CNT forests</td>
<td>AM</td>
<td>Assoc Prof Shailendra P. Joshi</td>
<td></td>
<td>Numerical investigation of CNT forests using discrete element modeling using FEA.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis, Software Development</td>
<td>Good background of solid mechanics, FEM is desirable, some coding experience will be useful</td>
</tr>
<tr>
<td>AM13</td>
<td>Poly(oxy)phthalic anhydride of Magnesium using FEM and Crystal Plasticity</td>
<td>AM</td>
<td>Assoc Prof Shailendra P. Joshi</td>
<td></td>
<td>The project will involve understanding the various methods available for generating random shaped grains that can fit to form a 3D polycrystal and then integrating it with the finite element software ABAQUS.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis, Software Development</td>
<td>Good background of solid mechanics, FEM is desirable, some coding experience will be useful</td>
</tr>
<tr>
<td>AM14</td>
<td>Impact Modeling of Cellular Structures</td>
<td>AM</td>
<td>Assoc Prof Shailendra P. Joshi</td>
<td></td>
<td>FE modeling and design of cellular structures subjected to impact; investigating structural failure modes as a function of material properties</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis, Software Development</td>
<td>Good background of solid mechanics, FEM is desirable, some coding experience will be useful</td>
</tr>
<tr>
<td>AM17</td>
<td>PDMS-based Optofluidic microresonators</td>
<td>AM</td>
<td>Assoc Prof Chau Fook Siong</td>
<td></td>
<td>The optofluidic lenses under investigation in this project consist of a liquid-filled PDMS chamber covered with a deformable PDMS membrane. When a pressure is applied, the membrane deforms, thus changing the radius of curvature and hence the focal length of the microresonators. Such microresonators, due to their adjustable focal lengths, are very useful in a range of applications including optical zooming and autofocusing in miniature cameras in smart phones and tablet PCs. In this project, the student will investigate the microresonators’ performances using optical design software Zemax®. In addition, the lenses will be fabricated using PDMS soft lithography processes, and their optical imaging performance will be experimentally measured.</td>
<td>None</td>
<td>No</td>
<td>Laboratory Investigation, Computing and analysis, Design, Feasibility/case studies</td>
<td>NA</td>
</tr>
<tr>
<td>AM75</td>
<td>Sound and vibration analysis of ship structures</td>
<td>AM</td>
<td>Assoc Prof Lim Han Meng</td>
<td>Assoc Prof Lee Heow Pueh</td>
<td>In this project, the student will perform a numerical analysis of sound and vibration of ship structures. The student will use simple models of beams and plates to study and predict the response and mobility of ship structures subjected to vibration. The student should have a strong interest in solid mechanics and structural dynamics. The student will have the opportunity to work with an industrial partner in ship building.</td>
<td>Offshore Oil &amp; Gas Technology</td>
<td>Damen Shipyards Singapore</td>
<td>Computing and analysis</td>
<td>NA</td>
</tr>
<tr>
<td>AM76</td>
<td>Numerical analysis of acoustic performance of floating floors</td>
<td>AM</td>
<td>Assoc Prof Lim Han Meng</td>
<td>Dr Ong Eng Teo</td>
<td>In this project, the student will use a finite element package to study the acoustic performance of floating floors. Finite element calculations will be conducted on Sylomer floating floors to study their vibration and acoustic performance. The computational results will be compared with laboratory tests. The student should have a strong interest in solid mechanics and structural dynamics. The student will have the opportunity to work with an industrial partner in ship building.</td>
<td>Offshore Oil &amp; Gas Technology</td>
<td>Damen Shipyards Singapore</td>
<td>Computing and analysis</td>
<td>NA</td>
</tr>
<tr>
<td>BN12</td>
<td>Robotic endoscopy system for Natural Orifice Endoscopic Surgery</td>
<td>BN</td>
<td>Dr REN Hongliang</td>
<td></td>
<td>The project is aiming at developing a novel flexible robotic and sensing system for Natural Orifice Endoscopic Surgery, the latest minimally invasive surgery paradigm, in which the access to human cavity is gained via body's natural orifice such as mouth or nose. The preliminary robot prototype was already built in the group. The FYP student need to improve it, characterize it and test out together with research fellow and postgraduate. This mainly involves mechanical design, modeling, characterization and surgical experiments. The FYP student will team up with the current members but with specific tailored focuses. This project involves device development and close interaction with multiple-disciplinary researchers including the surgeons from university hospital. For more information about our lab, please visit: <a href="http://bioeng.nus.edu.sg/mm/">http://bioeng.nus.edu.sg/mm/</a></td>
<td>None</td>
<td>No</td>
<td>Hybrid i.e. mixtures of experiment and theoretical, of experimental and numerical/software</td>
<td>NA</td>
</tr>
<tr>
<td>BN13</td>
<td>Active vision for Computer-Integrated Surgical systems</td>
<td>BN</td>
<td>Dr REN Hongliang</td>
<td>Dr Lim Chee Meng/Hui, Obstetrics &amp; Gynaecology</td>
<td>Visual servoing is an emerging approach to guide surgical robots automatically using visual information. Image processing, computer vision and control theory are combined in order to control the motion of an active vision system depending on the visual information. We will investigate methods of image-based visual servoing and position based visual servoing for surgical robots in in-vivo environments. The student can work on the preliminary hardware setup and focus on system integration and visual servoing algorithms. This project involves device development and close interaction with multiple-disciplinary researchers including the surgeons from university hospital. For more information about our lab, please visit: <a href="http://bioeng.nus.edu.sg/mem">http://bioeng.nus.edu.sg/mem</a></td>
<td>None</td>
<td>No</td>
<td>NA</td>
<td>hybrid i.e. mixtures of experiment and theoretical, and experimental and numerical/software.</td>
</tr>
<tr>
<td>BN17</td>
<td>OLD Microfluidic devices for cell/biomolecule separation</td>
<td>BN</td>
<td>Dr Zhang Yong</td>
<td>A precise and distinct particle separation method with high separation resolution is deterministic lateral displacement (OLD). Briefly, OLD consists of a pillar gradient array which has a specific critical size for particle separation with respective pillar spacing and array gradient. Particles larger than the critical size are bumped off its flow path and displaced laterally from its original fluid stream to follow the pillar gradient while smaller particles will continue the fluid path unaffected by the OLD pillar array. OLD devices can be used for separation of cells or biomolecules such as red blood cells, bacteria or biomarker proteins from blood, which is useful for disease diagnostics. The effect of pillar shape and buffer solution on the separation of these bioparticles will be studied.</td>
<td>None</td>
<td>No</td>
<td>Laboratory Investigation, Product development</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>BN18</td>
<td>Development of standardized light calibration system for medical diagnosis</td>
<td>BN</td>
<td>Prof Huang Zhewei</td>
<td>The project aims to develop a standardized light calibration prototype system for biomedical diagnostics at endoscopy.</td>
<td>Automotive Engineering</td>
<td>No</td>
<td>Product development, Software development, Design</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>BN22</td>
<td>Development of a microfluidics for biomedical applications</td>
<td>BN</td>
<td>Prof Lim Chee Teck</td>
<td>We have recently developed a technique to produce polymer microfluidics with circular cross-section. The unique feature of this microtube allows us to mimic the microcapillaries and blood vessels found in the human body. This project involves designing and developing a blood circulatory system using such microtubes. The aim is to develop blood vessels on a chip system. It is hoped that such a system will enable us to investigate the pathology of blood related diseases by observing what happens when diseased blood cells are made to flow through such a biosensor.</td>
<td>None</td>
<td>No</td>
<td>Laboratory Investigation, Design, Product development</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>BN23</td>
<td>Flexible and Wearable Liquid-State Microfluidic Tactile Sensor</td>
<td>BN</td>
<td>Prof Lim Chee Teck</td>
<td>Conventional commercial tactile sensors are often rigid and bulky. The use of these sensors may also unfeasibly limit the natural body movements. Moreover, a majority of these sensors can only measure one-dimensional forces. Here, we aim to design and develop flexible and wearable liquid-state microfluidic tactile sensors that are conformable and robust in response to different mechanical deformations over a wide range of pressures. In addition, these sensing platforms are expected to have multidimensional sensing capability with high sensitivity and specificity for various applications in soft robotics, electronics skins, prostheses, and real-time healthcare monitoring.</td>
<td>None</td>
<td>No</td>
<td>Laboratory Investigation, Design, Product development</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>C102</td>
<td>Object Detection and 3D Pose Estimation with a RGB-D Camera</td>
<td>CT</td>
<td>Asst Prof Lee Gim Hwe</td>
<td>The ability to detect objects and estimate their 3D poses is important for a robot to comprehend and interact with its environment. This project focuses on the use of a combination of image and depth information from a RGB-D camera (for example Microsoft Kinect) to detect and estimate the 3D pose of domestic objects that are commonly found in our home environment.</td>
<td>None</td>
<td>No</td>
<td>Software development</td>
<td>Excellent C/C++ programming skills.</td>
<td></td>
</tr>
<tr>
<td>C109</td>
<td>Distributed robust learning</td>
<td>CT</td>
<td>Asst Prof Xu Huan</td>
<td>The project studies machine learning algorithms in a distributed environment, and seeks to develop methods that are robust to corruptions and node failure. The goal is to develop a software package for such applications. This project needs good programming skill and strong math ability (linear algebra and probability).</td>
<td>None</td>
<td>No</td>
<td>Computing and analysis, Software development</td>
<td>linear algebra, probability, programming</td>
<td></td>
</tr>
<tr>
<td>C118</td>
<td>Unbias robust learning</td>
<td>CT</td>
<td>Asst Prof Xu Huan</td>
<td>This project studies machine learning algorithms in an online environment, and seeks to develop methods that are robust to corruptions. The goal is to develop a software package for such an application. This project needs good programming skill and strong math ability (linear algebra and probability).</td>
<td>None</td>
<td>No</td>
<td>Computing and analysis, Software development</td>
<td>linear algebra, probability, programming</td>
<td></td>
</tr>
<tr>
<td>C112</td>
<td>Chance constrained formation for load dispatch</td>
<td>CT</td>
<td>Asst Prof Xu Huan</td>
<td>Load dispatch aims to optimise the optimal output of a number of electricity generating units, to meet the system load, at the lowest possible cost. Conventional load dispatch problem uses deterministic models. To deal with unexpected fluctuations, we aim to use stochastic program with chance constraint to tackle this problem. This project needs good programming skill and strong math ability (linear algebra, optimization and probability).</td>
<td>None</td>
<td>No</td>
<td>Computing and analysis, Software development</td>
<td>linear algebra, probability, programming</td>
<td></td>
</tr>
<tr>
<td>C113</td>
<td>Machine learning algorithms to analyze sound signal</td>
<td>CT</td>
<td>Asst Prof Xu Huan</td>
<td>This project is about to apply machine learning algorithms to analyze sound signals such as songs. Based on sound signals, we want to study how to correctly identify the source of the sound. This project needs good programming skill and strong math ability (linear algebra and probability).</td>
<td>None</td>
<td>No</td>
<td>Computing and analysis, Software development</td>
<td>linear algebra, probability, programming</td>
<td></td>
</tr>
<tr>
<td>C114</td>
<td>Differential private learning algorithms</td>
<td>CT</td>
<td>Asst Prof Xu Huan</td>
<td>This project studies and compares different schemes of machine learning methods that preserves differential privacy, and develops new private learning algorithms. This project needs good programming skill and strong math ability (linear algebra and probability).</td>
<td>None</td>
<td>No</td>
<td>Computing and analysis, Software development</td>
<td>linear algebra, probability, programming</td>
<td></td>
</tr>
</tbody>
</table>
CT16 Design of a high temperature pneumatic actuator

