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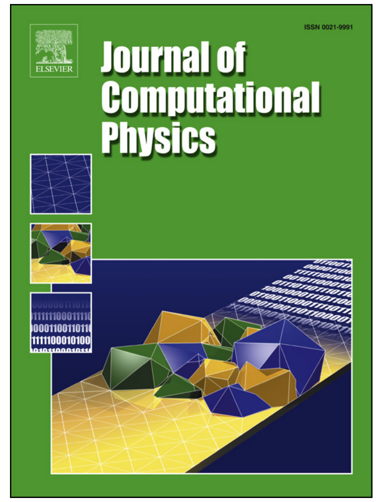

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Energy stable and high-order-accurate finite difference methods on staggered grids

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Abstract

For wave propagation over distances of many wavelengths, high-order finite difference methods on staggered grids are widely used due to their excellent dispersion properties. However, the enforcement of boundary conditions in a stable manner and treatment of interface problems with discontinuous coefficients usually pose many challenges. In this work, we construct a provably stable and high-order-accurate finite difference method on staggered grids that can be applied to a broad class of boundary and interface problems. The staggered grid difference operators are in summation-by-parts form and when combined with a weak enforcement of the boundary conditions, lead to an energy stable method on multiblock grids. The general applicability of the method is demonstrated by simulating an explosive acoustic source, generating waves reflecting against a free surface and material discontinuity.

1. Introduction

4: Some of the most popular numerical methods for wave propagation are high-order finite difference (FD) methods on staggered grids. In computational electromagnetism, these methods are based on the traditional second-order Yee-scheme [1] and extended to high-order via either explicit

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