UNIVERSITY of HOUSTON | ENGINEERING
Department of Biomedical Engineering

Ph.D. Dissertation Defense

# Assessing the Biomechanical Properties of Cornea using Optical Coherence Elastography

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**Engineering Building 1, Room 202: 11:00 AM**

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**Speaker: Jiasong Li**

**Abstract:** This defense reports on the development of measurement methods to assess the biomechanical properties of cornea based on low-coherence optical imaging, focusing on optical coherence elastographic techniques, to meet the growing demand for noninvasive high-resolution tissue characterization with improved diagnosis and treatment of ocular diseases. The research work was based on optical coherence tomography (OCT), a rapid, high-resolution, three-dimensional imaging modality that enables noninvasive depth-resolved imaging. The work is summarized in seven sections: 1) characterization the biomechanical properties of tissue mimicking phantoms, an ocular phantom, and mouse cornea in vivo using OCE; 2) assessment the biomechanical properties of mouse corneas of different ages in vivo using air-pulse OCE; 3) the development of a method to spatially map the localized elasticity of the rabbit cornea in situ after partial riboflavin/UV-A corneal collagen cross-linking using OCE; 4) rapid characterization of the biomechanical properties of porcine corneas before and after UV-induced collagen cross-liking at different intraocular pressures by OCE; 5) the development of method to differentiate untreated and cross-linked porcine corneas of the same measured stiffness with OCE; 6) evaluation of the effects of Riboflavin/UV-A corneal collagen crosslinking on porcine corneal mechanical anisotropy with noncontact OCE; 7) a comparison of two non-contact methods to assess mechanical properties of tissue mimicking phantoms: optical coherence elastography and Michelson interferometric vibrometry. These techniques, methods and applications are demonstrated with the experiments performed on tissue mimicking phantoms (gelatin, agar, and silicone) and corneas (mouse, rabbit, porcine, both ex vivo, in situ, and in vivo) under different conditions (normal vs. cross-linking, various intraocular pressures, etc.). This defense represents the frontier and emerging research area of optical coherence elastography and is expected to contribute to the field of biomechanical assessment with research and clinical based applications.