IHE summer studentships 2024 – list of projects

Version updated on 27th March 2024

Students please note: Some additional projects might be included until the deadline for students’ submission. You can access always the most updated project list via the website. However the current project list is a good representation of the projects that are on offer and so you can submit from now. But if you want to wait until closer to the deadline, at least you should prepare a draft of your application considering these current projects to ensure you are ready to submit at any time.

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| **Project number** | **Project description** |
| 1 | Project title: Smart wall design for pop-up diagnostic hubs, applying design for manufacture principles  Clinical unit: Moorfields Eye Hospital  Lead clinicians: Prof Paul Foster  Project outline: We propose an 8 week programme of work to refine and fully specify a novel, rapidly deployed clinic partitioning system developed during the acute COVID lockdown phase which was used to create new, socially-distanced clinic facilities to maintain NHS eye-care services. The project will include observation in Brent Cross, City Road and Hoxton Diagnostic Hubs, with interaction with medical staff, technical staff, clinic management and administrative staff in this emerging important method of delivering care to large number of people with chronic eye diseases. This will provide unique insights and experience in the operational parameters and design of these facilities. In addition, the candidate will work with UCL staff at The Bartlett School of Architecture, gaining exposure to the design and delivery techniques used to delivery a novel "smart wall" system - used to creating clinic space partitioning with integrated power, data connectivity, and down-lighting to allow safe movement. These smart walls produced using design for manufacture techniques, with a standard kit of parts from a very broad supply chain, sources from sustainable end suppliers.  Outputs: The candidate will refine the design, specify the final design and describe this in a final report, and ideally, publish this in a peer-reviewed medical/architectural/engineering journals.  Skills and clinical observation opportunities students will gain from this project: This will provide unique insights and experience in the operational parameters and design of these facilities. In addition, the candidate will work with UCL staff at The Bartlett School of Architecture, gaining exposure to the design and delivery techniques used to delivery a novel "smart wall" system  UCL staff involved on the project: Prof Peter Scully, Bartlett School of Architecture.  Pre-existing skills needed for this project: NA |
| 2 | Project title: Design an early walking aid for above knee amputees  Clinical unit: Prosthetic Rehabilitation Unit, RNOH  Lead clinicians: Dr Imad Sedki  Project outline: The main early walking aid for above knee amputees is called the "Femurett", which is an outdated design and its production was recently terminated by the manufacturer. This includes an adjustable prosthetic socket that fits different stump sizes, an adjustable length pylon and a lockable uniaxial knee.  Outputs: There a few potential improvements that could optimise the old Femurett to create a new walking aid that functions in a more similar manner to modern prostheses. This could end up being a commercially viable project due to the lack of competition world wide.  Skills and clinical observation opportunities students will gain from this project:  A good understanding about the biomechanics of gait, and knowledge about above knee socket design and the main categories of prosthetic knees.  UCL staff involved on the project: Dr Dr Rui Loureiro and other staff at the USL Institute in Stanmore.  Pre-existing skills needed for this project: An interest in biomechanics is essential, but knowledge base could be gained with support from the Prosthetic Rehabilitation Unit in Stanmore |
| 3 | Project title: Deep learning for better representations of billing diagnosis data  Clinical unit: Great Ormond Street Hospital, Data Research, Innovation and Virtual Environments unit (DRIVE)  Lead clinicians: Professor Neil Sebire  Project outline: Diagnosis information assigned to patients via hospital billing processes has long been used for statistical analysis. However, since the process for assigning these codes is for billing purposes, the billing codes are biased when representing patient diagnoses for clinical applications, for example, often diagnoses are excluded from being included for billing when they commonly co-occur. Furthermore, there exists additional structure within the assignment of billing codes which is often un-utilised for example, causal relationships between certain diagnoses. Research into developing ‘diagnosis representations’ for statistical analysis has focused on using naive loss functions (i.e., next token prediction) with the intent that the target model will learn ‘better’ representations as a side effect ((Rasmy et al., 2020), (Choi et al., 2016)). Despite the impressive performance that these models, this training paradigm entails several negative externalities including: high the computation time and; potentially amplifying biases within the training data ((Bender et al., 2021)). This project aims to understand whether smaller models with the addition of a priori symbolic knowledge of the coding guidelines are preferable to existing state-of-the-art diagnosis representation methods in terms of: compute, performance or interpretability.