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M&M Post-Graduate Topics

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Mrs Liora Ginsberg
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- **Research Field**
  Biomedical engineering - Microcirculation flow pattern in the lymph
- **General Description of Research Field**
  The lymphatic system is an important biological system, with main functions of immunity and transportation of excess fluid from amongst the capillaries in the loose connective tissue into the vascular system. Much research has been conducted on the flow patterns of the circulatory system, into which the lymphatic system flows, however little has been attempted on the lymphatic system.

  Parametric studies and numerical modelling of the micro-circulation of specific regions of the lymphatic system need to be conducted. The project takes place in the context on on-going final year projects and a PhD study.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Studies of lymph micro-circulation Study of the micro flow of the lymph in the lymphatic network. Use of CFD to model the micro flow movement of the lymph within a lymphatic segment / duct. **Requirements:** CFD		✓		
Comfort bed for premature babies Background: Kangaroo mother care is a method of care of premature infants. The method involves infants being carried, usually by the mother, with skin-to-skin contact. There is evidence that this method of care greatly helps in the development of the baby. The baby will be able to get warmth from the mother, feel her heart beat and breathing, hear her voice and of course cuddle on her body. However, this is not always possible immediately after birth. The mother may still be in recovery or she may be undergoing surgery. Problem: For premature babies born in rural hospitals, that need not go to a secondary or tertiary hospital, a comfort bed is needed that best approximate the experience the baby would have had with the mother. Additionally, the comfort bed should monitor the motion of the baby so that a warning can be given should the baby's condition deteriorate. **Requirements:** Design	✓			✓

Prof Jacomine Grobler
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- **Research Field**
  Algorithm development, optimisation and data science
- **General Description of Research Field**
  Optimisation algorithm development, data science, and machine learning applications for improved decision support.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Identification of tuberculosis in children through an analysis of x-ray images The clinical signs of tuberculosis in children differ from the clinical signs of tuberculosis in adults. A significant amount of research has been done in the identification of tuberculosis, but there is an opportunity for novel research in the detection of tuberculosis in children from x-ray images. A detailed literature review will need to be conducted to identify best practices in tuberculosis identification and image processing techniques already used in this context. Domain experts will also be consulted to obtain a better understanding of the indicators of tuberculosis in children. A dataset consisting of x-ray images will be obtained from Tygerberg Hospital. This dataset will be cleaned and analysed and used to train and test various image processing algorithms with the aim of identifying tuberculosis in the x-ray images. Finally, the results will be validated by domain experts. Other information: Thesis/dissertation to be co-supervised by Prof Pierre Goussard from Paediatrics and Child Health Possible funding available to cover tuition fees. **Requirements:** Previous background in data science and image processing Strong programming skills OR the willingness to develop these skills and background		✓	✓	✓

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Data analytics approach to predicting mortality in a neonatal intensive care unit There are various factors affecting the risk of mortality of neonates in a neonatal intensive care unit (NICU). The aim of this project is to investigate the use of data analytics for predicting this risk. A dataset with various features associated with risk factors is currently being collected at the Tygerberg Hospital NICU. The successful candidate for this topic will need to conduct an extensive literature review of the use of data analytics in the NICU environment. A rigorous process will then need to be undertaken to understand the dataset characteristics. The use of various predictive analytics algorithms such as neural networks and support vector machines, will then need to be investigated. Finally, the results will be validated by domain experts. Other information: Thesis/dissertation to be co-supervised by Prof Lizelle van Wyk from Paediatrics and Child Health Possible funding available to cover tuition fees. **Requirements:** Previous background in data science and image processing Strong programming skills OR the willingness to develop these skills and background		✓	✓	✓

Mr Shival Indermun
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- **Research Field**
  Robotics and Biomedical Engineering
- **General Description of Research Field**
  My research focuses on the advancement of autonomous robotic visual navigation within hospital environments, with a primary objective of supporting healthcare professionals and enhancing patient care. The central theme of my work is the integration of diverse data sources to enable precise robotic perception and navigation in highly dynamic settings. By leveraging concepts from computer vision, SLAM (Simultaneous Localization and Mapping), data association, and semantic data extraction. Additionally, I am engaged in biomedical engineering research, specifically collaborating with orthopaedic surgeons to optimize surgical planning. This involves utilizing software such as 3Dslicer to segment crucial areas from patient CT or MRI scans, followed by 3D printing to create accurate anatomical models. The ultimate aim of this interdisciplinary research effort is to provide surgeons with valuable tools for pre-operative planning and potentially offer haptic feedback through these 3D models.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Optimizing sterilization techniques and parameters for ensuring structural integrity of 3D-printed patient-specific PLA orthopaedic models The utilization of 3D-printed patient-specific orthopaedic models for medical purposes requires rigorous sterilization procedures to be used as a reference during procedures. This research aims to address the challenge of sterilizing PLA-based 3D-printed models without causing deformation or melting. Dr Rudolph Venter, currently runs the AOTC 3D printing lab, where he segments and 3D prints patient cases for operational rehearsals. See current link - http://www.sunorthopaedics.com/3d-printing-lab.html The research is aimed at identifying the optimal sterilization approach and process conditions (post). The research aims to provide healthcare professionals with safe and sterilized 3D-printed models for preoperative planning, medical education, and research, expanding the applications of 3D printing in the medical field. **Requirements:** Given the interdisciplinary topic, students may be be required to work with the AOTC Lab in Tygerberg Hospital. Knowledge of FDM 3D printing is advantageous, but not a prerequisite.		✓		

