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New Numerical Computation of Acoustic Propagation in the Ocean in the Presence of Internal Waves is 1000 Times Faster than Traditional Split-Step Fourier Approaches

Alfred Osborne
University of Torino, Dipartimento di Fisica Generale, Via Pietro Giuria 1, 10124 Torino, Italy

A new numerical model for acoustic propagation based upon the large angle parabolic type equations is found to execute about 1000 times faster than the FFT split step algorithm. The approach is applied to the imaging and nonlinear filtering of internal waves in shallow water regions for 3-dimensional propagation of acoustic waves. For appropriate array placement one can construct the inverse problem and hence the internal wave field from the acoustic measurements themselves. The unique nonlinear filtering method allows one to filter out the internal waves from the density field and hence to realized acoustic wave propagation in the absence of the internal waves.
The hyperfast acoustic model has some of the following characteristics: (1) The work can be extended to the fully 3-dimensional Helmholtz equation. (2) The method is a kind of multi-dimensional Fourier analysis which exactly solves the wave equations (PE, large angle PEs and Helmholtz)) so that the acoustic wave does not degrade with range as with more traditional numerical integrations. (4) Multi-dimensional Fourier transforms can be used to nonlinearly filter acoustic signals in a wide range of applications and hence the approach is quite robust to interference from background acoustic noise.