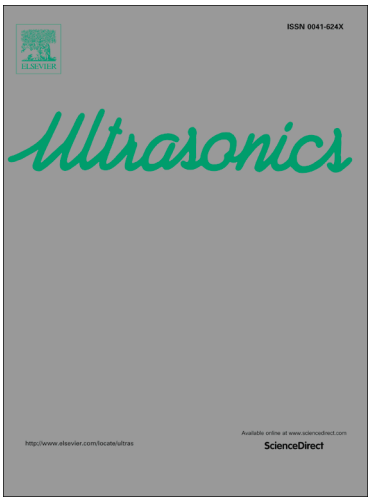

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Modelling Nonlinearity of Guided Ultrasonic Waves in Fatigued Materials Using a Nonlinear Local Interaction Simulation Approach and a Spring Model

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Abstract

Modelling and numerical simulation — based on the framework of the Local Interaction Simulation Approach — was developed to have more insight into nonlinear attributes of guided ultrasonic waves propagating in fatigued metallic materials. Various sources of nonlinearity were considered in this modelling work, with particular emphases on higher–order harmonic generation and accumulation of nonlinearity along wave propagation. The material hyper–elasticity was considered in the model using an energy density approach based on the Landau–Lifshitz formulation; and the "breathing" motion pattern of a fatigue crack in the material was interrogated using a spring model. Upon the successful validation with the model prepared in the commercial software based on the Finite Element Methods, two scenarios were comparatively investigated, i.e. the lower and higher frequency regime. In the first case propagation of a basic symmetric mode pair was simulated using the model to observe a cumulative characteristic of the second harmonic mode with nonlinear hyper–elastic material definition upon appropriate selection of

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