Dr Marisa Klopper
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- **Research Field**
  Tuberculosis
- **General Description of Research Field**
  My studies involve epidemiology of drug-resistant tuberculosis, as well as diagnostic tools, molecular drug-resistance mechanisms and M. tuberculosis physiology. Culturing of mycobacteria is central to these studies.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
1. Declumping system for bacterial cultures Bacteria often form biofilms, or, as we call it in mycobacterial research, clumps*, which means that the bacteria stick to each other by producing extracellular glue consisting of sugars, proteins and fatty acids. This makes it difficult to conduct work where precise enumeration of the bacteria is necessary, for example infection studies, where we need to know how many bacteria we introduce into the culture, per mammalian cell (a.k.a. multiplicity of infection, or MOI). Clumps also make it difficult to quantify how much of a compound is metabolized or produced per bacterial cell, from one strain to a next. The current practice to get rid of clumps, is to either sonicate the bacterial culture (not very effective), or to go through a series of steps where the culture is forced through progressively smaller apertures. Typically, this entails "syringing" up and down several times, using different sized needles, followed by forced filtration or gravitational straining. This is more effective than sonication, but is very time-consuming and has a risk of needle-stick injury or other accidents such as spills. It also tends to result in large losses of bacterial matter. The aim of the project is to develop a safe, effective (i.t.o. processing time and of achieving single cells) way of declumping bacterial culture with minimal losses. Different approaches may be investigated, such as combining techniques, using different types and sizes of apertures/pores, incorporating closed systems, automation, etc. *Technically, a biofilm adheres to a surface. In mycobacterial cultures, we see bunches of cells floating in the media as well. **Requirements:** Creative thinking.		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
2. Lossless optical density measurement of bacterial cultures Optical density (OD) measurements are typically used in bacterial culturing to monitor growth over time. However, it usually entails removing 1 ml of culture for every measurement. The volume is added to a non-sterile cuvette (high quality clear plastic) and placed in a spectrophotometer. Because the cuvette is typically not sterile, this volume cannot be replaced into the culture. Culturing is usually done in either 5ml (for starter cultures) or 20ml volumes, and the growth rate depends on the volume of culture, to some extent. Thus, every time an aliquot is removed to measure OD, the dynamics of growth may change. Further, there is a small risk of introducing contamination each time the culture flask is opened. The aim of the project is to devise a different way of measuring OD, to reduce risk of contamination, and to obviate the need for removing volumes of culture. **Requirements:** Basic knowledge of optics; creative thinking.		✓		

Prof Ryno Laubscher
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- **Research Field**
  Thermal-fluid dynamics
- **General Description of Research Field**
  Fundamental and applied research in combustion systems, heat exchangers and power cycles. Additionally my research focusses on the development of novel AI-based partial differential equation solvers for thermal-fluid problems.

Topics	**MEng Struct**	**MEng Resrch**	**PhD**	**Potential Funding**
A finite volume procedure for human cardiovascular system modelling In this project a 1D FVM network code will be developed by the student, which is capable of simulating blood flow through the systemic and pulmonary networks of the human cardiovascular system. The code should include the ability to simulate the fluid structure interaction between the arterial and venous walls and the blood flow. The newly developed 1D code will be validated using simplified artery/vein CFD models. **Requirements:** BEng Mechanical		✓		

Prof Josua Meyer
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- **Research Field**
  Heat transfer

- **General Description of Research Field**
  Heat transfer conveys energy from a high temperature to a lower temperature. The mechanisms of heat transfer are defined as conduction, radiation and convective. In convective heat transfer the heat transfer might be external forced convection, internal forced convection, or natural convection. Heat transfer has many applications and happens everywhere.

  The human body is constantly generating and/or rejecting heat by metabolic processes and exchanged with the environment and among internal organs by conduction, convection, evaporation, and radiation. Heat transfer is also one of the most important factors to consider when designing household appliances such as a heating and air-conditioning system, refrigerator, freezer, water heater, personal computer, mobile phone, TV, etc.

  Heat transfer also occurs in many other applications such as in car radiators, solar collectors, orbiting satellites, etc. However, one of the most important applications is in the generation of electricity which can happen in fossil fuel power plants, nuclear power plants or concentrating solar plants. The heat transfer during the generation of electricity happens in heat exchangers which normally has at least one passage through which a fluid flows. The passage geometry can be as simple such as a circular tube or it can have a very complex geometry with fins that not only enhances the heat transfer but induces flow rotation which reduces the size of the heat exchanger.

  For all these configurations empirical correlations are required for design and analyses purposes that can be used to estimate heat transfer rates. To develop thousands of empirical equations are not desirable as we first need to have a better understanding of the fundamentals and flow phenomena. Furthermore, different flow regimes (laminar, transitional or turbulent) normally each require its own empirical equations. Thus, to be able to understand complex heat transfer flow phenomena in complex geometries we must first understand what happens in simple geometries, such as in circular tubes.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Developing flow in smooth circular horizontal tubes with a uniform wall temperature; forced and mixed convection. Relevant to concentrated solar power (CSP) generation and heat transfer in blood vessels through human organs. A lot of work has been conducted in the field of heat transfer in circular tubes. Most of this work was limited to forced convection flow through horizontal tubes, and with fully developed flow. Thus implying that the flow was both hydrodynamically and thermally fully developed. However, forced convection occurs very rarely in practical applications. It only occurs for heat transfer in small tube diameters, low heat fluxes and for flow in zero gravity conditions. Therefore, if the heat transfer condition does not satisfy forced convection conditions the heat transfer phenomena would definitely and most probably result in mixed convection. However, no work has been done for mixed convection with a uniform wall temperature during developing conditions. The purpose of this study would therefore be to numerically investigate and compare with CFD in a circular tube developing flow for forced and mixed convection with a uniform wall temperature. **Requirements:** CFD		✓	✓	✓
Local and average heat transfer coefficients for developing single-phase laminar flow in horizontal circular tubes with a constant heat flux boundary condition. Wide range of Prandtl numbers. Relevance: concentrated solar power (CSP) generation and heat transfer in blood vessels through human organs. Correlations to calculate the local and average heat transfer coefficients for single-phase laminar flow in horizontal circular tubes with a constant heat flux are usually restricted to fully developed flow, high Prandtl numbers or constant fluid properties. Recently work has been conducted with water (see URL: 10.1016/j.ijheatmasstransfer.2017.10.070). The purpose of this study is to conduct a similar study, however, using CFD, and as working fluids air and glycol. The reason for air and glycol is that its Prandtl numbers are about an order of magnitude lower and higher than that of water. The equations that were developed in the previous study for water can therefore not be used for a wide range of Prandtl number applications. **Requirements:** CFD		✓	✓	✓

