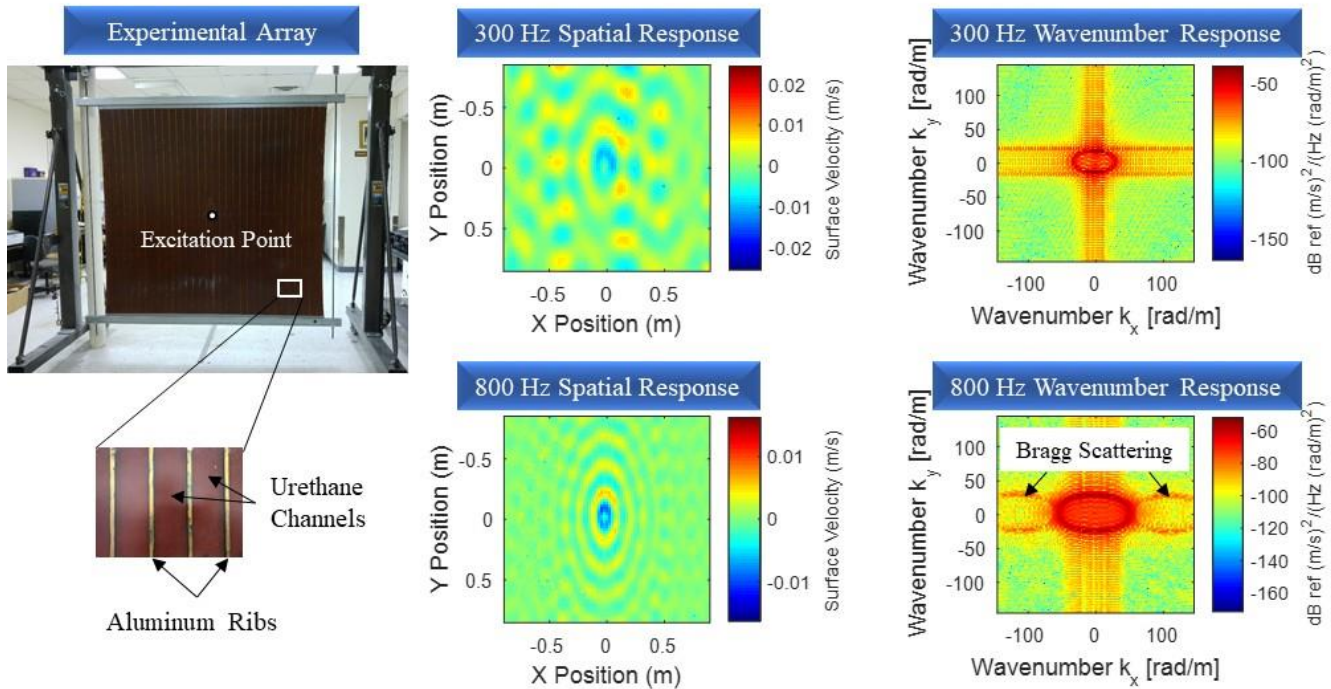


PHD DISSERTATION – DAGNY JOFFRE

Bragg Scattering Applications for Underwater Passive Localization Improvement



Bragg scattering is a phenomenon where waves, travelling through a material with periodic inclusions, will scatter and combine constructively to form additional waves with higher wavenumbers (shorter wavelengths). This research is studying the potential Signal-to-Noise Ratio (SNR) benefit of Bragg scattering in localization applications.

Hull-mounted sonar arrays are the localization method of interest. Traditionally hull-mounted arrays are panels made of a homogenous material such as urethane, embedded with sensors, and mounted to the hull of a ship or submarine. The array measurements tend to be disrupted by vibrations in the hull, which occur at relatively low frequencies.

The figure above shows the experimental array prototype, where a traditional pure urethane array has been modified to include periodic ribs. The Bragg scattering in the array is then observed. The top two figures show the spatial and wavenumber response of the panel to a 300 Hz excitation. The bottom two figures show the spatial and wavenumber response of the panel to an 800 Hz excitation. The 300 Hz response did not exhibit Bragg scattering, while the 800 Hz response did exhibit Bragg scattering. Therefore the ribbed array is working as a low-pass filter, where low frequencies (i.e. noise) will not scatter into the higher-wavenumber region but high frequencies (i.e. signals) will scatter. If only the scattered wavenumber region is considered, the SNR should be higher. The current research is focusing on quantifying these SNR improvements.