

**Purpose:** To increase interpretability of ultrasound and to measure respiratory motion.

**Method and Materials:** An ultrasound probe is affixed to a position-sensing articulating arm, and the calculated ultrasound image plane is dynamically intersected with a 3D CT image volume. The resulting synchronized ultrasound/CT image pair is superimposed on a multi-layer display or blended on a single monitor for real-time presentation.

Additionally the ultrasound stream is captured to file along with regularly sampled system transformations, and the ultrasound/CT image pairs can be extracted at a later time. The system is calibrated with derivations of the transformations among the coordinate systems of the patient, ultrasound probe, and articulating arm. The system was tested by capturing image pairs using a QA phantom, and calculating the proximity of registered points. Specifically, identifiable points were registered in the ultrasound image, and the transformations used in deriving the CT image plane were applied to those points. Distances were calculated between those transformed ultrasound points and the corresponding points in the CT image.

**Results:** In 12 experiments, the mean distance between the transformed ultrasound points and the corresponding CT ranged from 1.13 mm to 1.80 mm, with standard deviation between 0.81 mm and 1.76 mm, and maximum distance between 4.56 mm and 12.08 mm. The results were not consistently affected by the position or orientation of the phantom with respect to the articulating arm, nor by the depth of the image plane.

**Conclusion:** The system provides real-time and post-imaging super position of ultrasound and CT images, with displayed accuracy better than 2 mm. The high resolution of the CT image provides accurate context for interpreting the ultrasound. Moreover, it provides a static reference for observing and calculating the effect of respiratory motion and other real-time factors on patient anatomy. Work is funded by NIH grant 1RO1EB002899.