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Local and average heat transfer coefficients for developing single-phase laminar gas and glycol flow in horizontal circular tubes with a uniform temperature boundary condition. Relevant to concentrated solar power (CSP) generation and heat transfer in blood vessels through human organs. Correlations to calculate the local and average heat transfer coefficients for single-phase laminar flow in horizontal circular tubes with a uniform heat flux are usually restricted to fully developed flow, high Prandtl numbers or constant fluid properties. Recently work has been conducted with water (see URL: 10.1016/j.ijheatmasstransfer.2017.10.070). The purpose of this study is to conduct a similar study, however, using CFD, with air and glycol as working fluid. The reason for air and glycol is that its Prandtl numbers are about an order of magnitude lower and higher than that of water. The equations that were developed in the previous study for water can therefore not be used for a wide range of Prandtl number applications and were also developed for a constant heat flux boundary condition – not a uniform wall temperature. In this study a uniform heat flux needs to be used. **Requirements:** CFD		✓	✓	✓
Local and average heat transfer coefficients for developing single-phase laminar gas and glycol flow in horizontal circular tubes with a uniform heat flux boundary condition. Relevant to concentrated solar power (CSP) generation and heat transfer in blood vessels through human organs. Correlations to calculate the local and average heat transfer coefficients for single-phase laminar flow in horizontal circular tubes with a constant heat flux are usually restricted to fully developed flow, high Prandtl numbers or constant fluid properties. Recently work has been conducted with water (see URL: 10.1016/j.ijheatmasstransfer.2017.10.070). The purpose of this study is to conduct a similar study, however, using CFD, with and air and glycol as working fluid. The reason for air and glycol is that its Prandtl numbers are about an order of magnitude lower and higher than that of water. The equations that were developed in the previous study for water can therefore not be used for a wide range of Prandtl number applications and were also developed for a constant heat flux boundary condition – not a uniform wall temperature. In this study a uniform heat flux needs to be used. **Requirements:** CFD		✓	✓	✓

Dr Michael Owen
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- **Research Field**
  Heat transfer, thermodynamics, fluid mechanics
- **General Description of Research Field**
  Overall my research aims to contribute to sustainable production, use and manipulation of thermal energy. I make use of a combination of experimental, numerical (typically by means of CFD) and analytical methods to investigate thermodynamic cycles, thermal energy systems and components at a number of levels including high level feasibility analysis, system testing and analysis and component-level testing and simulation. There is a strong focus on industrial heat exchangers and cooling towers in particular (dry, wet and hybrid), as these systems directly affect thermal power plant efficiency (fossil-fuelled, nuclear and renewable) and have a direct influence on the energy/water nexus.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Simulation of high flow nasal cannula ventilation in infants and children High flow nasal cannula therapy is a non-invasive respiratory therapy that involves delivering humidified respiratory gas (typically rich in O2) to a patient's nasal cavity via a nasal cannula. The therapy improves breathing efficiency but the high flow rates make it relatively expensive and the exact mechanisms through which it works are not well understood. A better understanding of fluid mechanics associated with the therapy has the potential to realize more effective treatment and reduced costs, particularly for therapy in infants and children where there is little literature available. High flow oxygen therapy through nasal cannula (HFNC) is a commonly used method of respiratory support for patients with respiratory failure. Heated, humidified air is blended with oxygen and delivered at high flow rates via a nasal interface. The therapy improves breathing efficiency but the high flow rates make it relatively expensive and the exact mechanisms through which it works are not well understood. Studies of the use of HFNC compared to standard nasal oxygen in infants and children have conflicting results and further analysis is required to refine the use of HFNC. This project involves the numerical simulation (using an appropriate computational fluid dynamics tool) of HFNC in infants and children. A numerical model must be developed and validated against published information (e.g. positive end-expiratory pressure measurements from model-based studies). The model will be used to conduct a parametric analysis which aims to contribute to the understanding of the mechanisms through which the therapy works and to identifying optimal operating parameters. The project will be co-supervised by Dr Andre Gie, a Paediatric Pulmonologist at Stellenbosch University.		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Requirements: This project will suit a candidate with a mechanical engineering background since it is heavily reliant on an understanding of fluid mechanics. CFD will be used as the primary tool in this work and the student should have completed a relevant CFD module (or must complete such a module in the first semester of the MEng programme).				