C7 Assoc Prof Chen Chao Yu, Peter

A pneumatic rotary actuator is a device that converts a pneumatic energy into a rotary motion. It is normally used to rotate a mechanism or a system. The objective of this project is to design a quarter turn rotary type pneumatic actuator which will be used for industrial fire safety application, such as to operate an HRAC smoke extract damper. The actuator designed shall be able to withstand a temperature of 250°C. The scope of the project includes the design of the operating mechanism of the actuator (e.g., by rack and pinion, etc.), prototyping and evaluating its performance.

None No Product development NA

CT17 Automatic generation of shear flow for silk strand formation

C7 Assoc Prof Chen Chao Yu, Peter

It has been observed that stirring, shaking and mechanical agitation of silk protein solution promote silk strand formation due to the effect of the shear flow on amyloid fibril formation in vitro. Shear flow (Couette flow) is generated when two parallel plates separated by a liquid move relative to each other, which creates a uniform velocity gradient in the fluid. This project aims (i) to improve the current set-up for creating desirable shear flow patterns in silk protein solution and (ii) to conduct experiments to investigate the effect of various shear flow patterns in promoting silk strand formation.

None No Hybrid i.e. mixtures of experimental and theoretical, or experimental and numerical/software. (1) Knowledge in Fluid Mechanics. (2) Skills in numerical/software.

CT18 Manipulation of magnetic particles

C7 Assoc Prof Chen Chao Yu, Peter

The ability to manipulate magnetic micro-particles will enable more sophisticated manipulation of cells, molecules, and other micro-structures. The key challenge in manipulating such particles individually and simultaneously lies on the ability to localize the magnetic field acting on an individual particle, which enables the application of force and torque on individual particles without significantly affecting other particles nearby. This project will investigate ways to achieve localized manipulation of multiple magnetic micro-particles using various control strategies.

None No Hybrid i.e. mixtures of experimental and theoretical, or experimental and numerical/software. (1) Knowledge in Control Theory and Image processing. (2) Skills in programming Microcontroller.

