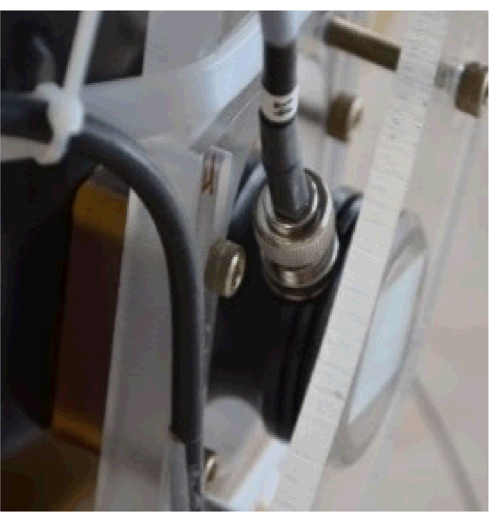
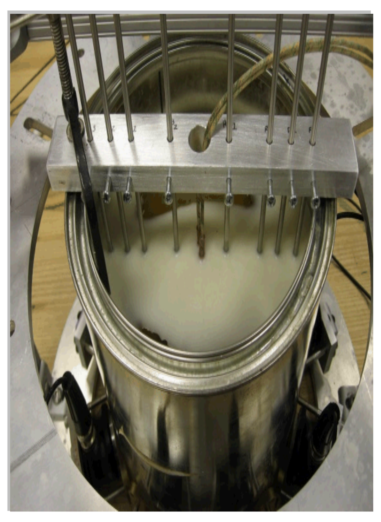
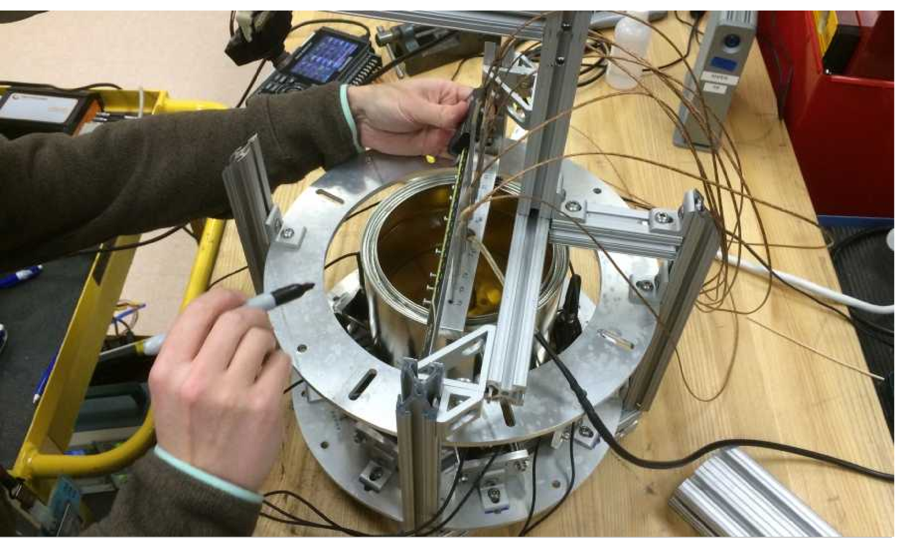
SAND2017-8573D





