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A Multi-Modal Ultrasound Breast Imaging System

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The Multimodal Ultrasound Breast Imaging System (MUBI) is a joint development of the Spanish National Research Council (CISC) and the Complutense University of Madrid (UCM). It is intended to be a flexible platform for multi-modal ultrasound imaging research, mainly oriented to breast diagnosis. Up to now, the following imaging techniques have been implemented: Phased-Array full angle spatial compound (FASC), Acoustic Radiation Force Imaging (ARFI) and Ultrasound Computed Tomography (USCT).

(2) Material and Methods

The first prototype is formed by two arrays that rotate into a water tank, controlled by independent stepper motors. A full parallel ultrasound system is used for excitation and signal acquisition. While only one array can be used as emitter, both of them can act as receivers, allowing pulse-echo and through-transmission operation modes. The system is able to perform emission and reception beamforming in real-time, and also gives access to the individual signals received by each array element. A standard personal computer controls the motors movement and the ultrasound equipment with Matlab scripts.

(3) Results

An automated algorithm was developed for detecting the breast contour and correcting the beam propagation path before the scan conversion in Full Angle Spatial Compound (FASC) of phased-array sector-scan images, reducing texture speckle and improving contrast-to-noise ratio. For Acoustic Radiation Force Impulse (ARFI), a specific full angle spatial compound algorithm was developed, including depth, angle and focal length equalization of individual displacement images. Ultrasound computed tomography (USCT) was also implemented, developing fast reconstruction algorithms of speed of sound and attenuation maps. In all cases, the algorithms were evaluated with signals acquired on tissue mimicking phantoms.

(4) Discussion and Conclusion

The MUBI platform has proven to be a flexible experimental tool for research in breast ultrasound. Several imaging modalities have been successfully implemented and tested with tissue mimicking phantoms. Current developments include a second hardware version with a complete ring of 16 arrays, reducing acquisition time by eliminating the circular movement.

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