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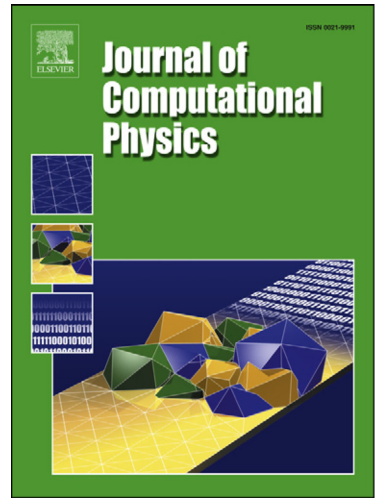

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Non-Conforming Curved Finite Element Schemes for Time-Dependent Elastic-Acoustic Coupled Problems

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Abstract

High-order numerical methods for solving time-dependent acoustic-elastic coupled problems are introduced. These methods, based on Finite Element techniques, allow for a flexible coupling between the fluid and the solid domain by using non-conforming meshes and curved elements.

Since characteristic waves travel at different speeds through different media, specific levels of granularity for the mesh discretization are required on each domain, making impractical a possible conforming coupling in between. Advantageously, physical domains may be independently discretized in our framework due to the non-conforming feature. Consequently, an important increase in computational efficiency may be achieved compared to other implementations based on conforming techniques, namely by reducing the total number of degrees of freedom. Differently from other non-conforming approaches proposed so far, our technique is relatively simpler and requires only a geometrical adjustment at the coupling interface at a preprocessing stage, so that no extra computations are necessary during the time evolution of the simulation.

On the other hand, as an advantage of using curvilinear elements, the geometry of the coupling interface between the two media of interest is faithfully represented up to the order of the scheme used. In other words, higher order schemes are in consonance with higher order approximations of the geometry. Concerning the time discretization, we analyze both explicit and implicit schemes. These schemes are energy conserving and, for the explicit case, the stability is guaranteed by a CFL condition.

In order to illustrate the accuracy and convergence of these methods, a set of representative numerical tests are presented.

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