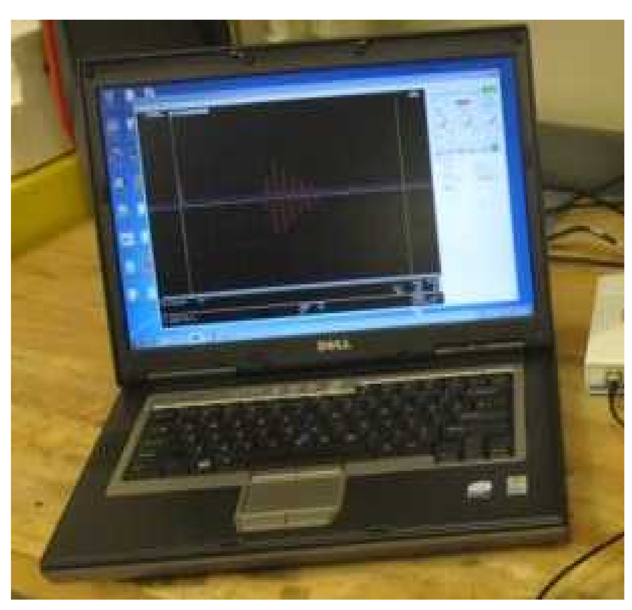


Thermal Gradient Measurement

David G. Moore, Ciji L. Nelson and Sarah L. Stair, NDE Department

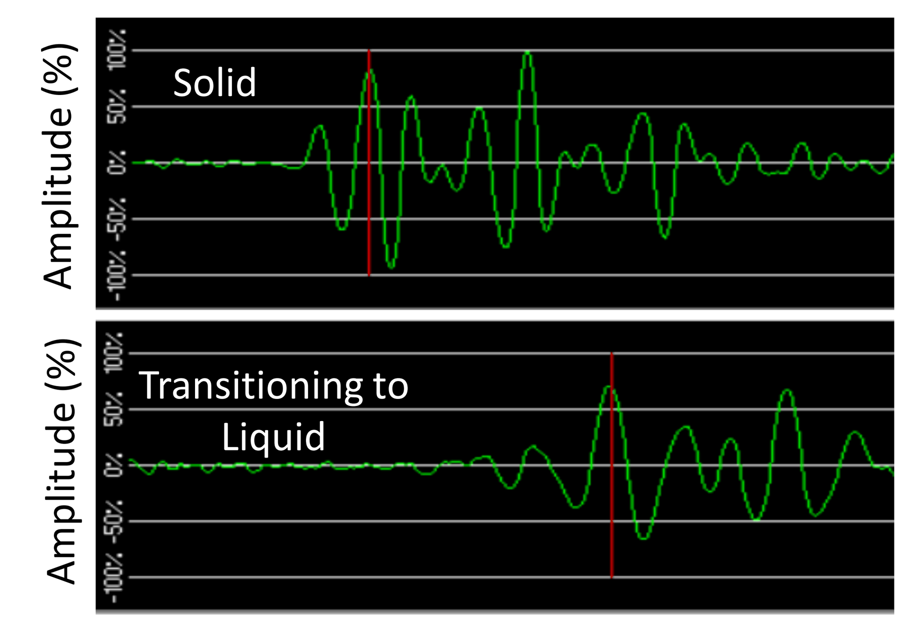
Ultrasound - Experimental Analysis

An ultrasonic inspection system that will allow non-invasive measurements of a thermal gradient and melt zones within highly dispersive waxes and energetic materials has been developed. Throughout the experiment, the material is exposed to a heat source and an ultrasound wave propagates through the dispersive media while the time of flight data is recorded. Relatively small variations in measured wave velocity and signal attenuation can quantify significant variations within a material's microstructure, such as a phase change from solid to liquid.



