

Ultrasound is a widely accepted imaging modality that has gained a firm and universal foothold in medical imaging. However, in the case of breast imaging, it serves mainly an adjunctive role. It is not on the front lines of screening and diagnosis because of limitations that include operator dependence, small field of view, and relatively poor image quality compared to other imaging modalities. Research to overcome these limitations began over 30 years ago and has led to the development of ultrasound tomography (UST), an operator independent technique for imaging the breast. Initially, limited computational power and slow data acquisition prevented rapid development of this method. However, in recent years, much progress has been made and UST is now poised to appear on the clinical stage.

We report on the performance of an experimental UST prototype at the Karmanos Cancer Institute (KCI) in Detroit, MI. Clinical data were collected under an IRB-approved protocol from subjects recruited at KCI's Alexander J. Walt Comprehensive Breast Center. The data were used to generate stacks of cross-sectional reflection images as well as images of the acoustic parameters of sound speed and attenuation. The combination of these images reveals major breast anatomy, including fat, parenchyma, fibrous stroma and masses. Fusion imaging, utilizing thresholding, is shown to visualize mass characteristics and facilitate differentiation of cancer from benign masses. These initial results indicate that operator-independent whole-breast imaging and the detection and characterization of cancerous breast masses are feasible using UST techniques. Clinical applications ranging from risk assessment to detection and treatment monitoring are discussed.

This presentation will provide an overview of how UST is applied to breast imaging, ranging from theory to clinical use.

Learning Objectives:

1. Understand how tissue properties can be measured with UST
2. Understand the differences between UST and other breast imaging modalities
3. Understand the issues related to clinical applications of UST.