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Unfitted Hybrid High-order Methods for the Acoustic Wave Equation

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We design an unfitted hybrid high-order (HHO) method for the acoustic wave equation. The wave propagates in a domain where a curved interface separates subdomains with different material properties. The key feature of the discretization method is that the interface can cut more or less arbitrarily through the mesh cells. We address both the second-order formulation in time of the wave equation and its reformulation as a first-order system. We prove H1-error estimates for a space semi-discretization in space of the second-order formulation, leading to optimal convergence rates for smooth solutions. Numerical experiments illustrate the theoretical findings and show that the proposed numerical schemes can be used to simulate accurately the propagation of acoustic waves in heterogeneous media, with meshes that are not fitted to the geometry. For the second-order formulation, the implicit, second-order accurate Newmark scheme is used for the time discretization, whereas (diagonally-implicit or explicit) Runge-Kutta schemes up to fourth-order accuracy are used for the first-order formulation. In the explicit case, we study the CFL condition on the time step and observe that the unfitted approach combined with local cell agglomeration leads to a comparable condition as when using fitted meshes [1].

REFERENCES

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