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VERIFYING ULTRASOUND BEAM PREDICTION MODELING FOR BREAST TUMOR TREATMENT

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OBJECTIVES
This study aims to experimentally verify the efficacy of a rapid ultrasound beam modeling algorithm in heterogeneous tissue-mimicking phantoms.
METHODS
Three heterogenous phantoms (102x30 mm, 250 bloom, 70% milk) were constructed with a ballistics gelatin recipe containing inclusions of canola oil. Acoustic properties were measured using through-transmission and radiation force balance techniques. With the phantom placed in the near-field of the ultrasound beam, a scanning hydrophone (Onda, HNR-0500) was used to measure the 2D pressure patterns created at the geometric focus of the focused ultrasound beam (f=940 kHz, 256 elements). Numerical models were created of the phantom using MRI scans, and the experimental data was compared to pressure patterns simulated with the Hybrid Angular Spectrum (HAS) acoustic simulation algorithm [1].
RESULTS
The experimental and simulated peak pressures differed by 9 ± 6 %. The average difference for full width half maximum of the beam over all three directions was 14 ± 7 %. The root mean square difference normalized was 7 ± 1 %.
CONCLUSIONS
HAS is a full-wave acoustic simulation algorithm shown to accurately predict pressure of a focused ultrasound transducer in heterogeneous environments. Because HAS is significantly faster than other acoustic modeling techniques (runs in seconds rather than hours), it is a potentially valuable clinical tool [1]. Experimental validation using magnetic resonance temperature imaging techniques in both phantoms and in vivo environments is ongoing.
ACKNOWLEDGEMENTS
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REFERENCES
[1] Vyas et al., IEEE Trans Ultra Ferro Freq, 59(6), 2012.

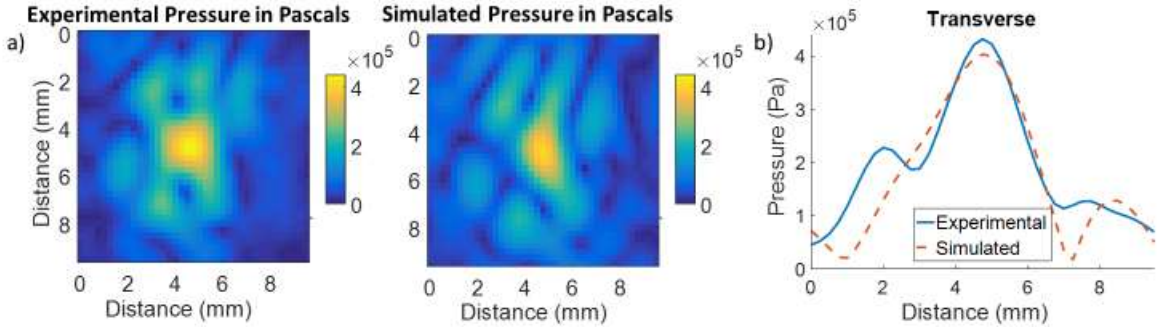

FIGURE 1: Comparison of hydrophone measurement and HAS simulation in (a) transverse plane and (b) transverse peak pressure trace after propagating through a heterogeneous phantom.