The basic imaging paradigm of medical US has remained unchanged, namely image formation results from transmission-reception of 180 degree backscatter assuming straight-line propagation. Our group has developed Quantitative Ultrasound CT (USCT) that creates images of the breast from the full 3D scatter field including both transmitted and reflected signals. While modern US provides a two-dimensional map of relative tissue "echogenicity," USCT computes quantitative 3D maps of tissue acoustic properties including sound speed, attenuation, scatter density, etc., as approximations of components of the wave equation. The method corrects for refraction, absorption, multiple scattering and more. High resolution reflection tomography is performed in which the sound speed and attenuation maps are utilized for aberration correction to significantly improve image quality. Clinical measurements suggest that in breast tissue, benign lesions and cancerous lesions may be identified by these inherent acoustic. The scanner uses a multi-frequency non-linear 3D inverse-scattering algorithm and despite the historical computational complexity of the problem, our method is fast and practical. Conventional breast sonography is a notoriously difficult exam to perform; the quality is dependent on the skill of the operator as well as technical features of the scanner. In order to obtain the needed high resolution, the field of view in sonography is very small, which greatly complicates interpretation and localization of masses. USCT promises an automated whole-breast scan providing a global view of the entire breast in 3D, facilitating comparison to prior exams in a reproducible geometry. Results of our trial with over 150 subjects with confirmed breast masses will be presented with detailed comparison to conventional sonography and MRI.

Learning Objectives:

1. Understand the principles of inverse-scatter tomography.
2. Understand the unique data acquisition and processing applied in ultrasound computed tomography.
3. Understand the potential clinical advantages of quantitative whole breast ultrasound imaging.