­    Thus far, a theoretical framework justifying the approach has been developed along with a pre-processing pipeline. The work outstanding includes: deriving a validation criteria for the learnt diagnosis embeddings, drawing inspiration from existing literature and identifying potential limitations and; experimenting with different model architectures and methods for incorporating the additional symbolic knowledge in an attempt to learn ‘optimal diagnosis embeddings’. Both the validation definition and model development will require liaising with clinical staff and clinically focused data scientists at GOSH to understand the qualities of ‘good’ diagnosis representations.  Deriving the validation approach and initial models is anticipated to be iterative and several such iterations will likely require the entire 8 weeks of the studentship. If, in the unlikely event that the work takes less than 8 weeks, the next steps would require examining how the learnt diagnosis representations could be used in existing GOSH data science processes.  Bender, E.M. et al. (2021) ‘On the dangers of stochastic parrots: Can language models be too big?’, in FAccT 2021 - Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency. Available at: https://doi.org/10.1145/3442188.3445922.  Choi, E. et al. (2016) ‘Multi-layer representation learning for medical concepts’, in Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining. Available at: https://doi.org/10.1145/2939672.2939823.  Rasmy, L. et al. (2020) ‘Med-BERT: pre-trained contextualized embeddings on large-scale structured electronic health records for disease prediction’.  Outputs: The outputs of the project are anticipated to be:  - A training and validation procedure for diagnosis representations, written as a Python package to enable wider use and easy reproducibility and;  - Initial experimental outputs demonstrating the efficacy of different diagnosis embedding methods;  Ultimately the results will be written up into an academic paper.  Skills and clinical observation opportunities students will gain from this project:  With respect to general ML skills, students will develop an understanding of how to validate unsupervised ML models using reasonable auxiliary objectives, gain technical skills in PyTorch as well as familiarity with training deep learning models. With respect to ML specifically in healthcare, students will gain an understanding of the complexity of healthcare data and obtain first-hand experience in engaging with clinical stake holders to develop ML solutions that drive true clinical benefit.  UCL staff involved on the project: Joshua Spear, Institute of Child Health  Pre-existing skills needed for this project: Students should be proficient in Python and in particular, students must have familiarity with performing data analysis using scientific computing packages including numpy, pandas etc Familiarity with any deep learning frameworks is not expected however, would be beneficial.  Students must also have so experience developing statistical models. This can be in any domain and for any task but students should have a broad understanding of what steps are required to train and validate such a model. |
| 4 | Project title: Developing “virtual biomechanical eye” – high-fidelity computational biomechanical model for understanding of various eye treatments in clinics  Clinical unit: Moorfields Eye Hospital  Lead clinicians: Mr Harry Petrushkin  Ms Karla Orsine Murta Dias  Project outline:  Ocular hypotony is a condition where the pressure of eye is reduced to the point where anatomy is disrupted and normal function is impaired. This occurs due to inflammatory disease, trauma and/or surgery of other ocular diseases [1].  When the eye pressure drops below 6.5mmHg (normal range 12 – 20mmHg), a variety of changes occur in some eyes potentially leading to loss of vision. In our unit at Moorfields Eye Hospital, we have pioneered a novel treatment consisting of hydrogel injections into the eye, increasing intraocular volume and thus pressure [2]. This has successfully led to many patients regaining the ability to read after decades of severe visual impairment. In most patients, treatment requires repeat injections over an average of 1–2 years. Better understanding of the mechanism behind treatment would enable improved and patient-optimised treatment over a shorter time, both encouraging the patients, and financially benefitting the NHS.  Based on the academic collaboration between Moorfields Hospital and UCL Mechanical Engineering department, we aim to build a computational model of human eye (similar to [3]), and develop a workflow to realise virtual surgery on the computational eye model. This will enable a detailed mechanistic understanding of the surgical procedure, and trial of new and/or altered surgical methods without risking patients, which will help advancement of clinical practice.  The model could start simple, with a spherical shell with internal pressure, then developing it more complex such as introduction of viscoelasticity and fibre-reinforced composite material property. The project will also benefit from the ongoing Human Organ Atlas Hub project [4], led by UCL Mechanical Engineering, in which an ultra-high-resolution X-ray tomographic image of eyes are available. Such image data will greatly enhance the fidelity of the model by adding detailed anatomical structures.  The model of different biomechanical and anatomical complexities will go under ‘virtual surgery’ – focused on the hypotonic eye treatment as described earlier – and the response of the eye to the hydrogel injection, in various ways (e.g. different quantity, timing, hydrogel material property, etc.), will be investigated. Depending on the student’s skill and interest, the project may also involve some laboratory experimentation at UCL Mechanical Engineering [5], to further the biomechanical representation of the model.  Timeline:  (Weeks 1-3): clinical experience and literature survey  (Week 4): basic training of computational model and image analysis  (Week 5): simple eye model development end virtual treatment process simulations  (Week 6-7): improvement of the model and further treatment testing  (Week 8): write up.  [1] Wang Q et al. Survey of Ophthalmology 64(5): 619-538, 2019.  [2] Testi et al. British Journal of Ophthalmology 107(12): 1765-1770, 2023.  [3] Nadarasa et al. Biomechanics and Modeling in Mechanobiology 17: 517-530, 2018.  [4] Human Organ Atlas Hub (https://mecheng.ucl.ac.uk/HOAHub/)  [5] Wilson A et al. Frontiers in Bioengineering and Biotechnology 10: 862969, 2022.  Outputs: Five key outputs are expected from the project:  (1) Training of the student: clinical experience and face to face interaction with leading clinicians, computational modelling and image analysis, theoretical and practical data analysis in biomechanical application, basic statistical methods.  (2) Preliminary scientific understanding of the surgical procedure.  (3) Pilot data for future funding applications, e.g. PhD studentships and/or research project grants.  (4) Scoping the other potential application of this computational approach, such as cataract surgery.  (5) Dissemination materials: computational models are often visually appealing and easy to be understood, hence the results from the project could be used effectively to explain the surgical procedure for patients and/or general public.  Skills and clinical observation opportunities students will gain from this project: 1. Solid Mechanics Proficiency: Through hands-on experience, the student will develop a strong understanding of solid mechanics principles. They will gain proficiency in applying these principles to the biomechanical modelling of the eye.  2. Computational Modelling Skills: The student will have the opportunity to enhance their skills in computational solid mechanics modelling, particularly finite element analysis (FEA). They will actively apply these techniques to simulate the complex biomechanical behaviour of the eye, contributing to the development of the virtual biomechanical eye model.  3. Medical Image Analysis Experience: The student will have the chance to work with various imaging modalities such as OCT (Optical Coherence Tomography) and ultrasound, gaining insights into the interpretation and analysis of clinical images related to ocular structures.  4. Interdisciplinary Collaboration: The project will involve collaboration with clinicians and researchers from diverse backgrounds, providing the student with valuable exposure to interdisciplinary teamwork. They will learn to communicate effectively across different domains, essential for translating research findings into clinical applications.  5. Clinical Observation Opportunities:  • Understanding Treatment Modalities in the Eye Hypotony Clinics: Students will attend ophthalmology clinics at Moorfields Eye Hospital, renowned for its expertise in eye care. They will observe clinical assessments, diagnosis, and treatment strategies employed in managing patients with eye hypotony.  • Patient Interaction: While not directly involved in patient care, the student will have the opportunity to observe clinical consultations and interactions, gaining first-hand exposure to the challenges and experiences of individuals with eye hypotony. This direct observation will enhance their understanding of patient-centred care and the impact of ocular conditions on quality of life.  • Clinical Workflow: By observing clinical workflows, the student will gain an appreciation for the integration of biomechanical models into the decision-making process, enhancing their understanding of how computational models can impact clinical practice.  • Real-world Application: Witnessing the application of biomechanical models in clinical scenarios will allow the student to bridge theoretical knowledge with practical implications, fostering a deeper understanding of the clinical relevance of their research.  Overall, this project offers a unique opportunity for the student to develop both technical skills in computational biomechanics and a comprehensive understanding of clinical applications in ophthalmology. They will be equipped with valuable insights and experiences that will shape their future career in research or clinical practice.  UCL staff involved on the project: Prof Ryo Torii, Mechanical Engineering  Dr Abigail Wilson, Mechanical Engineering  Pre-existing skills needed for this project: Knowledge of solid mechanics is important to the success of this project. Experience of computational solid mechanics modelling (finite element analysis) and medical image analysis is desirable.. |
| 5 | Project title: Virtual Ankle Arthroscopy - Mechanical  Clinical unit: UCL / Foot & Ankle Unit, RNOH  Lead clinicians: Karan Malhotra  Prof Rui Loureiro  Project outline:  Ankle Arthroscopy is a key skill to learn for registrars. It is also a technically challenging skill given the ankle is a small joint, which is hard to navigate around. Trainees / surgeons need good technical and triangulation skills, and experience in arthroscopy before it is feasible to do an ankle arthroscopy on a real patient. Yet is is difficult to spend a lot of time on cases on often busy lists. This may mean that during a 6 month placement they are unable to develop the required skills required to practice ankle arthroscopy. Virtual arthroscopic trainers may have a key role in allowing surgeons to experience arthroscopy in a safe environment without pressures of time, so that they can familiarise themselves with skills and techniques before applying them on patients.  The aim of this project is to work on aspects of developing a virtual ankle arthroscopy simulator. This project will focus on working along side higher degree students to develop a mechnical interface for hand held controls which can held by a surgeon whilst performing a virtual arthroscopy.  Outputs: To develop and refine hand held 'instruments' which can link up to a virtual simulation.  Skills and clinical observation opportunities students will gain from this project: Observing foot and ankle surgical clinics. Attending theatre which may also include arthroscopy (key hole surgery). Learning about using VR and designing simultors + working with Unreal Engine.  UCL staff involved on the project: Prof Rui Louriero  Pre-existing skills needed for this project: Understanding of engineering principles |
