

ACOUSTICS2008/1461

A comparison of planar projection and time reversal techniques

Gregory Clement

Harvard Medical School, Focused Ultrasound Lab - BWH Radiology, 221 Longwood Ave RM 521, Boston, MA 02115, USA

Planar projection methods, such as the angular spectrum approach, have been shown to rapidly relate fields between two planes in space/time, with only a single measurement plane needed to characterize an entire field. Variants of the method have been used for medical transducer characterization, as well as for HIFU treatment planning. Presently, a potential advantage of the approach is considered: Operating in the temporal frequency domain, backward planer projection (i.e. "space reversal") is invariant with respect to the spatial dimension, even in the presence of anomalous dispersion. This ability can be contrasted with time reversal, which is violated in the presence of the absorption term. Time reversal is compared with planar back-projection under a varying set of conditions, including the presence of dispersive and nonlinear homogeneous and heterogeneous media. The specific case of a simulated impulsive signal from a 30-cm diameter piston radiator is directed through a 50-cm section of a tissue-like medium ($B/A = 5$ to 7 , $c = 1480$ to 1600 m/s, $\rho = 0.9$ to 1.1 gm/cm³, $\alpha = 0.5$ to 2 db/cm/MHz) over a range of pressures. Ability of backward projection to restore initiating signals is verified, provided that significant signal levels of all relevant frequencies can be reached at the initial plane.