Notice and Invitation

Oral Defense of Doctoral Dissertation

The Volgenau School of Engineering, George Mason University

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Bachelor of Science, Clemson University, 2004

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Displacement Estimation in Pulsed Wave Ultrasound Based on Regression of the Phase Spectra

Wednesday, April 25, 2018, 3:00 p.m. – 4:30 p.m.

ENGR 4801

All are invited to attend

Committee:

Dr. Siddhartha Sikdar, Chair

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Abstract

Ultrasonic imaging provides a means of non-invasive analysis of biological structures. In emerging medical ultrasonic imaging applications such as functional imaging and elastography, analysis of tissue motion provides information on cell properties or state; such as activation in functional imaging or strain in elastography. Over the past several decades a number of methods have been developed to estimate either the displacement or the velocity of tissue. The performance of these methods is impacted by speckle, a term used to describe the constructive and destructive interference that occurs as the transmitted signal propagates through tissue and undergoes specular and diffuse reflections from a multitude of scatterers. The estimation errors induced by speckle applies practical limitations on the spatial and temporal resolution achievable by displacement estimation methods. This dissertation explores the fundamental assumptions of the underlying signal models on the processing algorithms used to calculate displacements and velocities in the presence of speckle. In doing so, a displacement estimation algorithm derived from the received signals' phase spectra is developed. The phase spectral displacement estimator is shown to enhance the analysis of tissue motion in the presence of speckle by providing a measure of estimator reliability and increased robustness to bias and aliasing. These benefits are commonly reserved for frequency-domain techniques requiring sufficient temporal sample support but are achieved here with only two samples. Examples of the estimator applied to simulated and experimentally collected data are shown.