

Advances in Time Reversal Nonlinear Elastic Wave Spectroscopy (TR NEWS) for Application to Nonlinear NonDestructive Evaluation, Imaging and Source Complexity

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Abstract

We describe recent developments in applying Time Reversal to locating, imaging and understanding complexity of nonlinear scatterers, an approach entitled Time Reversal Nonlinear Elastic Wave Spectroscopy (TR NEWS). The basis of the method is to excite one or more waves in a solid. If a crack is present, nonlinear mixing results at the crack, and manifestations of wave distortion in the form of sidebands as well as harmonics are created and scattered. Other scatterers such as layer boundaries, voids etc. produce only linear scattering. The full signal train is detected, and one filters out all but the nonlinear frequency band of interest. Following this, one time-reverses the filtered signal, re-emits it from the detector, and it focuses at the nonlinear source, i.e., the crack. One can scan the cracked region to extract information regarding the nonlinear scattering source, and ultimately, backscattering from the nonlinear source recorded away from the crack will be used to isolate it. We describe results of applying TR NEWS in addition to exploring issues of scattering source spatial-temporal complexity and resolution limits.