CT20 Design of a Robotic Arm for Artificial Tissue Engineering

C7 Assoc Prof Chen Chao Yu, Peter

Substantial progress is being made in the scientific community towards growing tissues and organs in the laboratory. It is now possible to manipulate biological cells and grow simple tissues through engineered methods. Successfully creating tissues and organs to replace damaged or defective ones can be a major contribution to the field of medicine. The objective of this project is to design and deploy a robotic arm to carry out the necessary biological processes in the engineering of artificial tissues. This project is a collaboration with Professor Harry Asada’s group at the BioSystems and Micromechanics Interdisciplinary Research Group (BioSyM IRG) under the Singapore-MIT Alliance for Research and Technology (SMART).

None No Product development, Design NA

CT21 A vision-based system for a tissue engineering robotic arm

C7 Assoc Prof Chen Chao Yu, Peter

Substantial progress is being made in the scientific community towards growing tissues and organs in the laboratory. It is now possible to manipulate biological cells and grow simple tissues through engineered methods. Successfully creating tissues and organs to replace damaged or defective ones can be a major contribution to the field of medicine. This project aims to develop a vision-based system, mounted on a robotic arm, to detect and recognize cell culture tubes and bio-devices and provide feedback. Strong programming skills and knowledge about software development are preferred. This project is a collaboration with Professor Harry Asada’s group at the BioSystems and Micromechanics Interdisciplinary Research Group (BioSyM IRG) under the Singapore-MIT Alliance for Research and Technology (SMART).

None No Product development, Software development, Design NA

CT22 Liquid handling end-effectors for growing artificial tissues

C7 Assoc Prof Chen Chao Yu, Peter

Substantial progress is being made in the scientific community towards growing tissues and organs in the laboratory. It is now possible to manipulate biological cells and grow simple tissues through engineered methods. Successfully creating tissues and organs to replace damaged or defective ones can be a major contribution to the field of medicine. The objective of this project is to design liquid handling systems for controlled dispensing of micro-volumes of various reagents with different viscosities. Accurate control of sample volume is required to produce the desired biological reactions when growing artificial tissues and organs. This project is a collaboration with Professor Harry Asada’s group at the BioSystems and Micromechanics Interdisciplinary Research Group (BioSyM IRG) under the Singapore-MIT Alliance for Research and Technology (SMART).

None No Product development, Design Hybrid i.e. mixtures of experimental and theoretical, or experimental and numerical/software. NA

CT25 Enhancement of mixing efficiency in curved microchannels

C7 Assoc Prof Chen Chao Yu, Peter

Mixing occurs in a microfluidic channel is challenging at low Reynolds number due to slow mass transport dominated by molecular diffusion. Curved microchannels (i.e., the spiral type) can induce secondary flow that may lead to improved mixing efficiency, which has direct implications in the design of heat exchangers based on microfluidic channels. The formation of such secondary flows, however, requires certain flow velocity, which would in turn increase the pressure drop along the curved channel. This project will investigate the optimal range of flow velocities and the geometry of the cross-section of the microfluidic channel to enhance mixing efficiency.

None No Computing and analysis, Design Experience working with computational fluid dynamics software (such as Fluent) is desirable.
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Supervisor</th>
<th>Design</th>
<th>Hardware</th>
<th>Software</th>
<th>Programming</th>
<th>Specific Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT28</td>
<td>Path planning for multi-robot systems</td>
<td>Assoc Prof Cher-Chao Yu, Peter</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Software development skills in C++, Linux, Python, ROS; hardware implementation of algorithms</td>
<td></td>
</tr>
<tr>
<td>CT29</td>
<td>Development of Robot Manta Ray</td>
<td>Assoc Prof Chew Chwee Meng</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Design (hybrid i.e. mixture of experiment and theoretical, or experimental and numerical/ software)</td>
<td></td>
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<tr>
<td>CT30</td>
<td>Soft upper limb-exoskeleton interface</td>
<td>Assoc Prof Chu Chee Kong</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Mechatronics, basic programming skill</td>
<td></td>
</tr>
<tr>
<td>CT31</td>
<td>Robot for automated cable binding – vision-based motion control</td>
<td>Assoc Prof Chu Chee Kong</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Software development skills in C++, Linux, Python, ROS; hardware implementation of algorithms</td>
<td></td>
</tr>
<tr>
<td>CT32</td>
<td>More ethanol surface engineering methods for artificial trucch</td>
<td>Prof May Whie Hang (SIMTech)</td>
<td>None</td>
<td>Yes (SIMTech)</td>
<td>No</td>
<td>Hybrid i.e. mixture of experiment and theoretical, or experimental and numerical/ software</td>
<td></td>
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<tr>
<td>CT33</td>
<td>Development of Tool Condition Monitoring for Drilling with High Aspect Ratio</td>
<td>Assoc Prof Hong Geok Soon</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Laboratory Investigation, Computing and Analysis, Software Development, Field Testing and Instrumentation, Hybrid i.e. mixture of experiment and theoretical, or experimental and numerical/ software</td>
<td></td>
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<tr>
<td>CT34</td>
<td>Analysis of functional 3-D Printing with Mechanical Properties.</td>
<td>Assoc Prof Hong Geok Soon</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Sound background on Matlab programming, C-programming, instrumentation and mathematical knowledge</td>
<td></td>
</tr>
<tr>
<td>CT35</td>
<td>A robotic marking system for large steel plates</td>
<td>Assoc Prof Michele H. Ambler</td>
<td>None</td>
<td>No</td>
<td>No</td>
<td>Hybrid i.e. mixture of experiment and theoretical, or experimental and numerical/ software</td>
<td></td>
</tr>
</tbody>
</table>

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### Design of a Teleoperated Robotic Vehicle for Spraying Applications

**C762**

**Design**

Assoc Prof Marcelo H. ANG Jr

There are many useful applications for a remotely-operated vehicle to do spraying applications. In this project, the student will design a nozzle-based spraying system onto an existing "drive by wire" vehicle. The operator remotely drives the vehicle to the locations to be sprayed. A user interface will be developed to control the swinging motion of the nozzle spray together with the motion of the vehicle. A target application is pest control in housing estates. In Pest control, workers carry chemicals on their back and do spraying of areas while walking. This is a very tedious and physically demanding process. A better solution is for the worker to operate the teleoperated robotic vehicle and do spraying motions remotely, without physical demands on the worker.

<table>
<thead>
<tr>
<th>Software development, Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solidworks and C/C++</td>
</tr>
</tbody>
</table>

None

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**Hybrid i.e. mixtures of experiment and theoretical, or experimental and numerical/software.**

**Basic knowledge in computer programming**

### Design of an Indoor Imaging Surveyor System

**C763**

**Design**

Assoc Prof Lee Gim Hee

In this project, the student will design and build an indoor imaging surveyor system (similar to the imaging system on a Google Streetview car). The surveyor system is a backpack that carries multiple RGB and RGB-D cameras connected to a hand-held laptop for data collection. The student will also write a software with C/C++ in the Robotics Operating System (ROS) to synchronize the cameras, capture datasets and visualize the multi-camera system.

