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**3D numerical study for defect detection with nonlinear elastic
wave spectroscopy and time reversal techniques**

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Nonlinear Elastic Wave Spectroscopy (NEWS) techniques have been developed to study the anomalously high level of "nonclassical" nonlinearity of cracked materials. Within AERONEWS project (<http://www.kuleuven-kortrijk.be/aeronews>), more recent innovative non-destructive NEWS techniques have been proposed to detect micro-inhomogeneities like cracks. It has been notably shown that NEWS and Time Reversal (TR) techniques can be combined to precisely localize cracks with a high sensitivity. NEWS techniques can be used either as a post-treatment of TR used as a tool for strong localized stress generation (TR-NEWS), or as a pre-treatment of TR used as a tool for defect (nonlinear source) identification (NEWS-TR). A 3D multiscale pseudo-spectral time domain (PSTD) code has been developed to simulate nonlinear acoustic propagation in heterogeneous nonlinear hysteretic solids. The hysteretic nonlinearity is introduced owing to a PM space model, based on a multiscale approach, extended in 3D owing to Kelvin notations. Using this algorithm, the influence of various parameters such as the defect position or the filtering method is particularly described for NEWS-TR and TR-NEWS methods. Finally, the sensitivity and feasibility of both methods are discussed.