

ACOUSTICS2008/3612 Efficient time reversal by Lanczos Iterations

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Time reversal methods have seen many applications in underwater acoustics, medical ultrasound, nondestructive evaluation, and several non-acoustics applications. Techniques to target and/or locate individual scatterers are based upon using iterative time-reversal. From a mathematical perspective, iterative time reversal is akin to the power method of extracting eigenvectors of the scattering operator. As such, standard iterative time-reversal inherits the limitations of the power method. For example, iterative time-reversal converges slowly in the presence of multiple scatterers of similar strength and has difficulty identifying weaker scatterers. On the other hand, Lanczos iterations surmount these difficulties, and tend to converge faster than the power method, even when the latter works well. In this contribution we show how Lanczos iterations can be adapted to time-reversal iteration. This allows the strongest eigenvectors of the scattering operator to be measured with greater accuracy and in many fewer iterations than required by standard time-reversal. We describe how this algorithm may be implemented in a practical situation and build a new time-reversal method around it. We apply this method to some numerical examples to demonstrate its effectiveness and compare its performance with the more traditional time-reversal iterations.