

Round robin tests for hole/slit differentiation using Nonlinear Time Reversal based NDT

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Nonlinear ultrasonic testing has become increasingly important during the last forty years due to the increase of higher sensitivity of electronic instrumentation and its associate signal processing mathematics [1]. The nonlinearity of materials results in nonlinear effects, which arise from defects in the materials present at all scales [2]. Applications include nonlinear nondestructive testing (NDT), harmonic medical ultrasound imaging and development of new materials such as nanocomposite and memory based materials. One of the strategic plans of the international NDT community is to define standards for developing nonlinear non-destructive testing for automated set-up in mass production [3]. The aim of this paper is to present round robin tests performed in an aluminum sample presenting a calibrated slit and a hole with the same size. The paper presents the Time Reversal based Nonlinear Elastic Wave Spectroscopy TR-NEWS device which is associated to the development of a phenomenological characterization of material local elastic properties [2] working at 20 MHz allowing the measurements of degradation and aging of complex structures. The experimental device was tested with the V3 calibration block, improved, and specially scaled in order to access to a wide range of multivalued parameters: mechanical properties, ultrasonic parameters (celerity and attenuation) and local geometric data. Also tested for biomedical applications too, the well-known complexity of the sample constitutes a strong advantage for the TR-NEWS efficiency. Linear and nonlinear signatures of material properties are measured locally thanks to an optimized signal processing involving time reversal, correlation and pulse inversion algorithms. REFERENCES 1. S. Dos Santos, M. Maslouhi, K.A. Okoudjou (Eds.), Recent Advances in Mathematics and Technology, Springer Nature, ISBN 978-3-030-35201-1, 170p (2020) 2. B.E. Anderson, et al, Nonlinear Ultrasonic and Vibro-Acoustical Techniques for Nondestructive Evaluation, Springer, 2019, pp. 547—581 3. S. Dos Santos, M. Lints, D. Arruga, A. Masood and A. Salupere, Standards for acousto-mechanical evaluation of multiscale hysteretic properties of complex material with nonlinear time reversal imaging <https://www.ndt.net/article/ndt-slovenia2017/papers/49.pdf> , in proc of the ICNDT 2017, Portoroz.