None

No

Software development, Design

Solidworks and C/C++ programming

### Fisheye-Stereo Visual Odometry on the Jetson TX1 Embedded System

**C764**

**Design**

Assoc Prof Lee Gim Hee

Dr. Lionel Heng

There is an existing implementation of fisheye-stereo visual odometry that works in real-time on x86 CPU platforms. This implementation is state-of-the-art, and is based on both photometric error minimization and bundle adjustment. The project requires the porting of this implementation to the Jetson TX1 embedded system which has a quad-core ARM Cortex-A57 processor and a Tegra X1 mobile GPU. The resulting implementation should have a similar level of performance as the existing CPU implementation. Excellent programming skills in C++ and CUDA are required. Knowledge of 3D computer vision is a plus.

None

No

Software development

Requirements: Excellent programming skills in C++ and CUDA are required. Knowledge of 3D computer vision is a plus.

### Mechanical Design of an Unmanned Air Vehicle for Delivery of Goods to Remote Areas

**C765**

**Design**

Assoc Prof Marcelo H. ANG Jr

The objective of this project is to design the mechanical airframe and propulsion systems of an unmanned aerial vehicle (UAV) and deploy a small cargo transportation service for the needs of a rural area in a vast and hard-to-reach region. The UAV should be capable of vertical takeoff-and-landing, travel at least 200 km in range, carry a payload of 20 kg and fly autonomously. A UAV with such specifications will assist hospitals in their provision of medical services and regular re-supply missions to their outposts, enabling them to reach previously unreachable villages. The availability of a drone with such specifications will also impact current operations as they re-think their processes and staff deployment in light of a drone paradigm.

None

No

Design

NA

### Design and Development of a Control System for a Long Range Unmanned Air Vehicle

**C766**

**Design**

Assoc Prof Marcelo H. ANG Jr

The objective of this project is to implement and design the autopilot, artificial intelligence and control system of an unmanned aerial vehicle (UAV) and deploy a small cargo transportation service for the needs of a rural area in a vast and hard-to-reach region. The system should be capable of vertical takeoff-and-landing, fly autonomously, "hug" the terrain during flight and adhere strictly to geo-fence and altitude limits - this is mainly due to the presence of other NGO aircraft assets flying in vicinity. The system should also be robust and reliable to operate in high altitude and humid environments. The airspace around the test-bed is known to be highly unpredictable.

None

No

Design and Software Development

NA

### A UAV Fleet Management in Remote Areas

**C767**

**Design**

Assoc Prof Marcelo H. ANG Jr

The objective of this project is to implement and design the launch and landing infrastructure for a fleet of unmanned aerial vehicles (UAV) and deploy a small cargo transportation service for the needs of a rural area in a vast and hard-to-reach region. The system should be capable of receiving the incoming UAV and allow each it to land precisely at separate landing sites. It is expected to implement land-based GPS systems that have centimeter range accuracy and able to allow UAVs to home into the landing site.

None

No

Design

NA

### Moving Object Detection around an Autonomous Vehicle

**C768**

**Design**

Assoc Prof Marcelo H. ANG Jr

Perception in an important capability of an autonomous vehicle to allow its efficient motion across a dynamic environment. This project aims at develop algorithms to detect moving objects around an autonomous vehicle. A dynamic vision sensor will used as the main sensing modality. The output of the algorithm are the relative position of each moving objects and the direction of its motion. This part of the SMART-NUS Autonomous Vehicles project, in which autonomous vehicles operating in real-life environments are available as experimental platforms.

None

Yes (SMART)

Software development

NA
Air vehicles or drones have been increasing in popularity and use, mainly for surveillance and monitoring. Most commercial-off-the-shelf quadcopter platforms today do well in streaming high quality imagery and recording. But their usefulness will be very much increased if they are able to do some actions while in motion. Such actions include spraying of chemicals, cutting, or other types of actions done on areas that are not easily accessible except via such drones.

The project aims at equipping a commercial off-the-shelf quadcopter with a tool and a vision system for teleoperation of the tool to perform a required action on the environment. The user interface will also be designed for the remote teleoperation of the system.

**EB1763** Biological cell study in microfluidics

- **Project Code**: EB1763
- **Title**: Biological cell study in microfluidics
- **Contact Author**: Assoc Prof Palani Balaya
- **Assist Author**: Assist Prof Rajeev Kumar
- **Student**: Single cell flow study in microchannels
- **Faculty**: EBTS
- **School**: NUS Mechanical Engineering
- **Discipline**: Mechanical
- **Availability**: January AY2015/16
- **Description**: The student will be expected to come up with an easy-to-assemble and inexpensive design of any one of the following cells used for non-aqueous battery research (such as for lithium-ion or sodium-ion batteries): three-electrode cell, three-electrode cell, three-electrode cell meant for XRD study/prismatic cell meant for commercial-scale battery. The student will be guided by an experienced researcher in these batteries. The guidance will come from the point of view of technical requirements of these cells. Hence, the student is expected to be well versed with lab to self-learn techniques used for product designing and manufacturing.

**FM14** Contact dynamics between two parallel inverted foils flapping in mean flow

- **Project Code**: FM14
- **Title**: Contact dynamics between two parallel inverted foils flapping in mean flow
- **Contact Author**: Assoc Prof Rajeev Kumar
- **Assist Author**: Assist Prof Rajeev Kumar
- **Student**: Single cell dynamics in microchannels
- **Faculty**: EBTS
- **School**: NUS Mechanical Engineering
- **Discipline**: Mechanical
- **Availability**: January AY2015/16
- **Description**: The self-excited flapping of thin flexible foil is of interest for its energy extraction, efficient propulsion, and the next generation aerospace vehicles. This proposal focuses on the flapping stability and response of foil structures of high extensional rigidity and low bending rigidity. The project will use in-house solver for coupling the Navier–Stokes equations to thin-membrane dynamics of arbitrarily large oscillation.
**FM21** Surrogate Reduced-Order Aerodynamic and Aeroelastic Modeling with Parameter Variations

**FM**

Dynamic systems such as aircraft vehicles undergoing Fluid-Structure-Interaction (FSI) are subject to variations in multiple parameters. For example, structural stiffness and mass distributions, payload, air density, air speed, and Mach number could change from one flight condition to another. In this study, the student will focus on the effect and impact of the parameter changes on the structural and aeroelastic behaviour of the aircraft. The student will undertake (a) a literature review on theory of fluid-structure interaction, (b) develop a computational model for fuselage, (c) develop a computational model for aeroelastic behavior, (d) develop a computational model for propulsion, and (e) develop a computational model for aeroelastic behavior. The prospective student is recommended to read the module ME6523 in Semester 4.

