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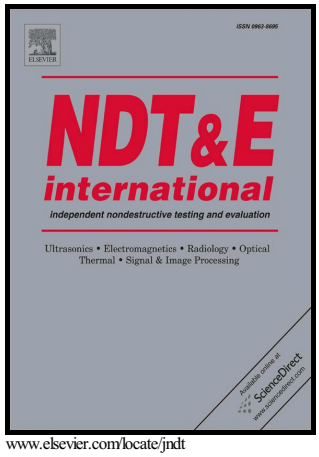

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Scattering of Torsional Flexural Guided Waves from Circular Holes and Crack-like Defects in Hollow Cylinders

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Abstract

A study on the scattering of torsional flexural guided waves from circular holes and crack-like defects in hollow cylinders is carried out through finite element simulation and laboratory experiment. Two types of defects: circular holes and crack-like defects with varying orientation angles are studied. Results show that the reflection coefficients for flexural modes with different helix angles of propagation detecting a crack-like defect vary greatly, while for a circular hole the reflection coefficients for different flexural modes are similar. It is observed that there exists a specific flexural mode that shows the maximum reflection coefficient for a crack-like defect. The scattering properties can be utilized to classify defects as circular hole and crack-like, the range of the orientation angle of a crack-like defect can also be predicted. The detection sensitivity for oblique crack-like defects is significantly improved by using flexural modes that propagate at a helix angle with respect to the pipe axis. A flexural mode sweeping technique is proposed for classifying and characterizing defects in hollow cylinders. The proposed classification and characterization method is validated by laboratory experiments. Pipeline inspection using flexural guided waves can be supplemental to current inspection using only axisymmetric waves in order to improve the probability of an accurate and reliable inspection process.