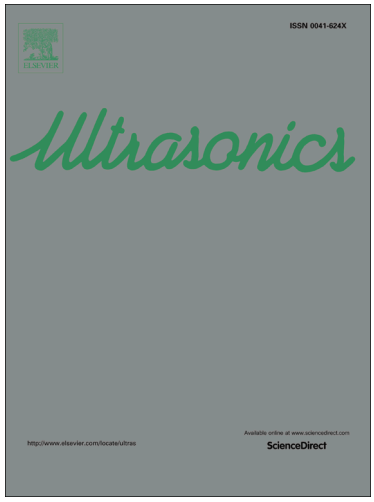

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Nonlinear Coda Wave Interferometry for the global evaluation of damage levels in complex solids

Yuxiang Zhang[a,b], Vincent Tournat[a,*], Odile Abraham[b], Olivier Durand[b], Stéphane Letourneur[a], Alain Le Duff[a,c], Bertrand Lascoup[d]

[a] *LUNAM Université, LAUM, CNRS UMR 6613, Université du Maine, Av. O. Messiaen, 72085, Le Mans Cedex 9, France*
[b] *LUNAM Université, IFSTTAR, MACS, CS4, 44344, Bouguenais Cedex, France*
[c] *Groupe ESEO, 10 Boulevard Jeanneteau, CS 90717, 49107, Angers Cedex, France*
[d] *IRT Jules Verne, Chemin du Chaffault, 44340, Bouguenais, France*

Abstract

A nonlinear acoustic method to assess the damage level of a complex medium is discussed herein. Thanks to the highly nonlinear elastic signatures of cracks or, more generally, internal solid contacts, this method is able to distinguish between contributions from linear wave scattering by a heterogeneity and contributions from nonlinear scattering by a crack or unbounded interface. The coda wave interferometry (CWI) technique is applied to reverberated and scattered waves in glass plate samples featuring various levels of damage. The ultrasonic coda signals are recorded in both the absence and presence of an independent and lower-frequency elastic "pump" wave, before being analyzed by CWI. The monitored CWI parameters quantifying changes in these coda signals, which therefore quantify the nonlinear wave-mixing effects between the coda and pump waves, are found to be dependent on the damage level in the sample. A parametric study is also performed to analyze the influence of sensor positions and average temperature on the method's output. The reported results could be applied to the non-destructive testing and evaluation of complex-shape materials and multiple scattering samples, for which conventional ultrasonic methods show strong limitations.

*Corresponding author
Email address: vincent.tournat@univ-lemans.fr (Vincent Tournat)