Finite element mechanical modeling for dynamic optical coherence elastography

Brief Description of Design Project Goals:

Overview:
The aim of this project be to develop and investigate finite element modeling approaches to determine the best mechanical approach to describe the OCE response of various tissue phantoms and biological tissues. Optical coherence elastography (OCE) is a new biomedical imaging technique to improve upon the ancient practice of diagnosing diseased tissue (e.g. tumors) by manual palpation. OCE is an example of a class of elastography techniques that can generate images based on the mechanical properties of tissue. Elastography works by mechanically perturbing/exciting the sample and measuring the resulting displacements with an imaging system. These displacements can then be utilized to deduce the underlying viscoelastic mechanical properties of the sample. OCE can provide higher resolution and displacement sensitivity, than its ultrasound or MR counterparts by leveraging the high-resolution and exquisite phase-sensitivity of an optical coherence tomography (OCT) system. Recent work in OCE is beginning to explore tissue mechanical properties through dynamic/harmonic excitation in the audio frequency regime. One promising line of research is mechanical spectroscopy – measurement of the frequency dependent mechanical response. Like other methods of spectroscopy, there is a potential for rich information, but this area of OCE is largely unexplored. In this project the MEng student/s will implement various viscoelastic mechanical models in a commercial FEM software package such as COMSOL, ANSYS, or Abaqus. These investigations will determine which mechanical modeling approaches best describe spectroscopic OCE experimental data of various tissue phantoms and biological tissues.

Specific MEng Contribution:
This project will provide the simulation results to interface with the experimental spectroscopic OCE project. The MEng students will implement FEM models based on different viscoelastic mechanical models, to (a) determine which model provides the best description of the OCE data from different biological tissues, and (b) utilize OCE data to reconstruct 3D maps of quantitative mechanical properties.
Advisor Name: Prof. Steven Adie
Email – sga42@cornell.edu
Phone - 607-255-2656
Office – B61 Weill Hall
Project Web Site: http://adie.research.engineering.cornell.edu

Number of MEng Students Needed: 2

Desired Skills:
Expertise in signal processing (MATLAB), FEM or mechanical modeling experience (COMSOL preferred), motivated to do biomedical imaging research.
Estimated Project Time Frame:
Fall 2016 + Spring 2017 semesters