Data collection setup

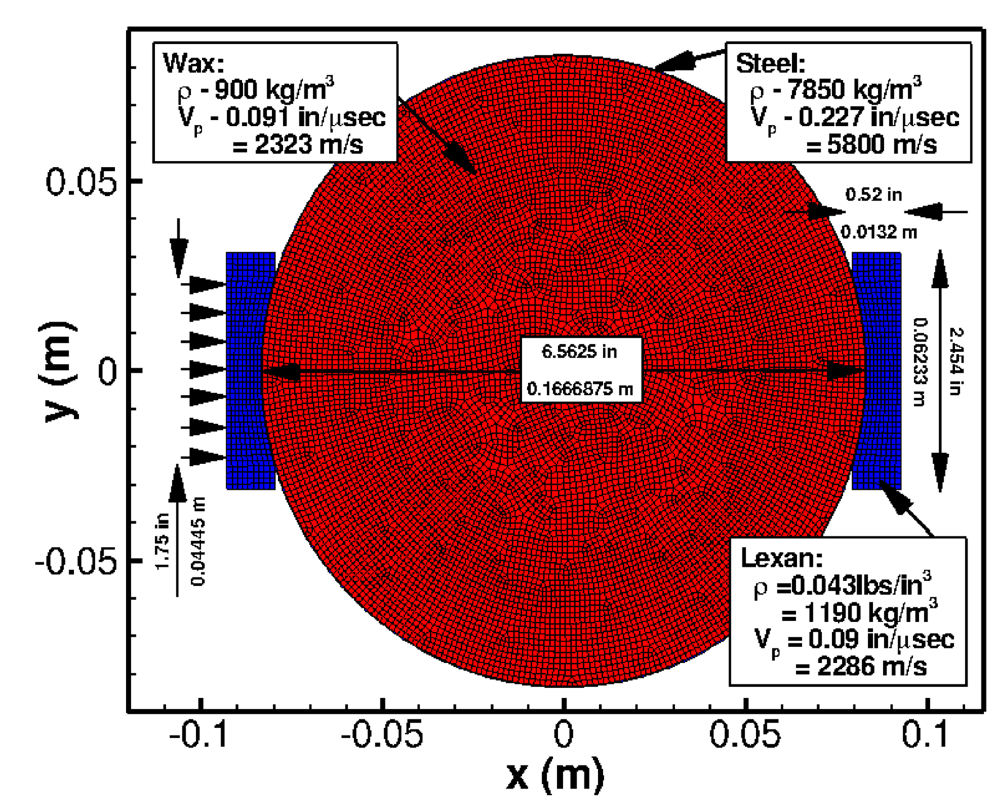
Experimental setup



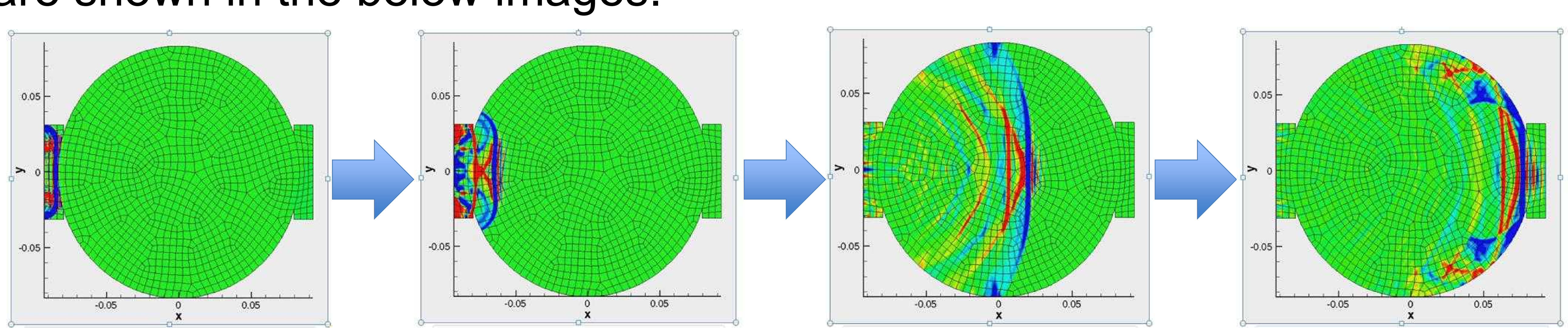
A-scan comparison

Finite Element Model

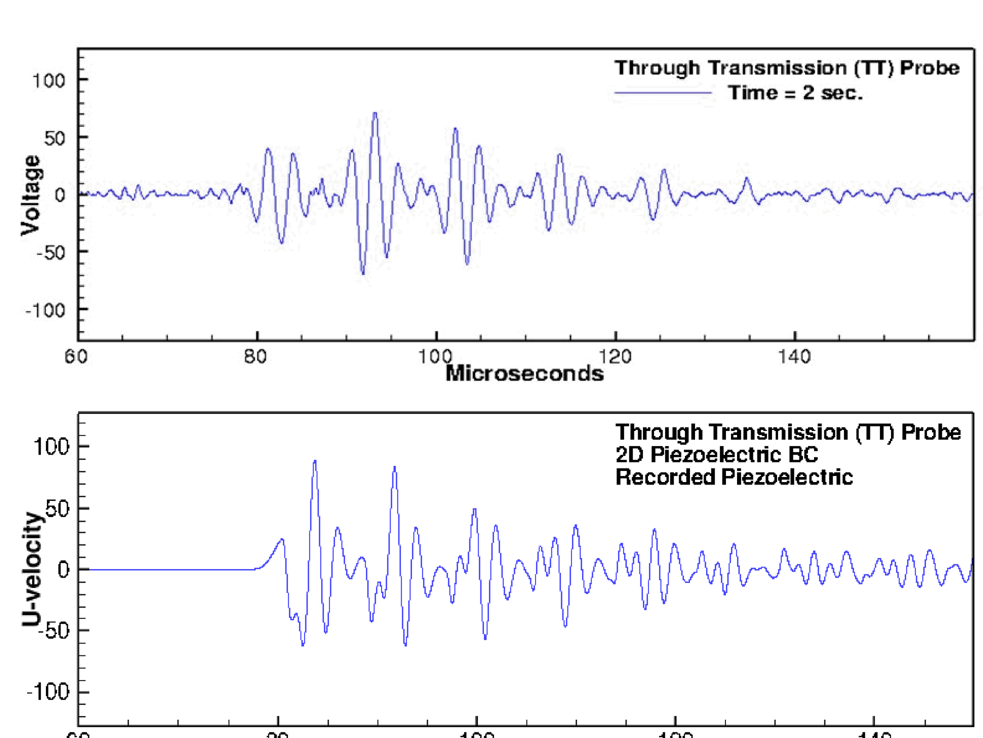
To complement the experimental results, a finite element code was developed using the Discontinuous Galerkin Method. The model characterizes how the acoustic wave travels through the media and how the sound wave interacts with the prescribed boundary conditions. The model results for wave propagation are shown in the below images.



Model setup and mesh



Modeled progression of an ultrasound wave propagating across the container



Measured (top) and modeled (bottom) ultrasound signal

Comparison of Results

The images at left compare the signals obtained via the measurement (top) and the model (bottom). The similarity between these graphs demonstrates the viability of using the results of the finite element model for developing an uncertainty bounds on the ultrasound technique for monitoring the phase and temperature of dispersive media.

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