AbstractID: 6803 Title: Evaluation of Breast Density Using Sound Speed Measurements

Purpose: Women with high mammographic breast density are at a 4- to 6-fold increased risk of developing breast cancer compared to women with fatty breasts. The purpose of this investigation was to confirm preliminary acoustic velocity measurements for breast density assessment, and to evaluate them with the current standard of care.

Method and Materials: A sample of ~100 patients was imaged with our computed ultrasound tomography clinical prototype with each dataset comprised of 45-75 tomograms ranging from near the chest wall through the nipple region. Whole breast acoustic velocity was determined by creating image stacks and evaluating the sound speed frequency distribution. The acoustic measures of breast density were evaluated by comparing these results to two mammographic density measures: (1) qualitative, as determined by a certified radiologist using the BI-RADS Categorical Assessment based on a 1 (fatty) to 4 (dense) scale, and (2) quantitative, via digitization and computerized analysis of archival mammograms. The former involved a radiologist's visual assessment of each mammogram, while the latter required digitizing cranio-caudal (CC) and mediolateral oblique (MLO) mammograms and implementing semi-automatic segmentation routines.

Results: Approximately 140 m/s difference in acoustic velocity was found between the fatty and dense BI-RADS Categories, with statistically significant differences in mean sound speed demonstrated between *each* category (ANOVA, $\alpha = 0.05$). In addition, an increased sound speed was exhibited with increased BI-RADS Category. Furthermore, moderately strong positive associations were demonstrated between mean acoustic velocity and quantitative measures of mammographic percent breast density for both MLO and CC views ($r^2 = 0.65$-0.76), respectively.

Conclusion: These results confirm the hypothesis that utilizing acoustical velocity can be used as an indicator of breast tissue density. Having an operator independent and non-ionizing means of whole-breast density evaluation has important clinical implications which include tracking temporal changes, identifying high-risk populations, and evaluating treatment response.