(281)

Full-Field Inspection of Three-Dimensional Structures using Steady-State Acoustic Wavenumber Spectroscopy

EliseAnne Koskelo and Eric Flynn, Engineering Institute, Los Alamos National Laboratory, Los Alamos NM 87545

Inspection of and around joints, beams, and other three-dimensional structures is integral to practical nondestructive evaluation of large structures. Non-contact, scanning laser ultrasound techniques offer an automated means of physically accessing these regions. However, to realize the benefits of laser-scanning techniques, simultaneous inspection of multiple surfaces at different orientations to the scanner must not significantly degrade the signal level nor diminish the ability to distinguish defects from healthy geometric features. In this study, we evaluated the implementation of acoustic wavenumber spectroscopy for inspecting metal joints and crossbeams from interior angles. With this technique, we used a single-tone, steady-state, ultrasonic excitation to excite the joints via a single transducer attached to one surface. We then measured the full-field velocity responses using a scanning Laser Doppler vibrometer and produced maps of local wavenumber estimates. With the high signal level associated with steady-state excitation, scans could be performed at surface orientations of up to 45 degrees. Since projection leads to asymmetrical distortion in the wavenumber in one direction, while plate thinning produces a symmetric increase in wavenumber, we were able to independently estimate both the orientations of the scanned surfaces and the degree of hidden corrosion. With both a two-surface joint and a three-surface joint test specimen, we were able to automatically remove the projection of each angled surface in the scan area and generate corrosion-indicating wavenumber maps for those surfaces as if they all were scanned from normal incidence.

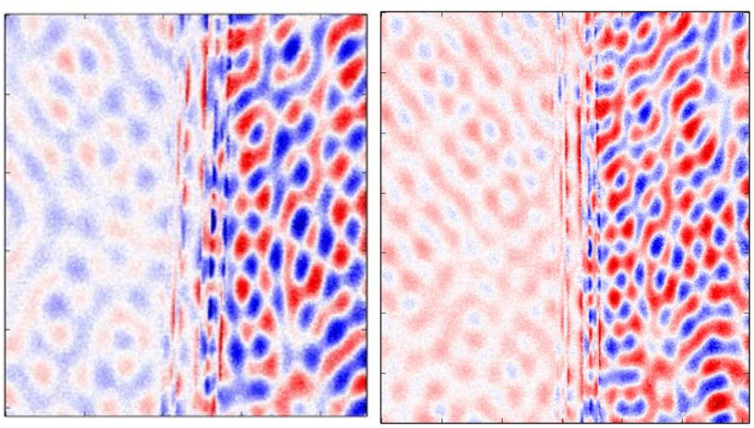

Figure 1. Raw steady-state measurements of a two-surface joint at 80 kHz and 125 kHz.

References:

1. Flynn, E. B. and G. J. Jarmer, “High-Speed, Non-Contact, Baseline-Free Imaging of Hidden Defects Using Scanning Laser Measurements of Steady-State Ultrasonic Vibration,” in *Structural Health Monitoring*, Stanford, CA, vol. **1**, pp. 1186–1193, 2013.