Prof Willie Perold

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- **Research Field**
  Biosensors
- **General Description of Research Field**
  The Sensor Applications & Nano-Devices (SAND) research group focusses on the development of sensing devices applicable to human disease (cancer, HIV, TB, Covid, etc.), plant disease, animal disease and water and soil pollution. The sensors are fabricated in the nanotechnology-laboratory at Electrical & Electronic Engineering. The research is multidisciplinary by nature.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Development of a membrane-based extreme optical transmission (EOT) device for nucleic acid based testing Extreme optical transmission has recently been shown to be an extremely versatile and sensitive sensing technique for biosensing applications. Various methods of manufacturing such sensors exist, although none are currently economically viable. This project would focus on development and optimization of a membrane-based manufacturing method for such sensors that can be implemented on large-scale. Co-supervision: Prof Anna-Mart Engelbrecht (Physiological Sciences) Collaboration: Joint Institute for Nuclear Research (JINR), industry **Requirements:** Image processing, multiphysics simulation and optimization. Testing and evaluation.		✓		
Developement of a whole-blood fluorescence spectroscopy device with application to point-of-care blood testing More than ever before, the COVID epiemic has made the need for fast, simple and cost-effective point-of-care or household testing processes abuntantly clear. The rise of non-communicable and lifestyle-related diseases has also introduced the need for easily accessible testing. This project would continue development of a test methodology and device to evaluate a patient's inflammatory state and provide information about their health status. The device would make use of whole-blood fluorescence spectroscopy, and focus on building a small and low-cost prototype and also implementing machine-learning processes to better interpret and understand the results from such a test. Co-supervision: Prof Resia Pretorius (Physiological Sciences) **Requirements:** Rapid prototyping, image processing, micro manufacturing, machine learning		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Development of a microbead-based test for diagnosis of infant TB Meningitis TB Meningitis is a largely overlooked threat in developing countries, especially in South Africa. The disease usually goes unnoticed until treatment is no longer useful, and very few testing methods currently exist to address this problem. This project would develop a handheld microbead-based assay to detect and quantify biomarkers associated with TBm in resource constrained settings like South Africa. Co-supervision: Prof Novel Chegou (Immunology Research Group, Tygerberg) **Requirements:** Image processing, machine learning, fluid mechanics, microfluidics		✓		
Development of a multi-bounce spectroscopy device for disease detection and treatment monitoring Fluorescence spectroscopy is a versatile, non-invasive and non-destructive analysis method that has been effectively used to perform a very wide variety of biological tests. However, the required electronics and software for very sensitive measurements can be prohibitively expensive. A potential solution to this is o perform multi-bounce spectroscopy, where the light beam passes through the sample multiple times to enhance the sensitivity of measurements. This project would develop a prototype of such a device to evaluate the method for application to biosensor designs. Co-supervision: Prof Resia Pretorius (Physiological Sciences) **Requirements:** Fundamental physics, micro manufacturing, image processing.		✓		
Detection and separation of circulating tumor cells using microfluidic methods Noncommunicable diseases are becoming more and more prevalent, especially in aging populations. The need for effective methods of diagnosing these diseases is also rising, and much effort is being put towards low-cost microfluidic methods of automating normally labour-intensive tests. This project would develop a device for the detection of circulating tumor cells using state-of-the-art microfluidic methods and simulation models. Co-supervision: Prof Anna-Mart Engelbrecht (Physiological Sciences) **Requirements:** High-frequency electronics, multiphysics simulation and modelling, optimization, micro manufacturing		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Integration of potentiostat measurements with lab-on-chip applications The development of cartridge-based diagnostics and lab-on-chip systems is revolutionizing healthcare diagnostics by reducing the time necessary to develop tests, perform tests and eliminating the need for operators to be involved. However, one of the current shortcomings is that many assays are still qualitative in nature, or involve expensive optical systems for quantification. This project would focus on implementing a low-cost potentiostat in a lab-on-chip format, using state of the art lithography and SLA 3D printing systems. Co-supervision: Physiological Sciences **Requirements:** Electrochemistry, integrated development, modelling and simulation using COMSOL multiphysics, lithography and additive manufacturing.		✓		
Development of an innovative microfluidic lateral flow assay Lateral-flow assays are the gold standard for home and rapid testing. However, their use is limited to tests where qualitative results are good enough, which disqualifies them from the greater majority of applications. Recent advances in microfluidics has made it possible to replace the basic material of which LFAs are made to make them easier to fabricate, and also open up new avenues for changing their output mechanism to become quantitative in nature. This project would focus on laying the groundwork for such a device, and develop a proof-of-concept implementation of a fully-microfluidic quantitative lateral flow assay. Co-supervision: Physiological Sciences or Immunolgy Research Group (Tygerberg) **Requirements:** Lithography and additive manufacturing, Multiphysics simulation/CFD, machine vision, analog electronics		✓		
Development of an Organ-on-Chip lung or neuron model Organ-on-chip systems are becoming indispensable in the search for new and novel drugs and treatment regimes, especially in non-communicable diseases. this project would focus on the development of a novel organ-on-chip system for neural or lung models, using state of the art lithography and manufacturing techniques. C-supervision: Dr Sanjeev Rambharose (Physiological Sciences) **Requirements:** Multiphysics simulation, machine vision, manufacturing systems, cell culturing and physiological models		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Miniature Surface Plasmon Resonance (SPR) with Digital Micromirror Device (DMD) technology Surface plasmon resonance (SPR) is a very powerful biosensing technique with applications in every field of pharmaceutical and medical testing. However, until now SPR machines have been large and bulky due to the optical systems involved. New developments in the field of MEMS and optics has made it possible to miniaturize many of the components necessary for an SPR system, and some work has been done to develop portable versions of the technology. This project would focus on developing such a portable SPR sensing platform for biosensor applications at the point-of-care (PoC). Co-supervision: Dr Gurthwin Bosman (Physics) **Requirements:** Optics/physics, integrated development, multiphysics simulation		✓		
Development of a COMSOL model of ZnO nanowire biosensors Zinc Oxide is a versatile piezoelectric material with promising applications in biosensor development and other fields. Specifically, Zinc Oxide nanowires have been successfully used as biosensors, but their function and optimal use is not yet fully understood. This project would focus on developing a COMSOL multiphysics model of a nanowire-based sensor to better understand the existing sensors and their limitations/strengths/weaknesses. Co-supervision: Prof Leon Dicks (Microbiology) **Requirements:** Multiphysics simulation, electrochemistry		✓		
Development of a spatial PCR prototype for rapid nucleic acid based tesing Nucleic acid-based diagnostics are fast becoming indispensable in the effective diagnosis of diseases of all kinds. Of particular interest is cancer and viral infections, that can be very difficult to detect without sensitive PCR processes that are difficult to implement in a household or resource-constrained setting. This project would develop a compact and energy efficient PCR platform for the detection of such targets, using spatial thermal cycling techniques, moving the sample inside microfluidic chambers between stationary temperature zones. Co-supervision: Medical Physiology (Tygerberg) or Physiological Sciences **Requirements:** Control systems, automation, image processing and microprocessor development		✓		

Dr Sanjeev Rambharose
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- **Research Field**
  Nanotechnology, drug delivery, physiology
- **General Description of Research Field**
  Physiological characteristics of diseases bring about both challenges and opportunities for targeted drug delivery. Novel engineered strategies are being increasingly used for the design of advanced drug delivery systems. The research group works at the interface of physiology, biochemistry, pharmaceutics and nanotechnology. The focus of the research group is to harness the characteristics of physiological systems to tailor precision drug delivery systems for both communicable and non-communicable diseases.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Development of a Nano-Integrated Transdermal (NIT) Drug Delivery System for Antiretroviral Drug and NeuroAIDS Therapy The development of an innovative nano- integrated transdermal (NIT) Drug Delivery Systems (DDS) as a medicinal product is capable of delivering either single or multiple ARV drugs simultaneously, as is required for HIV and AIDS drug therapy, via the skin is desired to overcome current limitations. Transdermal NIT preparations have the potential to improve bioavailability of various ARV drugs, decrease dosages required, decrease cost of therapeutics and reduce drug side effects. Specifically engineered DDS can allow targeted, controlled drug release which can decreases frequency of administration. These innovative DDS can therefore enhance therapeutic effects, compliance and adherence. **Requirements:** Physiological systems	✓	✓	✓	

