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A Plane Wave Discontinuous Galerkin Method with a Dirichlet-to-Neumann Boundary Condition for the Scattering Problem in Acoustics

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Abstract

We consider the numerical solution of an acoustic scattering problem by the Plane Wave Discontinuous Galerkin Method (PWDG) in the exterior of a bounded domain in $\mathbb{R}^2$. In order to apply the PWDG method, we introduce an artificial boundary to truncate the domain, and we impose a non-local Dirichlet-to-Neumann (DtN) boundary condition on the artificial curve. To define the method, we introduce new consistent numerical fluxes that incorporate the truncated series of the DtN map. Error estimates with respect to the truncation order of the DtN map, and with respect to mesh width are derived. Numerical results suggest that the accuracy of the PWDG method for the acoustic scattering problem can be significantly improved by using DtN boundary conditions.

Key words: Dirichlet-to-Neumann map, acoustic scattering, PWDG methods

1. Introduction

Acoustic, elastic and electromagnetic scattering problems arise in many areas of physical and engineering interest, in areas as diverse as radar, sonar, building acoustics, medical and seismic imaging. Mathematically, the problem of acoustic scattering is often modeled by the Helmholtz equation in the unbounded

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