IOWA STATE UNIVERSITY
Center for Nondestructive Evaluation

CNDE Webinar Presentation
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This webinar will be recorded and made available on the CNDE website

ABC's of Nonlinear Resonance Ultrasound Spectroscopy: Alloys, Bones and Concrete are just the start

Presented by: Research Scientist Dan Barnard
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Speaker:

Dan Barnard began working in ultrasonic nondestructive evaluation in January 1990, as a laboratory assistant in Dr. Otto Buck's group at Iowa State Universities Ames Laboratory (USDOE). Under the watchful eyes of Dr. Buck and Mr. David Rehbein, he began learning the basics of ultrasonic materials characterization, sample design and preparation and mechanical testing. After completing a MS in Metallurgy (Nonlinear Acoustics/Harmonic Generation) under the tutelage of Dr. Buck, he began working full time, splitting time between Ames Laboratory and the Center for Nondestructive Evaluation (CNDE). At CNDE, Dan was fortunate to work with Dr. David Hsu, where the two worked on a wide range of nondestructive evaluation topics including the testing of the Dripless Bubbler, the computer aided tap tester, and various hand-held scanning approach developments for the FAA, USAF, US Navy and various other sponsors. In 2008, he left Ames Lab for a full-time commitment at CNDE. He continues to work with other CNDE staff and students, and particularly enjoys development of novel approaches for materials inspections and characterizations.

Abstract:

Nonlinear Resonance Ultrasound Spectroscopy (NRUS), Nonlinear Elastic Wave Spectroscopy (NEWS) and other similar approaches are continually being applied to the characterization of more and more diverse materials, both naturally occurring and man-made. What essentially started as an approach for evaluating the particular characteristics of natural geo-materials has been applied to the characterization of human and animal bone, concrete, polymer matrix fiber composites and metals, and the applications continue to expand. In essence, the approach follows the nonlinear response of a sample materials natural resonance modes, which are a function of material properties and sample geometry, when driven over a range of excitation amplitudes. The nonlinear or excitation-dependent response in materials has been found to be highly sensitive to damage and other anomalous conditions, demonstrating sensitivity far superior to any linear responses. In this presentation, the author will describe the various approaches to the general class of measurements under the NRUS/NEWS banner, the materials tested and results complementary to other nonlinear acoustic approaches. Although this class of measurements will likely never be developed into an nondestructive evaluation approach where one takes a hand-held instrument into the field for measurements on a structure or structural elements of a larger construction, it is nonetheless a highly sensitive approach for characterizing a broad spectrum of natural and engineered materials.

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