| 6 | Project title: Virtual Ankle Arthroscopy - Software  Clinical unit: UCL / Foot & Ankle Unit, RNOH  Lead clinicians: Karan Malhotra  Prof Rui Loureiro  Project outline: Ankle Arthroscopy is a key skill to learn for registrars. It is also a technically challenging skill given the ankle is a small joint, which is hard to navigate around. Trainees / surgeons need good technical and triangulation skills, and experience in arthroscopy before it is feasible to do an ankle arthroscopy on a real patient. Yet is is difficult to spend a lot of time on cases on often busy lists. This may mean that during a 6 month placement they are unable to develop the required skills required to practice ankle arthroscopy. Virtual arthroscopic trainers may have a key role in allowing surgeons to experience arthroscopy in a safe environment without pressures of time, so that they can familiarise themselves with skills and techniques before applying them on patients.  The aim of this project is to work on aspects of developing a virtual ankle arthroscopy simulator. This project will focus on working along side higher degree students to develop software (suing Unreal engine) a surgeon will be interfacing with whilst performing a virtual arthroscopy.  Outputs: To develop and refine hand held the software but which instruments can link up to a virtual simulation.  Skills and clinical observation opportunities students will gain from this project: Observing foot and ankle surgical clinics. Attending theatre which may also include arthroscopy (key hole surgery). Learning about using VR and designing simultors + working with Unreal Engine.  UCL staff involved on the project: Prof Rui Loureiro  Pre-existing skills needed for this project: Understanding of software design |
| 7 | Project title: Patient App for Recording Study Data  Clinical unit: Foot & Ankle Unit, RNOH  Lead clinicians: Karan Malhotra  Project outline: Patients have procedures and other interventions performed - there are many scores used to identify how patients are faring - however the most commonly used ones are often PROMs - where we ask patients how they feel about the level of activity they can perform. This is however, only one crude form of assessment and is not suitable for all types of intervention.  When patients are part of a trial then they may need to be asked specific questions. There is therefore the need for a variety of questions to be asked, which may help to gauge researchers / surgeons how well a patient is doing.  The goal of this project is to create a customisable app that a patient can log their measurements  Outputs: Develop a specific app that can be used by patients to highlight early any concerns  Skills and clinical observation opportunities students will gain from this project: Exposure to foot and ankle trauma centre, attend clinics and theatre  UCL staff involved on the project: Karan Malhotra   Pre-existing skills needed for this project: n/a |
| 8 | Project title: Clinical Training Phantoms for Robotic Bronchoscopy  Clinical unit: Thoracic Medicine, UCLH  Lead clinicians: Dr Ricky Thakrar  Dr Neal Navani  Project outline: Lung cancer is a leading cause of cancer deaths worldwide. Diagnosis and staging are often performed using bronchoscopy and/or endobronchial ultrasound (EBUS) with transbronchial needle aspiration (TBNA) [1]. Mastery of bronchoscopy and EBUS-TBNA requires extensive training, but in the UK, there is no formal training program, and traditional apprenticeship methods, where a novice learns on patients, carry the risk of harm [2]. International guidelines recommend simulation training and validated skills assessments to objectively evaluate proficiency [3]. Robotic bronchoscopy platforms have recently been developed to improve the navigation, reach, and diagnostic accuracy of sampling of peripheral lung nodules. The key advantages hinge upon a thin, fully articulating bronchoscope with improved tip manoeuvrability that enables the operator to accurately navigate to lung nodules in the periphery and take biopsies. Recently, an Intuitive Ion robotic bronchoscopy system was installed at UCL Hospital (UCLH).  High-fidelity physical simulators have been proven to be effective in training [4]. However, commercially available simulators have fundamental limitations: they lack key anatomical features, unrealistic ultrasound properties, and incompatibility with needle biopsies. These limitations and high costs make them less suitable for widespread use. The ability to develop tangible motor skills is particularly crucial to improve personalised care in thoracic oncology. The unmet health need addressed here is the lack of high-fidelity, cost-effective models for training clinicians in robotic bronchoscopy. This has direct implications for patient health, as clinical training is key to optimising procedure outcomes. University College London have developed a novel framework for creating lifelike clinical training phantoms for bronchoscopy and EBUS procedures.  Using advances in soft tissue-mimicking materials and 3D printing technologies [5], the engineering team have created anatomically accurate models of the tracheobronchial tree, surrounding vascular structures, and lymph nodes. These phantoms present highly realistic bronchoscopy and ultrasound images, thereby allowing for effective training in peripheral nodules and lymph node sampling. Our initial tests at UCLH indicated that this new framework is highly promising for training. It received high praise from experts and industry after being presented at an Interventional Pulmonology Conference [6].  