**Aeronautical Engineering**

No

Computing and analysis

Introductions to computer programming.

**FM43** A fluid model for plasma-driven flow

**FM**

Plasma refers to the state of a fluid when its electrical properties become significant. Fluids subject to high electric or magnetic field may display electrical-related properties. On the other hand, electrical charges may be discharged into a fluid to render it sensitive to an electric field. In this project, the student will undertake (a) a literature review on theory of plasma fluid and (b) develop a computational model for plasma-driven flow in a box or simple (Poiseuille) channel flow. The prospective student is recommended to read the module ME6423 in Semester 1.

**Aeronautical Engineering**

No

Computing and analysis, Software development

Completed MES: Knowledge of fluid mechanics, beam theory and computer programming.

**FM44** Flow past a flexible surface.

**FM**

Waves are formed when air or water flows past a flexible surface - e.g. the fluttering of a flag in a wind. This project investigates the hydroelastic interaction of flow with a flexible surface. The flow will be modeled by a simple panel method, while the wall will be represented by a simple membrane or plate model. The effects of wall properties (such as stiffness and damping) on the formation of waves will be investigated. This project may be done on a regular PC or laptop. The prospective student is recommended to read the module ME6423 in Semester 1.

**Aeronautical Engineering**

No

Computing and analysis, Software development

Completed MES: Knowledge of fluid mechanics, beam theory and computer programming.

**FM48** Friction based serpentine bio-locomotion

**FM**

Friction is required for most locomotion in nature. Thus may a snake slither along due to frictional contacts between parts of its body and the ground. The project seeks to firstly set up a simple dynamic model for a snake based on multi-linked representation of its slithering body. The crawling/slithering motion of the model snake will be studied based on various friction models (such as Coulomb and viscoelastic friction). This study will allow us to understand better how slithering motion may be driven and controlled. The student needs to be familiar with the application of Newtonian dynamics and computation. This project may be done on a regular PC or laptop.

**Aeronautical Engineering**

None

Computing and analysis, Software development

Completed MES: Knowledge of mechanics/dynamics and computer programming.

**FM75** Kinematic simulation of natural convection by Immersed Boundary-Lattice Boltzmann Flux Solver

**FM**

Natural convection heat transfer from a body to a finite space enclosing it has a lot of industrial applications, which include reactor design, cooling of electric equipment, aircraft cabin insulation and thermal storage systems. In this project, the student will simulate the natural convection in a confined region by using our newly-developed immersed boundary-lattice Boltzmann flux solver. It is advised that the student has some basic knowledge in fluid mechanics and numerical computation to do this project.

**Aeronautical Engineering**

None

Computing and analysis

NA

**FM76** Numerical Simulation of Compressible Flows by Using Lattice Boltzmann Flux Solver

**FM**

The compressible flow is often appeared in aerospace engineering, which may have strong shock waves. From numerical point of view, it is a challenging task to accurately capture the strong shock waves and the boundary layers for simulation of compressible flows. In this project, the student will use our newly-developed lattice Boltzmann flux solver to simulate compressible inviscid and viscous flows. It is advised that the student has some basic knowledge in fluid mechanics and numerical computation to do this project.

**Aeronautical Engineering**

None

Computing and analysis

NA

**MN22** Numerical and experimental analysis: Micro laser joining of dissimilar materials

**MN**

Laser material processing has been widely used in industry. In this project, you will focus on micro laser joining process. Two different materials, i.e. dissimilar metals or metal/polymer materials, will be joined by using a pulse wave solid state laser source. You will learn how to investigate the effect of processing parameters in determining joint quality as well as be trained for simulating the micro laser joining process. In the end of the project, you will gain knowledge and experience on laser joining and on quality evaluation of joints. The prospective student is recommended to read the module ME6233 in Semester 1.

**Automotive Engineering**

Yes (A*) - Simtech

Hybrid i.e. mixtures of experimental and theoretical, or experimental and numerical software.

GPA: 4.0 (maximum). Basic knowledge on numerical simulation or CAD/CAM.

**MN24** Development of a 3D Food Printing Machine with Additive Manufacturing

**MN**

3D Food Printing is a process of making three-dimensional food by virtually any shape layer by layer from a 3D digital model. It offers a range of potential benefits. It can be healthy and good for the environment because it can help to convert alternative ingredients such as proteins into tasty products. It also open the door for food customization and therefore tune up with individual needs and preferences. In addition, 3D food printing holds great promise for nutrition. In this project, you will develop a prototype of the new 3D food printer for a selected food.

**None**

Lab investigation, Design, Feasibility/case studies

NA
<table>
<thead>
<tr>
<th>Project Title</th>
<th>Supervisor(s)</th>
<th>NA1</th>
<th>NA2</th>
<th>NA3</th>
<th>NA4</th>
<th>NA5</th>
<th>NA6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure Prediction in Augmented Reality Environment</td>
<td>Prof Andrew YC Nee</td>
<td></td>
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<td></td>
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<tr>
<td>Depth camera based rehabilitation system with bare hand detection</td>
<td>Assoc Prof Ong Soh Khim</td>
<td></td>
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</tr>
<tr>
<td>Augmented Reality Product Visualization based on 3D CAD Model</td>
<td>Assoc Prof Ong Soh Khim</td>
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</tr>
<tr>
<td>Development of Product Disassembly Sequence Generation Algorithm based on 3D CAD Model</td>
<td>Assoc Prof Ong Soh Khim</td>
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<td></td>
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</tr>
<tr>
<td>An Interactive Augmented Reality Work Cell for Programming Robot Tasks</td>
<td>Assoc Prof Ong Soh Khim</td>
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<tr>
<td>Interactive stereo-aware for Free-form Surface Modelling Methods</td>
<td>Assoc Prof Zhang Yunfeng</td>
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</tr>
<tr>
<td>Hybrid machining for complex part repair - laser cladding and 5-axis machining</td>
<td>Assoc Prof Zhang Yunfeng</td>
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</tr>
<tr>
<td>Developing an AR tool to collect information data of an object</td>
<td>Prof Andrew YC Nee</td>
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</tr>
</tbody>
</table>

**MN32**

Based on computer-aided analysis, sensor and augmented reality (AR) **technology**, a system will be developed to predict possible failure scenarios of a product and its visualization. Finite element analysis can predict crack generation and propagation by using recorded sensor data, while mobile AR environment provides an immersive way for user to visualize the scenario. The project will start with the study of the concept of AR, followed by the FE analysis of failure prediction. Programming skill is needed to illustrate how the integration works.

**MN33**

This system is to provide entertaining rehabilitation programs based on a hand and arm detection platform. The hand and arm features will be tracked using 3 cameras. With the 3D information of the hand and arm, more entertaining and intuitive virtual and augmented reality games can be developed to promote the rehabilitation progress. OpenGL will be used to render the virtual objects based on the 3D information. Creative encouraging schemes, such as visual/audio/tactile feedbacks, may be developed to encourage the repetitive exercises.

