

AbstractID: 7675 Title: Calibration of bent-ray ultrasound tomography and its application to breast cancer detection and diagnosis

Purpose: Travel-time tomography plays a central role in our current ring transducer array (Computerized Ultrasound Risk Evaluation -- CURE) study of patients with suspicious breast masses. To properly calibrate an algorithm used for bent-ray tomographic inversion of clinical ultrasound data, the following issues need to be addressed: balancing the data contribution and an *a priori* model, determining the stopping criteria for the iteration of the inversion, and estimating the resolving power of the tomography algorithm, that is, determining the reliability of the inversion.

Method and Materials: In this study, quantitative assessments of the above issues are made based on synthetic models. The simulated ultrasonic data are generated using a high-order finite-difference time-domain acoustic-wave equation to model wave propagation through different numerical breast phantoms. The breast models are obtained by digitizing the reconstructed images of patient data and phantom data scanned by the CURE device. Checkerboard and perturbation tests are also performed to provide a quantitative estimate of the resolving power of the bent-ray tomography algorithm. Guided by the synthetic study, the tomography algorithm with optimum parameters is applied to *in-vivo* patient data acquired using CURE for breast cancer detection and diagnosis.

Results: Our series of synthetic simulations show that an optimum trade-off parameter can be chosen effectively using L-Curve analysis. In addition, the stopping criteria can be chosen based on convergence rates of the iteration. Checkerboard and perturbation tests set a quantitative upper limit of the resolving power of the bent-ray tomography for ultrasound data acquired with a ring array.

Conclusion: Calibration of the bent-ray tomography algorithm provides a high degree of confidence in tomographic inversion results, and helps in obtaining optimal tomographic images from *in-vivo* ultrasound breast data.