Prof Kristiaan Schreve
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- **Research Field**
  Machine vision; Biomedical Engineering
- **General Description of Research Field**
  I am interested in applications and basic research related to machine vision in industrial and biomedical engineering environments. My main focus is on dimensional measurements and accuracy prediction in 3D applications using cameras (e.g. quality control, reverse engineering, diagnostics, etc.), however the field is also related to applications in robot navigation.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Optical Measurement of Tibial Bone Segments Mounted in an Ilizarov Fine Wire Fixator During Normal Gait The movement of the two segments of a fractured bone relative to each other is critical for bone regrowth. Ilizarov frames (Google for images) / hexapod frames are frequently used in reconstructive surgery. Each ring block is fastened to a bone segment, but minor 6 DoF (degrees of freedom) movement of the segments is possible during normal gait. These movements are little understood and have not yet been quantified, despite being critical for bone regrowth. A method to track these movements has been proposed. This requires rigidly mounting one additional threaded half-pin in each bone segment, close to the fracture, and not attached to a ring so that the end can be visually observed. In this study an optical method, using stereo cameras, must be developed and tested to measure the movements with sufficient accuracy in a clinical or laboratory environment. The method must then be used to quantify the relative movement between the bone segments during normal gait. **Requirements:** Programming experience (python preferably); Engineering mathematics up to 2nd year level			✓	

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Integrated Length and Weight Measurement for Infants A crucial activity in nutrition surveillance is growth monitoring and promotion to timeously identify and treat children who are malnourished or at risk for malnutrition. Malnutrition, specifically stunting is much more than a physical condition. Stunting is when a child plots more than 2 standard deviations below the WHO Child Growth Standards' median. The nutritional status of infants is directly linked to their anthropometrical data, specifically weight and length. In a previous study, a device was built that integrates these two measurements and allows for the digital recording of the data and plotting on a growth chart. The current device is in a prototype stage. For effective use by clinicians, the device needs to be redesigned for usability and robustness. Firstly, the principal components of the device need to be packaged robustly. The measurement process must be stream lined so that it can be done fast and accurately. The data recording (including age, ID, clinician, photo's, etc.) must be automated as much as possible keeping in mind the clinical setting. Fail safes need to be built into the device to prevent incorrect recording of data. **Requirements:** Python programming experience. CAD modelling.	✓			
Smart pill box TB (tuberculosis) and chronic diseases are very prevalent in rural South Africa. Successful treatment of such diseases is dependent on patient's taking their prescribed medication on a regular basis. In the case of TB, for example, this can lead to bacteria becoming immune to existing medicine with serious consequences for the patient and high cost to the country. We need a smart pill box that can assist a patient to correctly take the medication at the prescribed times. The device must record the removal of medication (thereby assuming that the patient is taking the medication), it must remind the patient when prescriptions must be renewed or when a clinic visit is required. It must also be able to measure and record at least one key secondary symptom (vital sign) to assist in tracking the patient's progress. The AURUM Institute of Health has a related device that is distributed in South Africa: https://tbdigitaladherence.org/technologies/smart-pill-box/, but this device does not have all the functionality required. For a first iteration of this product, it will be acceptable to focus on one prevalent disease, such as TB or diabetes. **Requirements:** Python programming. CAD modelling. Raspberry Pi experience.	✓			

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Anti-rotation device for patients lying in traction Patients with femur fractures in some rural hospitals wait a very long time for surgery, some times up to 6 weeks. During this time, the patient lies in traction and it is not unusual that the fracture heals during this time. With current traction systems it is not always possible to prevent rotation of the foot, which means that the fracture can heal in the wrong orientation. To some extent, Thomas splints (e.g. https://emed.ie/Procedures/Thomas_Splint.php) can help in these instances, but there are some practical problems with their use, e.g. many different sizes are required for different sized patients. Some patients also refuse to wear them. A low cost anti-rotation device is needed that can be incorporated into existing traction systems in typical South African rural hospitals. It also requires a low cost weight system. **Requirements:** CAD modelling.	✓			

Mnr Wayne Swart
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- **Research Field**
  Biomedical Engineering
- **General Description of Research Field**
  Biomedical engineering encompasses many fields of research, including biomechanics predominantly for orthopaedic applications, implant design, prosthetics, diagnostic devices and technology that supports therapeutic applications. The Biomedical Engineering Research Group (BERG) have strong ties with various practitioners at Tygerberg campus, most notably in the fields of orthopaedics and psychiatry. We also strive for continual industry engagement with various companies with different specialties.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Instrumentation of Illizarov Frame Illizarov frames are frequently used to fix tibial fractures and facilitate bone healing at the fracture site. Healing of these fractures requires an optimal fixture of the fractured ends relative to one another in order to allow relative displacement between the fixed ends and facilitate the generation of the healing tissue. That is, if the fractured ends are fixed too rigidly in close proximity to each other or if the fracture ends are fixed with too much clearance relative to one another, the healing process does not occur correctly. Literature, based on in-vitro test data, suggests that there is an optimal relative displacement range that leads to a faster healing. An instrumented Illizarov frame that can accurately estimate the relative displacement within the fracture will provide surgeons with valuable feedback on the potential efficacy for the given frame setup in any clinical setting. The objectives of this project are to instrument an Illizarov frame and to validate fracture displacement estimations through load frame testing. The frame needs to be instrumented in such a manner that data can be collected outside of a laboratory context, i.e. the instrumentation can be done on an Illizarov frame fixed to a patient. The instrumentation should be able to accurately estimate the relative bone displacement at the fracture site based on measurements and known heal strike force data. Validation will require a rigorous experimental design process including the creation of a representative model of the surrounding tissue and a thorough experimental procedure that can be used to relate the measurements to the actual relative displacement at the fracture site. Any candidate for this project will require a background in Mechanical or Mechatronic Engineering and should be comfortable multi-disciplinary applications. This project forms part of a collaborative research effort with the Advanced Orthopaedic Training Centre at Tygerberg campus and may require the candidate to visit Tygerberg campus to discuss and experience the clinical nature of the aimed applications. As such, the candidate will be expected to conduct themselves in a respectful and professional manner. **Requirements:** Mechanical / Mechatronic Engineering degree.		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Modelling the Behaviour of an Illizarov Frame under Load This topic will investigate the behaviour of an Illizarov frame under load. An Illizarov frame is an external fixation used in orthopaedic surgery to treat broken or damaged bones of the arm or leg. It is often used to treat complex fractures. This project will be co-supervised by Mr Wayne Swart and Prof Gerhard Venter and will involve the development of a finite element model of the Illizarov frame and appropriate bone segments that the frame is attached to. The material properties of the frame and bone segments will be obtained from experiments and/or literature. Both linear and non-linear finite element models will be investigated and will be validated through the use published data as well as physical experiments. Understanding the behaviour of these frames under load is important. These frames are designed to allow limited axial movement in the fracture to help promote bone growth. However, lateral movements and rotations should be constrained. Understanding how these frames behave under load will aid the orthopaedic surgeon in the design and attachment of the device to obtain optimal bone growth. This project will start by considering only axial loads, but will eventually be extended to also include loads experienced while walking, eg during heel strike. This project forms part of a collaborative research effort with the Advanced Orthopaedic Training Centre at Tygerberg campus and may require the candidate to visit Tygerberg campus to discuss and experience the clinical nature of the aimed applications. As such, the candidate will be expected to conduct themselves in a respectful and professional manner. **Requirements:** Finite element modelling. The student should have completed the Finite Element Methods 414 module (or similar) or should be willing to take this module in the first year of the MEng study. Some Python programming will most likely also be required.		✓		