**MN34**

About two out of every 1,000 newborns develop cerebral palsy and by 8 years old, one in 276 children suffer from it. Cerebral palsy causes motor, sensory, and learning dysfunction that hinders the ability of children to play and communicate and hence this condition affects their development. The student is to help design and prototype a stimulating and active play and learning environment that helps the child to interact with toys and learning materials as well as with other children by embedding sensors and actuators in the environment.

**MN35**

Disassembly is an important domain in product maintenance and remanufacturing. Conventionally, product disassembly is performed manually based on experience. During disassembly process, several problems such as noisy components and more than one disassembly routes will increase the complexity of a disassembly task. Effective disassembly sequence with minimal time and error is essential to improve the efficiency of maintenance and remanufacturing process. In this project, student is required to conduct a comprehensive survey on the development of the hybrid machining tools, as well as critical problems such as rusty components and more than one disassembly routes. Effective disassembly sequence based on 3D model of the product will be generated using optimization algorithms. C++/Java software development is required to complete this project.

**MN36**

Computer aided design (CAD) is an important module during early phase of product development cycle. CAD designers will create 3D model of the product based on the specifications given by the engineers. Often, the designers and engineers will communicate to improve the product design in a back-and-forth manner. In this project, the student is required to develop a realistic visualization of the 3D CAD model in real-time. This interface will serve as a common product design platform for both designers and engineers, which will increase the efficiency and promote effective communication during the product development cycle.

**MN37**

The programming of industrial robots is time-consuming and requires skilled programmers. This project utilizes task-based and visual programming in an augmented reality environment to simplify the programming process. An augmented reality robotic work cell will be constructed to allow the programmer to interact with the objects contained therein for the planning and programming of robotic tasks. A computer application will be developed to make use of RGB-D cameras to reconstruct and label objects in the work cell as workpieces, obstructions, etc. User interactions with these objects will generate robot trajectories to complete tasks. This project will require C++/Java programming.

**MN38**

Interactive stereo-aware for Free-form Surface Modelling Methods

- Geometric modeling, surface parametric modeling methods are available for representing free-form surfaces, each having its characteristics. For the students who study this subject, it is much desirable to have an interactive graphical aid that helps visualize these methods with a user-friendly interface. In this project, an interactive stereo software is to be developed to demonstrate the characteristics of various surface models, and composite surface construction methods.

**MN39**

Hybrid machining for complex part repair - laser cladding and 5-axis machining

- For repair parts with complex geometries, hybrid machining (laser cladding and 5-axis milling) has emerged as a very promising technique. In this project, the student is expected to conduct a comprehensive survey on the development of the hybrid machining tools, as well as critical issues on laser cladding, 5-axis path generation, and final inspection.

**MN65**

Augmented Reality (A.R.) is a tool that has been gaining traction in helping investigators during the investigation of a potential crime scene. This project aims to develop an A.R. technique to help to collect the necessary deformation data of a deformed object. Prospective student are expected to develop techniques with the help of AR to help annotate key features on the deformed object which may provide a clue as to how deformation has occurred. Prospective student may need to make use of point cloud cameras to help with the investigation.

**Software development requirements**

- C++/Java programming
- Basic knowledge of sensors
- Basic knowledge of microcontrollers and circuits.

**Software development tools**

- Microsoft Visual Studio
- SolidWorks

**Hardware requirements**

- Computer
- Programming (C++/Java)
- Practical project experience in Augmented Reality