This studentship is designed to be completed in 8 weeks with extensive opportunities for clinical engagement (>2 weeks).  The success of this studentship would have a significant impact on the demonstration of the capabilities of the newly developed, low-cost fabrication method at UCL. The goal is to provide crucial proof-of-concept data for a program to accelerate clinical training in robotic bronchoscopy in the UK, which would attract follow-on funding and interest from other clinical specialties and industry. The project will also lead to the development of a cost-effective and efficient approach to lung phantom development that will fulfil crucial clinical training needs with implications across medical training more broadly. The Principal Investigator of this grant is dedicated to training in bronchoscopy, and with the technical expertise and leadership provided by our engineering collaborators, we aim to become a world leader in simulation training in thoracic medicine.  Outputs:  1) to fabricate a new generation of robotic bronchoscopy phantoms in collaboration with the Wellcome-EPSRC Centre for Interventional and Surgical Sciences (WEISS);  2) to determine the feasibility of using a phantom as a clinical training simulator for robotic bronchoscopy through a single-arm evaluation study conducted by expert clinicians. The primary outcome measured will be unbiased scoring of the model's performance, with the goal of achieving a reliable inter-rater agreement sufficient for formative assessment [7].  == Work packages:  WP1: Clinical exposure and interaction with the clinical teams [Weeks 1-3]  WP2: Fabrication of clinical training phantoms [Weeks 4-7]  These phantoms, fully compatible with robotic bronchoscopy and ultrasound will be fabricated by the student, working as a team with the engineering collaborators at UCL WEISS.  WP3: Evaluation of phantoms [Weeks 4-7]  Evaluation of phantoms will take place in the clinical training laboratories at UCLH. At least two Consultants in Thoracic Medicine who have >3 years of clinical experience will be invited to take part. Participants will be given a brief overview and then instructed to perform sampling from 3 peripheral nodules with robotic bronchoscopy. A standardised evaluation protocol will ensure that the feedback is consistent across multiple experts and that the phantom is appraised in the same way. The experts will evaluate the simulation of the airway and peripheral nodule structures. They will also provide scores for needle biopsy, the realism of the phantom, and its effectiveness as a training tool. Evaluation of phantom durability, portability, and maintenance will also be performed.  WP4: Write-up, hand-over, and dissemination [Week 8]  Other considerations: This study is exempt from ethical approval from HRA and therefore deliverable in the proposed project duration.  === References  1. Vilmann P et al. Eur Respir J 2015; 46: 40-60.  2. SehgalI et al. Respirology. 2017;22:1547-1557  3. Wahidi MM, et al. Chest 2016;149:816-35.  4. Kennedy CC, et al. Chest. 2013;144:183-192.  5. Mackle et al. Proc. SPIE 10870, Design and Quality for Biomedical Technologies XII, 108700P  6. Maneas E, et al. World Congress of Bronchoscopy and Interventional Pulmonology 2022  7. Downing SM. Validity: on meaningful interpretation of assessment data. Med Educ 2003; 37: 830-837  Skills and clinical observation opportunities students will gain from this project: The student will work very closely within a multidisciplinary team that spans thoracic medicine at UCLH and engineering at UCL. This studentship is designed to give the undergraduate student an opportunity to shadow clinicians and take part in a translational research project at UCLH.  The studentship will offer at least 2 weeks of clinical experience at UCLH working amongst clinical teams, with the rest of the project focussed on the research aims. These clinical opportunities will comprise the following:  - comprehensive testing of the phantoms developed by the student, as a critical component of the project success. This testing will be performed with the student in a clinical setting at UCLH together with the lead clinician and the UCL collaborators;  - working together with the lead clinician to perform 3D segmentation, thereby gaining an understanding of anatomical features of the lung that are of critical interest for robotic bronchoscopy.  The following technical skills will be gained by close interaction with a team at the Wellcome-EPSRC Centre for Interventional and Surgical Sciences (WEISS), which includes Prof Adrien Desjardins, Dr Efthymios Maneas, and Ms Anastasia-Theodora Stoica.  - 3D medical image segmentation to identify structures of interest from anonymised patient data;  - 3D drawing to design the phantoms;  - Precision fabrication techniques including 3D printing.  UCL staff involved on the project: Dr Efthymios Maneas; Department of Medical Physics & Biomedical Engineering  Prof Adrien Desjardins; Department of Medical Physics & Biomedical Engineering  Pre-existing skills needed for this project: There are no pre-existing skills needed for this project. The student would ideally have a keen interest in working in a multidisciplinary team that comprises clinicians and engineers, and a hands-on approach in the laboratory and with digital tools. |
