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Numerical study of nonlinear full wave acoustic propagation¹ ROBERTO VELASCO-SEGURA, PABLO L. RENDON, Centro de Ciencias Aplicadas y Desarrollo Tecnologico, UNAM — With the aim of describing nonlinear acoustic phenomena, a form of the conservation equations for fluid dynamics is presented, deduced using slightly less restrictive hypothesis than those necessary to obtain the well known Westervelt equation. This formulation accounts for full wave diffraction, nonlinearity, and thermoviscous dissipative effects. A CLAWPACK based, 2D finite-volume method using Roe's linearization has been implemented to obtain numerically the solution of the proposed equations. In order to validate the code, two different tests have been performed: one against a special Taylor shock-like analytic solution, the other against published results on a HIFU system, both with satisfactory results. The code is written for parallel execution on a GPU and improves performance by a factor of over 50 when compared to the standard CLAWPACK Fortran code. This code can be used to describe moderate nonlinear phenomena, at low Mach numbers, in domains as large as 100 wave lengths. Applications range from modest models of diagnostic and therapeutic HIFU, parametric acoustic arrays, to acoustic wave guides. A couple of examples will be presented showing shock formation and oblique interaction.

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