**Software development**

- Theoretical, or experimental and numerical/software.
<table>
<thead>
<tr>
<th>Project Code</th>
<th>Project Title</th>
<th>Faculty/Instructor</th>
<th>Principal Investigator</th>
<th>Project Description</th>
<th>Background Knowledge</th>
<th>Skills Required</th>
<th>Computing &amp; Analysis</th>
<th>Software Development</th>
<th>Other Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MN56</td>
<td>Estimation of the force/energy exerted on a deformed object using a point cloud camera (Kinect Camera)</td>
<td>Prof Andrew Yeow</td>
<td>Assoc Prof Ong Soh Khim</td>
<td>The Kinect Camera is a cheap RGB-D camera solution that can be used to obtain the depth information of an object from an image and present it in the form of a point cloud. Proposed project aims to explore the use of this point cloud information to estimate the deformation of an object. This information ideally is to be used to estimate the energy required to result in the deformation observed. Prospective student choosing this project are expected to develop a feasible method in which this energy can be estimated from the depth information extracted from the point cloud.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis</td>
<td>Software development</td>
<td>Basic mechanical knowledge and a reasonable level of programming knowledge. CAD software experience will also be beneficial and appreciated.</td>
</tr>
<tr>
<td>MN57</td>
<td>A time-based Optimization of Numerical Simulation Result Visualization</td>
<td>Prof Andrew Yeow</td>
<td>Assoc Prof Ong Soh Khim</td>
<td>Flexible structures are often subjected to large amount of data and are time-consuming to visualize the whole model with lower-level devices. Image-based rendering technique is proposed to reduce the rendering time. In this project, some related details will be studied, then model-based, image-based and student proposed method will be compared.</td>
<td>None</td>
<td>No</td>
<td>Collaborating and Analysis</td>
<td>Software development</td>
<td>C++ programming</td>
</tr>
<tr>
<td>MN58</td>
<td>Real-time Interaction with Flexible Structures in Augmented Reality</td>
<td>Prof Andrew Yeow</td>
<td>Assoc Prof Ong Soh Khim</td>
<td>Flexible structures are often subjected to large amount of data and are time-consuming to visualize the whole model with lower-level devices. Image-based rendering technique is proposed to reduce the rendering time. In this project, some related details will be studied, then model-based, image-based and student proposed method will be compared.</td>
<td>None</td>
<td>No</td>
<td>Hybrid C. mixtures of experiment and theoretical, or experimental and numerical software.</td>
<td>C++ programming using Microsoft Visual Studio. Basics of finite element analysis. Basic knowledge of sensors, microcontrollers and circuits.</td>
<td></td>
</tr>
<tr>
<td>MN59</td>
<td>Crack Modeling in Augmented Reality for Real-time Stress Analysis</td>
<td>Prof Andrew Yeow</td>
<td>Assoc Prof Ong Soh Khim</td>
<td>Cracks may occur in structural components undergoing excessive stresses. To perform stress analysis with FEAs, the cracks should be included in the mesh model. One method is inserting the crack model into the original intact mesh with local re-meshing. With basic AR systems, the student is expected to develop methods and algorithms for interactive modeling of cracks and adapting mesh models. More importantly, the changes of mesh geometry and stiffness matrix should be derived, and used to update the inverse matrix for real-time solution.</td>
<td>None</td>
<td>No</td>
<td>Hybrid C. mixtures of experiment and theoretical, or experimental and numerical software.</td>
<td>Knowledge of computational geometry and linear algebra especially on matrix operations. C++ programming using Microsoft Visual Studio. Basics of finite element analysis.</td>
<td></td>
</tr>
<tr>
<td>MN61</td>
<td>Multi-pass Path Generation in Robotic Welding of Complex Joints</td>
<td>Prof Andrew Yeow</td>
<td>Assoc Prof Ong Soh Khim</td>
<td>Robotic welding usually requires computer-based simulation using virtual robot prior to transferring the welding paths into actual robot motions. The Robot Operating System (ROS) presents a flexible framework for robot software development. The objective of this project is to develop a virtual environment for robotic welding simulation. By defining the welding paths on the virtual workspace, the virtual robot should be able to simulate the robot motions by following the paths accurately and smoothly. Furthermore, a graphical-user interface will be necessary such that the welding parameters can be tuned and reflected during simulation. This project requires C++ programming.</td>
<td>None</td>
<td>No</td>
<td>Software development</td>
<td>A reasonable level of C++ programming knowledge. CAD software experience will also be beneficial and appreciated.</td>
<td></td>
</tr>
<tr>
<td>MN62</td>
<td>Robotic Welding Simulation In The Robot Operating System (ROS)</td>
<td>Prof Andrew Yeow</td>
<td>Assoc Prof Ong Soh Khim</td>
<td>Robotic welding usually requires computer-based simulation using virtual robot prior to transferring the welding paths into actual robot motions. The Robot Operating System (ROS) presents a flexible framework for robot software development. The objective of this project is to develop a virtual environment for robotic welding simulation. By defining the welding paths on the virtual workspace, the virtual robot should be able to simulate the robot motions by following the paths accurately and smoothly. Furthermore, a graphical-user interface will be necessary such that the welding parameters can be tuned and reflected during simulation. This project requires C++ programming.</td>
<td>None</td>
<td>No</td>
<td>Software development</td>
<td>A reasonable level of C++ programming knowledge. CAD software experience will also be beneficial and appreciated.</td>
<td></td>
</tr>
<tr>
<td>MN63</td>
<td>Simulation of EDM Machining Condition by Matlab or other software</td>
<td>Prof Nathan Mustakir</td>
<td>Andrew Yeow (MakeIn Machine Co.)</td>
<td>An attempt will be made in this study: 1. To understand how WEDM machining condition list is being constructed. 2. To use Matlab or other software to simulate EDM machining condition.</td>
<td>None</td>
<td>No</td>
<td>None</td>
<td>Year (MakeIn Machine Co.)</td>
<td>Hybrid C. mixtures of experiment and theoretical, or experimental and numerical software.</td>
</tr>
<tr>
<td>MN64</td>
<td>Temperature Control of a 3D Plastic Injection Printing Machine for Mechanical Parts</td>
<td>Assoc Prof Lu Wen Peng</td>
<td></td>
<td>3D plastic injection printing machine provides the flexibility with the usage of various plastic materials and geometries of 3D printed part. In this project, student will continue to improve the existing 3D plastic injection printing machine with temperature control. Temperature control is one of the critical issues to print various plastic parts. In this project, student will improve the integrated system, e.g., installing virtual hoses or cables on a real machine.</td>
<td>None</td>
<td>No</td>
<td>Field testing and instrumentation Design</td>
<td>Automotive Engineering</td>
<td>No</td>
</tr>
<tr>
<td>MS01</td>
<td>Molecular modeling for organic electrodes for Na ion batteries</td>
<td>Assist Prof Sergei Margach</td>
<td></td>
<td>You will use computer modeling to study compounds which are promising for use in organic Na ion batteries, which hold the promise of sustainable and scalable electricity storage.</td>
<td>None</td>
<td>No</td>
<td>None</td>
<td>Computing and Analysis</td>
<td>The project requires interest in computer modeling and ability to learn new software tools and concepts behind them.</td>
</tr>
<tr>
<td>MS02</td>
<td>Molecular modeling for organic electrodes for Li ion batteries</td>
<td>Assist Prof Sergei Margach</td>
<td></td>
<td>You will use computer modeling to study compounds which are promising for use in organic Li ion batteries, which hold the promise of sustainable and scalable electricity storage.</td>
<td>None</td>
<td>No</td>
<td>None</td>
<td>Computing and Analysis</td>
<td>The project requires interest in computer modeling and ability to learn new software tools and concepts behind them.</td>
</tr>
<tr>
<td>MS03</td>
<td>Computer design of materials for organic solar cells</td>
<td>MS</td>
<td>Assist Prof Sergei Marchenko</td>
<td>You will use computer modelling to compare properties of CdO and CdSe based acceptor materials with different functionalisations, which hold promise to improve the performance of organic solar cells.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis</td>
<td>The project requires interest in computer modeling and ability to learn new software tools and concepts behind it.</td>
<td></td>
</tr>
<tr>
<td>MS04</td>
<td>Simulations of vibrational spectra of mercury compounds</td>
<td>MS</td>
<td>Assist Prof Sergei Marchenko</td>
<td>You will compute and compare vibrational spectra of different Hg-containing molecules and their dependence on isotope. This is critical for both detection and manipulation of Hg compounds which are at the same time toxic and needed in many technologies.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis</td>
<td>The project requires interest in computer modeling and ability to learn new software tools and concepts behind it.</td>
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</tr>
<tr>
<td>MS05</td>
