Jan 17, 2024

NSERC USRA 2024

Undergraduate Student Biomedical Instrument Developer

Optical Cancer Imaging Lab

The Optical Cancer Imaging Laboratory (OCIL) at the British Columbia Cancer Research Centre (BCCRC) is seeking enthusiastic students for research and development of non-destructive optical instruments for early cancer detection and diagnosis. BCCRC presents a unique experience for students in a multidisciplinary clinical and research environment.

Optical Coherence Tomography (OCT) is the optical analog to ultrasound imaging, but it has higher resolution. We are developing this technology for medical imaging in the oral cavity and endoscopic imaging in the lung. We currently have multiple OCT and OCT-autofluorescence systems at the BCCRC for both clinical and laboratory imaging. These systems are constantly being upgraded for increased functionality and performance.

OCT systems require state-of-the-art multi-domain (optical, mechanical, electrical, computational) technologies and expertise. Previous co-op student OCT projects have included data acquisition system programming, OCT probe development, data analysis algorithm development, and human and animal imaging.

The following projects are under consideration for the term starting May 2024.

1. Optomechanical Interface Design for Image Catheters

Our imaging catheters scan by rotating an optical fiber and lens assembly inside a stationary clear plastic tube less than 1mm in diameter. The lens and fiber are “pulled back” in the tube for volumetric (3-D) imaging. The imaging catheter connects to a rotary-pullback device (RPD) which activates the fiber motion. The interface between the RPD and catheter must transmit mechanical torque and translation to drive the optical fiber, couple light across the interface, and allow for the imaging catheter to be quickly and easily disconnected. Our current design has several shortcomings, including misalignment, connection failures, and difficulty to use in a clinical setting. We are looking for a capable student to design and test revisions to the interface that would address these issues. This project includes the design and construction of revised optomechanical interfaces, including small optical and mechanical assemblies, modification of firmware for automation, and analysis of findings.

2. Firmware Developer – Optical Scanner

We have developed three optical scanners for research that share a common USB interface. Different scanning geometries are possible, including, optical fiber scanning (rotation and pullback of an optical fiber), micro motor scanning (rotation of a small mirror and pullback of the mirror-motor assembly), and dual-galvanometer mirror scanning. The firmware for the first two scanners has been completed and the third one requires implementation. It is expected that existing code (written for a desktop computer) can be ported to this embedded application. This project requires a solid background in firmware development, embedded system design, and electronics hardware. The scanner platform is based on a Microchip PIC24. The most qualified candidates will have previous experience with this microcontroller, familiarity with git, MPLAB, and Visual Studio.

3. Neural Network based Segmentation Tools

We have discovered that airway dilation correlates with the likelihood of a lung transplant patient experiencing chronic lung allograft dysfunction (chronic transplant rejection). We are looking to further develop a deep learning image processing tool to segment and quantify dilation from three-dimensional images of the small airways. We are also interested in modifying existing deep learning tools developed for the oral cavity for application in segmentation of OCT images acquired in the lung and fallopian tubes cavity. This project may include manual segmentation, neural network development, classical image processing, feature selection, and analysis.

QUALIFICATIONS

Preferred candidates will be in their senior years of a multidisciplinary engineering program, have an outstanding academic record, and previous work experience. These are challenging positions that require a high degree of creative problem solving and non-routine work. Experience with lasers, optics, fiber optics, small mechanical assemblies, actuators, electronics hardware, machine learning, and MATLAB are assets. Excellent oral and written communication and documentation skills are a necessity. Students will be expected to work with a high degree of independence and autonomy.

Interested candidates should forward an application (resume and transcript) to Pierre Lane (plane@sfu.ca) with “2024 USRA” in the subject line by Feb 1st, 2024.