Topics	**MEng Struct**	**MEng Resrch**	**PhD**	**Potential Funding**
Exploring the use of Virtual Reality Based Visualization for pain management in burn care Although some studies suggest that virtual reality (VR) serves as a useful addition to burn wound pain management techniques, it is not yet fully understood whether VR simply serves as a distraction or if it affects pain perception. The purpose of this project will be to investigate the affect of VR in pain management through the design of an experimental procedure and the associated stimulation and monitoring equipment, which will include a finely controlled temperature stimulus device as well as ambient temperature sensing. Furthermore, a measuring technique to quantify subject reflex response to the stimulus in terms of time and acuteness of physical motion will have to be designed and developed. The VR stimulus will be delivered by means of a commercial VR system; however, some digital environmental design will be required. A background in temperature measurement and control as well as electronic design is highly recommended to any candidate for this project. This project will require the student to design a controlled electrically driven device and therefor the candidate should be comfortable with electronic applications. A background in electronics and measurement will be an advantage. Additionally, some control theory may have to be applied in the design. This project forms part of a collaborative research effort with the Department of Psychiatry at Tygerberg campus and may require the candidate to visit Tygerberg campus to discuss and experience the clinical nature of the aimed applications. As such, the candidate will be expected to conduct themselves in a respectful and professional manner. **Requirements:** A background in driving electronics, measurement and control will be beneficial. Some programming background (predominantly C based applications) will be beneficial.	✓			

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Olfactory stimulus for augmented VR anxiety treatment The purpose of this project is to determine the efficacy of olfactory stimulation as a fear enhancement tool during the use of VR (virtual reality) exposure therapy procedures. VR has proven to be a useful tool for exposure therapy purposes in anxiety conditions (Freitas et al., 2021). Olfactory enhanced VR treatment could be relevant in treatment procedures for anxiety and related disorders. The primary objective of the project will be to develop, test and validate an olfactory stimulus device that can accurately control smell intensity and guarantee quick response times in smell dissipation after delivery. This will require a rigorous test methodology to ensure a high confidence that the desired stimulus intensity is being achieved. The secondary objectives will be to investigate the effect of olfactory stimulus in VR environments in terms of subject response; and the development of a closed-loop control system for anxiety level stimulus using heartrate variability and EDA (electrodermal activity) response. This project will require the student to design an electromechanical device and therefor the candidate should be comfortable with multi-disciplinary applications. A background in electronics and measurement will be an advantage. Additionally, some control theory may have to be applied in the design. This project forms part of a collaborative research effort with the Department of Psychiatry at Tygerberg campus and may require the candidate to visit Tygerberg campus to discuss and experience the clinical nature of the aimed applications. As such, the candidate will be expected to conduct themselves in a respectful and professional manner. Freitas, J.R.S., Velosa, V.H.S., Abreu, L.T.N., Jardim, R.L., Santos, J.A.V., Peres, B., Campos, P.F., 2021. Virtual Reality Exposure Treatment in Phobias: a Systematic Review. Psychiatr. Q. 92, 1685–1710. https://doi.org/10.1007/s11126-021-09935-6 **Requirements:** Some electronics and measurement background will be beneficial. Some programming background (predominantly C based applications) will be beneficial.	✓			

Prof Gerhard Venter
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- **Research Field**
  Computational (structural) mechanics with focus on structural analysis and numerical design optimization and related technologies

- **General Description of Research Field**
  My research typically deals with complex finite element analyses combined with structural and/or multi-disciplinary optimization. These techniques are applied to a wide range of interesting topics, typically driven by and in collaboration with an industry partner. Currently my group does some work in load reconstruction of real world forces on complex structures, material characterization using inverse modelling, optimum design and investigation into the fatigue life of welded and bolted connections in high strength steels and DIC related topics.

