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Center for Nondestructive Evaluation

CNDE Webinar Presentation
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Ultrasound NDE Using Dispersion Compensated Guided Wave Measurements

Presented by: Ron Roberts
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Speaker:
Ron Roberts began work in NDE research as an Undergraduate Research Participant at Argonne National Laboratory. After getting his B.S. in Physics from Purdue University in 1979, he began study under Jan Achenbach at Northwestern University in theoretical elastic wave propagation, while continuing experimental thesis research at Argonne. He completed his Ph.D. in 1984, then worked as a Research Engineer at Argonne until 1989, at which time Don Thompson convinced him to move to Ames to join CNDE. He has worked on a myriad of ultrasound NDE applications at CNDE implementing model-based inspection design, including early pioneering work in the design and application of phased array technology. While at Argonne, Ron became intrigued with the possibility of removing the effects of multi-mode dispersion in guided wave measurements, in that case for leak detection in reactor cooling systems. Based on principles first pondered at that time, the present seminar reports on the recent successful implementation of measurement protocols and data processing for dispersion compensated guided wave measurements.

Abstract:
The use of structure-guided waves for NDE inspection offers the possibility of reaching remote difficult-to-access locations by transporting wave energy through structural members. The difficulty encountered in this approach is that structure-born wave energy generally propagates via multiple geometry-dependent wave modes, with each wave mode displaying a frequency dependent wave velocity (dispersion). Consequently, an acoustic signal starting out as a short-duration pulse is seen to disperse into an extended-duration noise-like wavetrain, making the interpretation of measured signals seemingly impossible. Although the measured signal may appear to be random noise, the propagation characteristics of the structure responsible for dispersion of transported signals are completely deterministic. It therefore should be possible to remove the effects of multi-mode dispersion from the received signals, thereby providing an easy-to-interpret indication of defect location, provided the propagation characteristics of the structure are known with sufficient accuracy. This presentation explores this possibility for the simple case of defect location in a uniform thickness plate, for which guided wave modes are well understood. Measurement protocols theoretically sufficient for multi-mode dispersion compensation are summarized, along with difficulties encountered when applying theory to practice. Examples of successful efforts to overcome these difficulties are presented.

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