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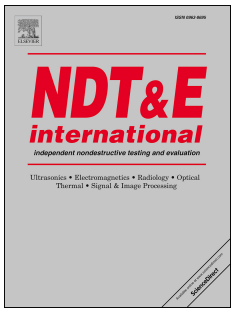

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Quantitative imaging of Young's modulus in plates using guided wave tomography

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Abstract

An ultrasonic tomographic imaging technique is proposed for measurement of the distribution of Young's modulus in an isotropic plate. This technique is based on velocity mapping which is performed by applying full waveform inversion on the ultrasonic signals captured by transducers around the stiffness variations. The resulting wave velocity maps are then converted to Young's modulus maps by the known dispersion relation of selected guided modes. Finite element simulations were carried out to investigate the reconstruction performance of A_0 mode propagating through various smoothly varying stiffness defects in a plate. It is shown that for selected cases an average through-thickness Young's modulus can be accurately reconstructed and its potential to describe flexural stiffness of the plate is discussed. The model was validated by experiments, where Young's modulus was varied in a steel plate via heating. The map of the Young's modulus was reconstructed from temperature measurements and ultrasound data and results from the two methods showed excellent agreement.

Keywords: Elastic constants, guided wave tomography, full waveform inversion

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