<td>Modeling of cell-penetrating peptides</td>
<td>MS</td>
<td>Assist Prof Sergei Marchenko</td>
<td>Kinetic simulations of structure and dynamics of cell-penetrating peptides, whose understanding and control are important for a range of biomedical applications.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis</td>
<td>The project requires interest in computer modeling and ability to learn new software tools and concepts behind it.</td>
<td></td>
</tr>
<tr>
<td>MS06</td>
<td>Modelling of pristine blue analogues as potential battery electrode materials</td>
<td>MS</td>
<td>Assist Prof Sergei Marchenko</td>
<td>Blue analogues are promising electrode materials for printed lithium ion batteries; however, the mechanism of their operation is not well understood. You will use computer simulation techniques to study key atom interactions with these materials.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis</td>
<td>The project requires interest in computer modeling and ability to learn new software tools and concepts behind it.</td>
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</tr>
<tr>
<td>MS07</td>
<td>Computer modeling of aluminum anodes for lithium ion batteries</td>
<td>MS</td>
<td>Assist Prof Sergei Marchenko</td>
<td>Aluminum has been studied experimentally as a promising anode for Li-ion batteries, yet there are no computational studies that would help understand and improve such anodes. You will model lithiation of aluminum using a novel ab initio methodology.</td>
<td>None</td>
<td>No</td>
<td>Computing and Analysis</td>
<td>The project requires interest in computer modeling and ability to learn new software tools and concepts behind it.</td>
<td></td>
</tr>
<tr>
<td>MS29</td>
<td>Nanoscale Adhesion Measurement with Atomic Force Microscopy</td>
<td>MS</td>
<td>Assoc Prof Xing Kayang</td>
<td>Atomic Force Microscopy (AFM) is a powerful nanoscale surface characterization technique, which has been intensively used in R&amp;D and solar cell / solar panel manufacturing process qualification. It has a wide range of applications in dimensional measurement and nanoscale material characterization, especially for nanoscale structures with variations in mechanical and physical properties (e.g., modulus, adhesion, electrical conductivity, etc.). This project focuses on adhesion measurement of Ag nanorods on polymer film. Transparent flexible, conductive film with Ag nanorods is a good candidate to replace ITO as transparent electrode for flexible solar cell solar panel. Adhesion of Ag nanorods on the flexible polymer film is critical to affect the function and performance of the transparent electrode. In this project, the student will investigate the feasibility of adhesion measurement of Ag nanorods on the flexible conductive polymer film with AFM.</td>
<td>None</td>
<td>Yes (A*) - Simtech</td>
<td>Laboratory Investigation</td>
<td>Composites</td>
<td></td>
</tr>
<tr>
<td>MS32</td>
<td>Understanding the Scanning Probe Microscopy experiments and Analysis</td>
<td>MS</td>
<td>Assoc Prof Xing Kayang</td>
<td>The project aims to develop the analysis methodology for the images obtained from Scanning Probe Microscopy (SPM) based techniques. In particular, the energy dissipation during the SPM scanning is related to the changes of surface properties and compositions. The project will use certain analysis methodologies to develop the analysis, such as how does the energy dissipation is related to composition changes or phase transformation of the materials, how does the electrochemical reaction would affect the energy dissipation processes during the SPM images and analysis. The student will work closely with the Ph.D students in the lab during this project.</td>
<td>None</td>
<td>No</td>
<td>Laboratory Investigation, Hybrid i.e. mixture of experimental and numerical/software</td>
<td>Materials Science and Engineering, Physics</td>
<td></td>
</tr>
<tr>
<td>MS38</td>
<td>Fabrication of battery-supercapacitor using asymmetric design</td>
<td>MS</td>
<td>Prof Lu Li</td>
<td>For supercapacitors, increasing the operating voltage in electrolytes is a very vital factor because the energy density of these devices is proportional to the square of the operating voltage. As well known, the working voltage in aqueous solution can only be 1.0 V, while the value can be up to 4.0 V in non-aqueous electrolytes. This project will aim at constructing battery-supercapacitor new hybrid power system in different organic electrolytes.</td>
<td>Energy and Sustainability</td>
<td>No</td>
<td>Laboratory Investigation</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>MS48</td>
<td>Processing Based Optimisation of Microstructure and Properties of Metals</td>
<td>MS</td>
<td>Assoc Prof Manoj Gupta</td>
<td>The project will aim to develop light weight metal based materials through different processing routes. Microstructure will be evaluated using microscopy techniques. Mechanical properties characterization will be performed to assess the best processing method.</td>
<td>Automotive Engineering</td>
<td>No</td>
<td>Feasibility/case studies</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>MS49</td>
<td>Porous and Nitrogen doped carbon nanofibers electrocatalysts for oxygen reduction and oxygen evolution reactions</td>
<td>MS</td>
<td>Prof Seeram Ramakrishna</td>
<td>The oxygen reduction (ORR) and oxygen evolution reactions (OER) are kinetically challenged necessitating effective and selective catalysts. Recent studies have shown that ORR and OER can be accelerated by effective nano-structured catalysts. In this project, we will prepare porous and nitrogen doped carbon nanofibers based on electrospinning method which can improve the electrocatalyst activity significantly. Furthermore, the porous and nitrogen doped carbon nanofibers will also be applied in aqueous lithium-air batteries.</td>
<td>Energy and Sustainability</td>
<td>No</td>
<td>Laboratory Investigation</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>MS50</td>
<td>Electrospun carbides electrocatalysts for oxygen reduction reaction</td>
<td>MS</td>
<td>Prof Seeram Ramakrishna</td>
<td>Nanomaterial catalysts are attracted wide attentions due to their significant potential application in both fuel cell systems and metal-air batteries. In this regard, nanosize non-noble metal catalysts are prepared by a electrospinning method followed by heat treatment at elevated temperatures. The obtained catalysts will show high electricity for the ORR with a high stability in alkaline media due to their unique nanofiber structures.</td>
<td>Energy and Sustainability</td>
<td>No</td>
<td>Laboratory Investigation</td>
<td>NA</td>
<td></td>
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<tr>
<td>MS51</td>
<td>Electrospun Fe, Co and Ni nanofibers as the electrocatalysts for aqueous lithium-air batteries</td>
<td>MS</td>
<td>Prof Seeram Ramakrishna</td>
<td>The development of non-noble metal catalysts is of great importance due to their significant potential application in lithium-air batteries. Fe, Co, and Ni are promising candidates for their natural abundant and lower price. In this project, Fe, Co, and Ni nanofibers will be synthesized by an electrospinning method followed by heat treatment at elevated temperatures. Due to the unique nanofiber structure, the obtained metal catalyst will surely show an improved electrocatalyst activity in the application of aqueous lithium-air batteries.</td>
<td>Energy and Sustainability</td>
<td>No</td>
<td>Laboratory Investigation</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>MS52</td>
<td>Hybrid nanoparticles for the controlled release of biomolecules for cardiac restoration therapy</td>
<td>MS</td>
<td>Prof Seeram Ramakrishna</td>
<td>Changing lifestyles and stress caused by urbanization are further contributing to the increased cases of myocardial infarction that eventually lead to congestive heart failure. Every day, 15 people die from cardiovascular diseases (heart disease and stroke) in Singapore. Approximately, 1 out of 3 deaths in Singapore is due to heart disease or stroke (source: myheart.org.sg). Cardiovascular diseases (CVD) are the single leading cause of death globally. Current therapeutic approaches used to treat patients with chronic heart failure include pharmacologic therapies, mechanical devices, and surgical intervention, but however, heart transplantation remains the only possible solution for end-stage heart failure. The ultimate goal of the nanoparticle design is the production of an ideal structure that can replace the natural extracellular matrix until host cells can repopulate and resynthesize a new natural matrix. Electrospray functionalized nanoparticles with biologically significant polymers are of interest due to their good biocompatibility and mechanical properties for cardiac restoration therapy.</td>
<td>None</td>
<td>No</td>
<td>Laboratory Investigation</td>
<td>NA</td>
<td></td>
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<tr>
<td>MS53</td>
<td>Chinese herbal medicine encapsulated nanostructures to cure neurodegenerative disease: fabrication &amp; characterization</td>
<td>MS</td>
<td>Prof Seeram Ramakrishna</td>
<td>Based on electrospinning and electrospraying techniques, Chinese herbal medicine (wolfberry) encapsulated nanofibers and nanoparticles will be fabricated and characterized.</td>
<td>None</td>
<td>No</td>
<td>Design</td>
<td>NA</td>
<td></td>
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