| 9 | Project title: Using vibration therapy for specialist rehabilitation following traumatic brain (TBI) and spinal cord injury (SCI)  Clinical unit: London Spinal Cord Injury Centre (LSCIC), RNOH  Lead clinicians: Mr Manish Desai, Consultant in Spinal Injury and Trauma Rehabilitation  Mrs Emma Linley, Clinical Specialist Occupational Therapist and Team Lead  Project outline: Previous work has been carried out looking at how vibrations can be used for rehabilitation post traumatic brain and spinal injury, in particular focused on spasticity. UCL staff at RNOH have experience in using Virtual Reality and Robotics, examining its effect on neuropathic pain within various patient cohorts. There is a push to produce low-cost systems involving frugal technology such as vibration which this project aims to initially investigate, looking at using sensors such as electroencephalogram (EEG) as a first step to integrate with existing systems and potentially maximise outputs for future studies.  Outputs: To conduct a feasibility study, initially on healthy populations on the cortical effects of vibration further advancing pre-existing studies the group have conducted. This will lead to a manuscript to be submitted for a journal publication. Secondly, work on how best to integrate vibrations into the pre-existing UCLTouchRehab system aimed at a patient population.  Skills and clinical observation opportunities students will gain from this project: An excellent understanding of how technology can be utilised within a clinical setting. First-hand experience on the ward to see how this technology could benefit patients, and how best to implement it with regards to patient and clinician input.  UCL staff involved on the project: Dr. Peter Snow and Prof. Rui Loureiro, UCL Department of Orthopaedics and Musculoskeletal Science  Mr Manish Desai Hon Associate Professor, Department of Orthopaedics and MSK science  Pre-existing skills needed for this project: An interest in applying technology to rehabilitation is essential, prior experience with using EEG would be highly beneficial. |
| 10 | Project title: Computer vision in endoscopic spinal surgery  Clinical unit: Spinal surgery department, department of Trauma and Orthopaedics, the Whittington Hospital. Spinal surgery department, the Royal National Orthopaedic Hospital  Lead clinicians: Lt Col David Baxter  Mr Michael Mokawem  Project outline: This project will use an existing stand alone AI GTU with a bank of endoscopic spinal surgery videos to train a computer vision AI to recognise the different types of tissue and instruments seen in endoscopic spinal surgery. Ultimately they will help develop a tool which will provide real time image analysis during surgery. The first 3 weeks of the project will involve frequent attendance at endoscopic surgery operating lists and clinical training events as well as remote training on the use of Tensor Flow. In the later part of the project hybrid working will be possible, whilst the student classifies the surgical data and trains the computer vision algorithm. They are expected to give a departmental presentation during this time and will be supported to present this work at a national conference and publish in a peer reviewed journal.  Outputs: The key outputs for this project will be a functioning computer vision algorithm which can perform instrument and tissue recognition in endoscopic spinal surgery. Secondary outputs will be a presentation at a national conference (clinical or/and computer vision) and a co-authored publication in a peer reviewed journal.  Skills and clinical observation opportunities students will gain from this project: Students will be expected to attend theatre lists at both the Whittington hospital and the Royal National Orthopaedic Hospital to observe endoscopic spinal surgery. They will be supported becoming proficient with Tensor flow and using Linux based operating systems and in image classification for endoscopic spinal surgery procedures. Previous students working with the group have presented at international conferences and co-authored papers.  UCL staff involved on the project: Professor Rui Loureiro, Create Laboratory  Dr Peter Snow, Create Laboratory  Pre-existing skills needed for this project: The ideal student will have demonstrable skills using Linux based operating systems and Tensor Flow software. They should have a basic understanding of artificial intelligence and specifically computer vision. Training will be provided but motivated students are encouraged contact the lead clinician prior to starting and will be offered on line training. |
| 11 | Project title: Improving pelvic rehabilitation using epidural stimulation in people with Spinal Chord Injury  Clinical unit: London Spinal Cord Injury Centre, RNOH  Lead clinicians: Mr David Baxter  Project outline: Spinal Cord Injury (SCI) is a life-changing event, affecting the control of limbs and organs, causing loss of sensation, changes in autonomic function, and many more debilitating consequences. Particularly devastating consequences of SCI are the loss of bladder, bowel and sexual functions, substantially impacting health, quality of life, and dignity.  Research focussed on pelvic function has been highlighted as a priority among the SCI population, however research in this field remains particularly limited. Recently, some significant discoveries have come from studies of epidural Spinal Cord Stimulation (eSCS) after SCI, which have been focused on recovery of lower limb function.  eSCS involves placing electrode arrays in the epidural space, which apply small electrical pulses to specific nerve roots (L1 through to S1 in this case). In studies where eSCS has targeted lower limb muscles, there have been participant reported improvements in bladder, bowel and sexual functions, including improved voiding efficiency, activation of the pelvic floor and detrusor muscles, and reduced time required for bowel management. As the eSCS was not configured to target pelvic function in these studies, the potential benefits may be substantially more than already reported.  In preparation for our 3-year research trial – ‘ImPRESS’ (Improving Pelvic Rehabilitation using Epidural Stimulation after Spinal cord injury), we have three potential student projects to develop some preliminary data / protocols.  