  Most of my research projects have some finite element, some meta-modelling (machine learning) and some optimization components associated with it. The vast majority of the topics requires programming, typically in Python. An interest in these fields, or at least a willingness to learn, is thus a requirement for potential students.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Modeling the Behavior of an Illizarov Frame under Load This topic will investigate the behavior of an Ilizarov frame under load. An Ilizarov frame is an external fixation used in orthopedic surgery to treat broken or damaged bones of the arm or leg. It is often used to treat complex fractures. This project will be co-supervised by Mr Wayne Swart and Prof Gerhard Venter and will involve the development of a finite element model of the Ilizarov frame and appropriate bone segments that the frame is attached to. The material properties of the frame and bone segments will be obtained from experiments and/or literature. Both linear and non-linear finite element models will be investigated and will be validated through the use published data as well as physical experiments. Understanding the behavior of these frames under load is important. These frames are designed to allow limited axial movement in the fracture to help promote bone growth. However, lateral movements and rotations should be constrained. Understanding how these frames behave under load will aid the orthopedic surgeon in the design and attachment of the device to obtain optimal bone growth. This project will start by considering only axial loads, but will eventually be extended to also include loads experienced while walking, eg during heel strike. **Requirements:** Finite element modeling. The student should have completed the Finite Element Methods 414 module (or similar), or should be willing to take this module in the first year of the MEng study. Some Python programming will most likely also be required.		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Development of a Bone Growth Model for Finite Element Analysis This proposed Master's project aims to develop a bone growth model for finite element analysis (FEA). Bone growth is crucial in orthopaedic applications, such as fracture healing, bone remodelling, and implant design. Understanding the complex process of bone growth and its interaction with mechanical stimuli is essential for improving clinical outcomes and optimizing implant performance. The project will begin by reviewing existing literature on bone growth mechanisms and their relationship with mechanical factors. Based on this knowledge, a mathematical model will be developed to simulate bone growth patterns. The model will consider various factors, including cellular activities, mechanical loading, and biochemical signalling, to capture the dynamic nature of bone growth accurately. The developed bone growth model will be integrated into FEA simulations to predict the mechanical behaviour of bone structures during the growth process. This will enable the evaluation of the effects of bone growth on the mechanical integrity and performance of orthopaedic implants or structures. Moreover, the model will facilitate the exploration of optimal implant designs that promote proper bone growth and enhance long-term implant success rates. The outcomes of this project will contribute to advancing the understanding of bone growth mechanisms and their implications for orthopaedic applications. When integrated into FEA, the developed bone growth model will provide a powerful tool for orthopaedic engineers to optimize implant designs, predict the mechanical performance of bone structures during growth, and enhance patient outcomes regarding implant longevity and functional restoration. This project will be co-supervised by Prof Martin Venter and Prof Gerhard Venter. **Requirements:** None		✓		

Prof Martin Venter

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- **Research Field**
  Generative Design, Machine Learning, Material Modelling, Soft Robots and Inflatables
- **General Description of Research Field**
  I am interested in computational methods as part of the design process. This allows us to share the burden of making design decisions that can become complex, like biologically inspired artificial creatures and inflatable structures. Over the past few years, I have been exploring the potential applications of compliant and selectively reinforced materials in the fields of pressure-rigidised structures and soft robotics. In addition, our research group is interested in combining powerful non-linear simulation tools, such as finite element methods, with the ever more important field of machine learning in a modern generative design approach.

  This is a multidisciplinary field taking elements from several computational fields. Researchers in this area will develop non-linear finite element methods, numerical design optimisation, programming and machine learning skills. Much of what we do requires insightful experiment planning in tandem with advanced tools to deal with large volumes of data. This new field is open to exploration, which can be both challenging and rewarding.

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Development of a Bone Growth Model for Finite Element Analysis This proposed Master's project aims to develop a bone growth model for finite element analysis (FEA). Bone growth is crucial in orthopaedic applications, such as fracture healing, bone remodelling, and implant design. Understanding the complex process of bone growth and its interaction with mechanical stimuli is essential for improving clinical outcomes and optimizing implant performance. The project will review existing literature on bone growth mechanisms and their relationship with mechanical factors. Based on this knowledge, a mathematical model will be developed to simulate bone growth patterns. The model will consider various factors, including cellular activities, mechanical loading, and biochemical signalling, to capture the dynamic nature of bone growth accurately. The developed bone growth model will be integrated into FEA simulations to predict the mechanical behaviour of bone structures during the growth process. This will enable the evaluation of the effects of bone growth on the mechanical integrity and performance of orthopaedic implants or structures. Moreover, the model will facilitate the exploration of optimal implant designs that promote proper bone growth and enhance long-term implant success rates. The outcomes of this project will contribute to advancing the understanding of bone growth mechanisms and their implications for orthopaedic applications. When integrated into FEA, the developed bone growth model will provide a powerful tool for orthopaedic engineers to optimize implant designs, predict the mechanical performance of bone structures during growth, and enhance patient outcomes regarding implant longevity and functional restoration. **Requirements:** An interest in programming and must complete introduction to FEM in the first 6 months.		✓	✓	

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Design and Development of a Drop Foot Prosthetic This proposed Master's project focuses on designing and developing a drop foot prosthetic. Drop foot is a gait abnormality characterized by the inability to lift the front part of the foot, leading to difficulties in walking and an increased risk of tripping or falling. Prosthetic devices offer a solution by supporting and assisting individuals with drop foot to regain a more natural and functional gait. The project aims to design and develop an innovative drop foot prosthetic that addresses individuals with this condition's specific needs and challenges. The design process will involve the following: A comprehensive review of existing prosthetic devices. Biomechanical analysis of the gait cycle. Consultation with healthcare professionals and potential end-users. Based on the gathered knowledge, a prototype of the drop foot prosthetic will be developed using advanced design tools and manufacturing techniques. The prosthetic will incorporate mechanisms to assist with foot dorsiflexion during the swing phase of the gait cycle and provide stability during the stance phase. The design will also consider comfort, adjustability, and ease of use. The performance and functionality of the drop foot prosthetic will be evaluated through biomechanical testing and user trials. Feedback from individuals with drop foot and healthcare professionals will be incorporated into the iterative design process to optimize the prosthetic's effectiveness and user satisfaction. The outcomes of this project will contribute to the advancement of drop foot prosthetics, providing individuals with improved mobility, stability, and quality of life. The designed prosthetic can offer a cost-effective and accessible solution for those experiencing drop foot, facilitating their daily activities and reducing the risk of falls. The project also opens opportunities for further research and development in assistive technologies and rehabilitation engineering. **Requirements:** Complete the intro to FEM in the first six months.		✓		

