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Localized nonlinearity time reversal imaging with chaotic cavities

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Recent results have shown that Nonlinear Elastic Wave Spectroscopy (NEWS) and Time Reversal (TR) techniques can be combined to localize defects. NEWS techniques can be used either as a post-treatment of TR used as a tool for generating strong localized stress (TR-NEWS), or as a pre-treatment, of TR used as a tool for defect identification (NEWS-TR). The TR process can be implemented with a programmable multi-elements ultrasonic system. But recently, it has been demonstrated that a single PZT ceramic glued on the sample can also be used as a TR mirror. In this case the quality of the retrofocusing process, and so the microdamage localization, depends on the sample geometry. In this study, numerical and laboratory studies, performed in order to determine and enhance the possibility to localize microdamage based on a combination of a time reversal technique using an emitter with a chaotic shape and nonlinear elastic wave response, will be presented. The benefit of using such emitters is clearly found in breaking the symmetry of the problem, leading to an unambiguous retrofocusing. Moreover, chirp-coded excitation, instead of short pulses, is studied in order to transmit more energy on the defect without increasing the peak intensity of the excitation.