Development of an Acoustic Clutter Generating Phantom

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Background, Motivation and Objective

In vivo ultrasonic imaging is plagued by acoustic clutter. The abdominal wall produces reverberation and aberration that reduces the conspicuity of underlying structures. Phantoms are commonly used to test ultrasound systems and beamforming methods in laboratory settings, but these low noise environments fail to approximate *in vivo* conditions in the clinic. To address this gap, we have developed a clutter-generating material that could be placed on top of a traditional phantom to generate clutter levels similar to that of an abdominal wall.

Statement of Contribution/Methods

We have developed a method by which a phantom created from agar, alcohol, and mineral oil can be fabricated with tunable levels of acoustic clutter. Agar spheres with diameters ranging from 0.6-2.5mm were stored in water/alcohol solutions that were 1.5% Germall Plus and between 0% and 15% 1-propanol by volume (n=3 per concentration of 1-propanol). After being stored in the water/alcohol solutions, the spheres were strained and transferred to a solution of mineral oil and 1.5% Germall Plus. 1cm of the agar-oil phantom material was placed above an ATS Model 549 phantom containing 8mm diameter anechoic cylinders. Images were acquired with a Verasonics Vantage 256 scanner, a P4-2v array, and a focal depth of 5cm. This data was used to assess contrast, contrast-to-noise ratio (CNR), and lag-one coherence (LOC), a validated predictor of channel signal-to-noise ratio (Long et al, 2018).

Results/Discussion

The speeds of sound of the agar spheres in water/alcohol solutions were in the range of 1500-1600m/s for concentrations of 1-propanol of 0-15%. When the spheres were transferred to mineral oil (c =1440m/s (Selfridge, 1985)), the differences in speed of sound produce clutter. The agar-oil mixtures produced monotonic decreases in contrast, CNR, and LOC; image quality worsened with increasing 1propanol concentration. The contrast, CNR, and LOC are shown for each batch as the average of the metric across five realizations of the agar-oil mixture. The measured contrast was between 0.8dB and 13.1dB, CNR was between 0.1 and 1.8, and LOC was between 0.1 and 0.6. With this wide range of reproducible image qualities, this clutter generating phantom shows promise as a useful tool for ultrasound development. Future work will include characterizing the stability of the prepared phantoms through time.



Image Quality with Varying 1-Propanol Concentration