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Explicit and implicit hybrid high-order methods for the wave equation

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The Hybrid high-order (HHO) method was originally devised for diffusion and elasticity problems [1, 2], and the realm of applications has been considerably extended since then. In this work, we consider the version of the HHO method that uses as discrete unknowns cell- and face-based polynomials of degree (k + 1) (cells) and k (faces) order with $0 \leq k$, yielding for steady problems optimal convergence of order (k + 1) in the energy norm. Firstly, we address the time second-order form of the wave equation, and we devise, analyze, and evaluate numerically an HHO scheme for the space discretization combined with a Newmark-like time-marching scheme. Secondly, for the first-order form, diagonally implicit and explicit Runge–Kutta time-marching schemes combined with the HHO method are considered, and we highlight the link with the hybridizable discontinuous Galerkin (HDG) methods [3]. Finally, we present numerical experiments recovering optimal convergence rates for smooth solutions and exhibiting robust performances in the case of contrasted media. Further insight into our results can be found in [4, 5].

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