As a team, we have capacity to take on one student, and could offer one of the following projects to a suitable candidate:  1. Matlab data  Lower limb mapping will be performed on all participants in the ImPRESS trial. A large amount of data is collected in mapping sessions, and we are developing Matlab code to assist with analysis. The student will analyse the data we have already collected, further develop the matlab code, conduct a literature review of mapping procedures used by other groups, and initiate a standard mapping protocol that can be used in future for new patients with SCI receiving epidural stimulators.  2. MRI image processing  The student will use software to process and analyse MRI images of the spine and spinal cord, to map where the nerve roots are in relation to anatomical landmarks. The outcome of this project will be to prepare a protocol of this process.  3. Review of bladder outcomes and programmes for individuals with eSCS  We have a small group of patients who are under the care of both Neuro-urology and the Neuromodulation team. These patients have had an epidural spinal cord stimulator implanted, and additionally had bladder investigations (urodynamics) performed. The student will analyse this data to review bladder outcomes and application of eSCS on a case-by-case basis.  Outputs: This will depend on which project is chosen. We expect they all to lead to a conference presentation and/or journal publication. The student will also develop procedures, protocols and/or codes that will be used in our ImPRESS trial.  Skills and clinical observation opportunities students will gain from this project: The student will learn about Spinal Cord Injury, treatment for bladder and bowel function after SCI, and the technology and neurophysiology associated with epidural spinal cord stimulation. The student will also have the opportunity to observe in clinical settings, including the placement of epidural electrodes in an operating theatre during spinal surgery.  UCL staff involved on the project: Lynsey Duffell, Department of Medical Physics & Biomedical Engineering  Pre-existing skills needed for this project: None, the student will be given the project (from the options above) most suited to their skill set. |
| 12 | Project title: Elucidating the Prognostic Value of Clinical and Tumor Factors in Metastases Treated with Stereotactic Body Radiotherapy (SBRT)  Clinical unit: GI Oncology, UCLH  Lead clinicians: Dr Douglas Brand  Prof Maria Hawkins  Project outline: Metastases, the spread of cancer from primary site to other organs, signify a complex and challenging stage in the disease course for many cancer patients, particularly those with colorectal cancer (CRC). Stereotactic body radiotherapy (SBRT) has emerged as a non-invasive and highly precise method for treating liver metastases. It allows the delivery of high-dose radiation to tumors while minimizing exposure to surrounding healthy liver tissue.  Although SBRT has shown promise for managing CRC metastases, there remains substantial variability in patient outcomes. Further understanding of the factors influencing SBRT effectiveness is essential for optimal patient selection and personalized treatment strategies. This project aims to investigate the specific clinical characteristics (such as the patient's overall health, primary cancer type) and tumor features (such as size, number, and location of metastases) that hold the strongest predictive value regarding patient response to SBRT. By identifying these key factors, we hope to improve risk assessment and refine treatment decisions for those facing this challenging form of cancer. Of further interest is comparing the outcomes for patients with CRC with other originating sites  Project Aims   * To identify key clinical features (e.g., patient age, performance status, primary tumor type) and tumor characteristics (e.g., size, number of lesions, location) associated with improved outcomes after SBRT for metastases. * To develop a prognostic model or scoring system to help predict patient outcomes, stratify risk groups, and guide personalized treatment decisions.   Methodology   1. Data Collection:    * Retrospective review of medical records for patients undergoing SBRT for metastases at UCLH.    * Collection of (e.g.):      + Patient demographics (age, sex, comorbidities)      + Primary tumor details (origin, histology)      + Metastasis specifics (number, size, location)      + SBRT treatment parameters (dose, fractionation)      + Outcome measures (overall survival, local control, toxicity) 2. Statistical Analysis Modelling:    * Descriptive statistics to characterize the study population.    * Univariate analysis to identify potential prognostic factors.    * Multivariate analysis to build a predictive model considering significant factors.    * Potentially, use Kaplan-Meier curves and log-rank tests for survival analysis.   Expected Timeline  Weeks 1-2 = Clinical observation. Outpatients, radiotherapy planning (all stages). Learning about the use of electronic health records and radiotherapy treatment planning systems. Development of initial database of patients.  Weeks 3-4 = Further clinical observation possible depending on interest. Development of systematic review of current literature (to form basis of future publications). Development of patient characteristic database.  Weeks 5-8 = Development of models that examine the interaction of clinical characteristics on outcomes. Additional clinical days can be arranged ad-hoc if strongly desired. Some write up of results should occur before end of placement, ideally to abstract format.  Outputs: Completion of a clinical service evaluation;  Present findings as a conference abstract;  Write up findings into a full-length research paper or letter.  Skills and clinical observation opportunities students will gain from this project: Understanding of clinical activities involved in cancer treatment pathways; Familiarity with medical imaging types in common use, particularly in a radiotherapy context; Radiotherapy plan interpretation and analysis; Data analysis and statistics skills; Data presentation skills.  UCL staff involved on the project: Dr Douglas Brand  Prof Maria Hawkins  Pre-existing skills needed for this project:  None essential. Some knowledge of data analysis helpful but can be taught. |
