ACOUSTICS2008/844
Super-resolution imaging of active sound and vibrational sources using a time-reversal sink

Eric Bavu[a], Alain Berry[a], Jean-Dominique Polack[b], Vincent Gibiat[c] and Charles Besnainou[b]
[a]Univ. de Sherbrooke, Mechanical Engineering Depart., 2500 Boulevard de l'Université, Sherbrooke, QC, Canada J1K 2R1
[b]Institut Jean le Rond d'Alembert, Laboratoire d'Acoustique Musicale, 11, rue de Lourmel, 75015 Paris, France
[c]Université Paul Sabatier, PHASE, 118, route de Narbonne, 31062 Toulouse cedex 9, France

Theory and experiments of super-resolution focusing using a time-reversal sink have been investigated in high-frequency regime [Rosny and Fink, Phys.Rev.Lett. **89**] and in audible range [Bavu, Besnainou, Gibiat, Rosny and Fink, Act.Acust., **93**]. This technique, generalized to the case acoustic and vibrational imaging of active sources, allows super-resolution imaging and provides a new method of characterization of active sources in a known background medium.
This imaging technique involves a measurement in the background medium using an array, and the simulation of the backpropagating-field in a fictive medium. An ideal numerical time-reversal sink (NumTRAS) is then used to refine results and obtain high-contrast, high-resolution imaging of initial sources.
The algorithm has been validated in parallel supercomputer simulations, in both vibrational and acoustics fields and has been used to detect active vibrational sources in a clamped Mindlin plate and active sound sources in an anechoic room. All results show high-resolution imaging capabilities when compared with classical time-reversal backpropagation. NumTRAS provides an alternative to other imaging and source detection techniques, such as acoustic holography and beamforming. Beyond the applications of acoustic and vibrational non-destructive evaluation of industrial structures, NumTRAS has applications in evaluation of musical structures and is being tested to detect and characterize moving sources.