Department of Electrical and Computer Engineering
University of Rochester, Rochester, NY
Ph.D. Public Defense

Thursday, October 29, 2015
10:00AM
Hopeman Engineering Building, Room 224

Shear Wave Imaging and Tissue Characterization Using Vibration Elastographic Techniques

Alexander Partin

Supervised by
Professor Kevin J. Parker

Abstract

Certain diseases produce changes in the elastic properties of soft tissues. Conventional imaging modalities in some cases have poor performance in diagnosing these types of diseases. To overcome this problem, elastographic imaging techniques that focus on evaluating the elastic properties of tissues, *i.e.*, tissue stiffness, have been developed in the past three decades. Soft tissues, however, inherently incorporate both elastic and viscous characteristics. Relatively few studies are available that examine the potential diagnostic contribution of tissue viscous properties, and the effect of tissue viscosity on the evaluation of tissue stiffness with existing elastographic techniques.

The main goal of this dissertation is to contribute to the development of elastography imaging for characterizing the viscoelastic properties of soft tissues with a particular focus on liver tissue. The crawling waves and vibration transient sonoelastography imaging techniques have been investigated in this thesis and applied to tissue-mimicking phantoms and liver specimens. Both techniques employ mechanical vibration sources to induce shear waves in tissue and an ultrasound imaging system to track and display the shear wave propagation.

The crawling waves imaging technique, which generates planar shear wave interference in tissues, is implemented on *ex vivo* mouse and rat livers with various degrees of fat concentration. Based on the experiments, higher amounts of triglyceride fats in animal liver specimens result in increased shear speed dispersion slope. A modified configuration of the crawling waves experimental setup and the local shear speed estimation algorithm are proposed which are more suitable for *in vivo* applications. This method is applied to homogeneous and heterogeneous phantoms, and *ex vivo* human liver.

The vibration transient sonoelastography imaging technique is also introduced. This technique is implemented with an ultrasound system with high frame rate acquisition capabilities. A processing algorithm is proposed for mapping the local shear speed in biomaterials. This technique is validated against the crawling waves technique and implemented on homogeneous and heterogeneous phantoms, and *ex vivo* bovine liver.