Newmark's schemes and Isogeometric approximation of acoustic waves with absorbing boundary conditions

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ABSTRACT

Simulations of acoustic waves propagation in geophysics have been mostly based on finite difference or finite element methods also including domain decomposition methods in the case of discontinuous data at the physical interfaces. In the last decades, an increasing number of works have tried to improve the low-order accuracy of finite differences or finite elements by considering either spectral or spectral element methods, see e.g. [3, 4].

In this presentation, we consider the numerical approximation of 2D acoustic wave problems by the Isogeometric method based on B-splines and NURBS basis functions in space, see e.g. [1, 2], and Newmark's finite difference schemes of different order in time, both explicit and implicit.

While homogeneous Neumann conditions provide a good mathematical representation of a free surface where full reflection occurs, we consider instead first order absorbing boundary conditions, which have been introduced for the numerical simulation of wave propagation in infinite domains in order to truncate the original unbounded domain into a finite one and to keep spurious wave reflections as low as possible.

Several numerical examples in different geometries illustrate the stability and convergence properties of the proposed numerical methods with respect to the isogeometric discretization parameters, namely the local polynomial degree of the NURBS basis functions, mesh size, time step size and the parameters of the Newmark's time advancing scheme.

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