| 13 | Project title: Studying the Variability in the Shape of the Intramedullary Femoral Canal Using Statistical Modelling  Clinical unit: RNOH - Surgical Technology Laboratory  Lead clinicians: Mr Johann Henckel  Project outline: The functionality and long-term survivorship of total hip arthroplasty (THA) is dependent on a number of factors, including accurate positioning of the prosthetic components.  Intra-operative positioning of the stem (the femoral part of the THA) is limited in uncemented THA, given that the shape of the internal femoral canal dictates the final fit of the prosthesis. Current predictions of the prosthetic femoral version (PFV) are inaccurate and therefore, better understanding the internal geometry (anatomical variations) of the femur may lead to more accurate predictions leading to better patient outcomes.  The aim of this study is to use Statistical Shape Modelling (SSM) to describe the most common types of 3D shape variations of the intramedullary canal of the proximal femur. The objectives are; 1) build a dataset that is consistent and suitable to train the SSM; 2) use Principal Component Analysis (PCA) to extract the main modes of variation; 3) use feature-based measurements to associate each PCA to a known anatomical characteristic of the canal.  This study will involve the analysis of pre-operative pelvic CT scans of patients who subsequently underwent THA using uncemented stems of a single design. The patients' femoral canals will be rendered using medical image analysis software. From a number of datasets an average shape of the anatomy will be generated and the point mapping between each input shape and the mean shape will be performed. PCA will then be used to analyse the dataset and capture the main features which are variable amongst the patients.  Outputs: The study of the variability of the intramedullary femoral canal will inform planning of implant component placement (e.g. stem position) to optimise function, range of movement and implant longevity. We would expect the results of this study to be written up as a manuscript for peer-review.  Skills and clinical observation opportunities students will gain from this project:  Clinical Observation Opportunity (e.g. attending operating theatres, outpatients to learn about the clinical problems linked to the project). Image segmentation training. Improving presentation skills.  Better understanding of imaging used in clinical settings.  UCL staff involved on the project: Engineering Supervisor: Dr Anna Di Laura, Department of Mechanical Engineering  Pre-existing skills needed for this project: Student with interest and background in bioengineering, biomechanics in orthopaedics,  multidisciplinary research. The project will include 3D image analysis and the use of  state-of-the-art software solutions for image segmentation and registration. |
| 14 | Project title: Application of Statistical Shape Modelling to Restore the Centre of Rotation in Total Hip Replacement  Clinical unit: RNOH - Surgical Technology Laboratory  Lead clinicians: Mr Johann Henckel  Project outline: Total Hip Replacement (THR) is often needed to restore hip joint function and relieve pain. Restoration of the centre of rotation (CoR) allows for an improved kinematic of the hip, decreasing the risk of implant loosening, patient dissatisfaction and failure.  The aim of the project is to aid the surgical planning of primary hip surgery using Statistical Shape Modelling SSM. SSM will be applied to a set of patients who previously underwent primary hip replacement. 3D reconstructions of the diseased hips (patients with Osteoarthritis have altered acetabular anatomy) will be generated from computed tomography (CT) scans using medical image segmentation techniques. A virtual representation of the native pelvic morphology of each case will be reconstructed using SSM. The difference in hip joint centre between the CoR predicted by the statistical model and the one achieved postoperatively will be calculated.  The SSM-based virtual reconstruction of the defect as well as the difference in hip joint centre will inform the surgical planning of primary hip reconstruction and guide the positioning of the acetabular component. This will ultimately optimise acetabular component orientation and position and reduce the need for revision surgery.  Outputs: The study of the variability of the acetabular shape will inform planning of implant component placement (e.g. cup position) to optimise function, range of movement and implant longevity. We would expect the results of this study to be written up as a manuscript for peer-review.  Skills and clinical observation opportunities students will gain from this project: -Medical image analysis (generating 3D models of patient anatomy from CT data)  -Analytical and problem-solving skills  -Knowledge of healthcare informatics  -Building a statistical shape model and conducting PCA  UCL staff involved on the project: Engineering Supervisor: Dr Anna Di Laura, Department of Mechanical Engineering  Pre-existing skills needed for this project: Student with interest and background in bioengineering, biomechanics in orthopaedics,  multidisciplinary research. The project will include 3D image analysis and the use of  state-of-the-art software solutions for image segmentation and registration. |