Ultrasonic Wavefield Imaging: Research Tool or Emerging NDE Method?

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Ultrasonic wavefield imaging refers to acquiring full waveform data over a region of interest for waves generated by a stationary source. Although various implementations of wavefield imaging have existed for many years, the widespread availability of laser Doppler vibrometers that can acquire signals in the high kHz and low MHz range has resulted in a rapid expansion of fundamental research utilizing full wavefield data. In addition, inspection methods based upon wavefield imaging have been proposed for standalone NDE with most of these methods coming from the SHM community and based upon guided waves. If transducers are already embedded in or mounted on the structure as part of an SHM system, then a wavefield-based inspection can potentially take place with very little required disassembly. A frequently-proposed paradigm for wavefield NDE is its application as a follow-up inspection method using embedded SHM transducers as guided wave sources if the in situ SHM system generates an alarm.

This presentation considers the broad role of wavefield imaging in ultrasonic NDE, both as a research tool and as an emerging NDE method. Examples of current research will be presented based upon both guided and bulk wavefield imaging in metals and composites, drawing primarily from the author’s work. Progress towards wavefield NDE will be discussed in the context of such issues as defect detection and characterization capabilities, required scan times, equipment cost, and operator training; recent research efforts will be highlighted that can potentially enable wavefield NDE.