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Computational Design of Novel Soft Sensors This proposed Master's project focuses on the computational design of novel soft sensors. Inspired by biological systems, soft sensors have gained significant attention due to their ability to conform to complex shapes and interact with delicate and irregular surfaces. They find applications in various fields, including robotics, healthcare, and wearable technology. However, designing soft sensors with desired sensing properties and performance remains challenging. The project aims to address this challenge by employing numerical optimization techniques and finite element analysis (FEA) to design and optimize novel soft sensors computationally. The project will begin by characterizing existing soft sensor materials' mechanical and sensing properties through experimental testing and literature review. Using this knowledge, a computational framework will be developed to simulate soft sensor designs' mechanical behaviour and sensing response. FEA will be utilized to model the deformation and strain distribution of the soft sensor under different loading conditions. Advanced optimization algorithms will be employed to find optimal sensor designs based on specific performance criteria, such as sensitivity, resolution, and robustness. Additionally, machine learning techniques can be integrated into the design process to assist in exploring a vast design space and accelerate the optimization process. This may involve training machine learning models using datasets generated from FEA simulations and experimental data, enabling sensor performance prediction for untested designs. The outcomes of this project will contribute to developing novel soft sensors with enhanced sensing capabilities and performance characteristics. The optimized designs can find applications in robotic manipulation, human-machine interaction, and healthcare monitoring. Moreover, the computational design approach will offer a cost-effective and efficient way to explore and iterate soft sensor designs, facilitating advancements in soft robotics and wearable technology. **Requirements:** Complete the intro to FEM in the first six months.		✓		

Dr Andie de Villiers
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- **Research Field**
  Computational Mechanics
- **General Description of Research Field**
  This field involves the modelling and simulation of mechanical problems. The field comprises of three parts: modelling, numerical implementation and computational implementation. The appropriate equations and boundary conditions need to be identified/developed to capture the physics of a system. It is often difficult to find analytical solutions for these problems, and numerical methods such as the finite element method is used to solve the equations. These problems can not be solved by hand and should be solved computationally. Depending on the problem at hand commercial software may or may not be useful.

Topics	**MEng Struct**	**MEng Resrch**	**PhD**	**Potential Funding**
A peridynamic model of skin Skin is a living material. Not only is the material properties anisotropic and incompressible but it is also influenced by the environment and changes over time. Peridynamics is a non-local continuum mechanics framework originally developed to overcome challenges that classical continuum mechanics encounter when modelling discontinuities, such as cracks, as well as long-range forces. The aim of this project is to develop a peridynamic model of the skin and find suitable peridynamic material parameters. **Requirements:** Students should have a background in solid mechanics and a love for mathematics and programming.		✓	✓	✓

Dr Johan van der Merwe
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- **Research Field**
  Data-informed preoperative planning and endoprosthesis design.

- **General Description of Research Field**
  Conventional implant systems may result in suboptimal patient outcomes due to a mismatch between implant geometry and pathological anatomy. This could be caused by misrepresentation of the target population, or severe defects outside of the original system's design scope, requiring modification.

  Patient-specific solutions are an attractive alternative due to the capabilities afforded by additive manufacturing. However, the development of patient-specific devices is a multidisciplinary and iterative process that requires extensive effort on the part of various stakeholders. This could lead to increased expense and delays in treatment within an already resource constrained healthcare system. Ideally, the benefits associated with standardized implant systems such as economy of scale, logistical efficiency, and quality control, should be pursued where possible.

  Therefore, this research follows a data-informed approach to implant design and preoperative planning, to enable targeted standardization of implant systems and design processes, and predictive automatization of patient-specific solutions. Applications in orthopedic and maxillofacial surgery include fixation, large defect reconstruction and joint replacement.

Topics	**MEng Struct**	**MEng Resrch**	**PhD**	**Potential Funding**
Internal fixation implant analysis and design Applications considered for this project include fixation plates, pins, and screws for various anatomies. The scope may vary based on prior art as well as student background. Possible activities include needs identification via ethnographic research, market assessment and stakeholder engagement; Research questions and hypotheses must be developed, followed by data collection for morphological shape analyses and comparison to available implant geometry; Implant geometries must be proposed based on the findings and optimized for form and function; Verification will be done via simulation and experimental testing. **Requirements:** Students must have sufficient scientific or engineering background for further study at a postgraduate level in one or more of the following: statistics, scientific programming, machine learning, digital image processing, numerical simulation, and optimization.		✓	✓	

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Functional implants for large bone defect reconstruction The focus for this project is the generation of engineered and additively manufactured lattice structures for large bone defect reconstruction. Applications include various anatomies but will most likely focus on the femur and mandible. After initial needs identification and data collection, lattice geometries must be selected, and implant fixation features incorporated into a functional design. Numerical optimization and simulation must be performed, along with experimental validation. Extended scope would include design customization, automatization, and early failure prediction. **Requirements:** Students must have sufficient scientific or engineering background for further study at a postgraduate level in one or more of the following: statistics, scientific programming, machine learning, digital image processing, numerical simulation, and optimization.		✓	✓	
Design of patient-specific joint replacements This project investigates the design of patient-specific joint replacement implants, such as for the mandible or shoulder, after needs identification and analysis of prior art and current challenges. Research questions and hypotheses must be developed, followed by data collection for morphological shape analysis in conjunction with biomechanical simulation and motion capture. The resulting database must be used to inform patient-specific implant design, possibly in conjunction with modular or standard components. Experimental verification will involve kinematic and wear testing. Project scope may vary based on prior art as well as student background. **Requirements:** Students must have sufficient scientific or engineering background for further study at a postgraduate level in one or more of the following: statistics, scientific programming, machine learning, digital image processing, numerical simulation, and optimization.		✓	✓	
Data-informed bone models for preoperative planning and surgical navigation This project is concerned with the generation of 3D patient-specific or patient-matched bone models for use in preoperative planning and surgical navigation. Potential applications include surgery for hip dysplasia and ankle fractures. Data collection will occur after needs identification, and methods for matching or fitting models to individual patients must be investigated. Solutions may involve digital image processing, statistical learning, and automated 3D model registration. Verification will occur via simulated test cases. **Requirements:** Students must have sufficient scientific or engineering background for further study at a postgraduate level in one or more of the following: statistics, scientific programming, machine learning, digital image processing, numerical simulation, and optimization.		✓	✓	

Topics	MEng Struct	MEng Resrch	PhD	Potential Funding
Design and development of a drop foot prosthetic This project focuses on designing and developing a cost-effective drop foot prosthetic. Prosthetic devices mitigate gait abnormalities and the associated the risk of tripping or falling, by facilitating a more normal gait. The design process will involve a review of existing devices, consultation with healthcare professionals and potential end users, biomechanical testing and analysis of the gait cycle, and the development and testing of a prototype. **Requirements:** Students must have sufficient scientific or engineering background for further study at a postgraduate level in one or more of the following: statistics, scientific programming, machine learning, digital image processing, numerical simulation, and optimization.		✓	✓	