Why does time reversal break down in granular media ?

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Time reversal (TR) focusing of ultrasound in granular packings is experimentally investigated [1]. Pulsed elastic waves transmitted from a compressional or shear transducer source are measured by a TR mirror, reversed in time and back-propagated. We find that TR of ballistic coherent waves onto the source position is very robust regardless driving amplitude but provides poor spatial resolution. By contrast, the multiply scattered coda waves offer a finer TR focusing at small amplitude by a lens effect. However, at large amplitude, these TR focusing signals decrease significantly due to the vibration-induced rearrangement of the contact networks, leading to the breakdown of TR invariance. Our observations reveal that granular acoustics is in between particle motion and wave propagation in terms of sensitivity to perturbations. These laboratory experiments are supported by numerical simulations of elastic wave propagation in disordered 2D percolation networks of masses and springs, and should be helpful for source location problems in natural processes.

Références

1. M. Harazi, Y. Yang, M. Fink, A. Tourin, X. Jia, Time reversal of ultrasound in granular media, *Eur. Phys. Jour. Special Topics : From Ill-condensed Matter to Mesoscopic Wave Propagation* (in press).