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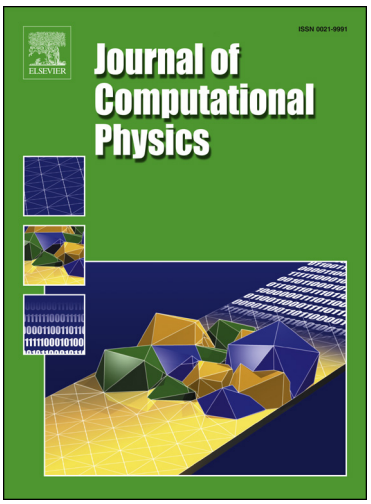

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Element Centered Smooth Artificial Viscosity in Discontinuous Galerkin Method for Propagation of Acoustic Shock Waves on Unstructured Meshes

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Abstract

This work aims at developing a high-order numerical method for the propagation of acoustic shock waves using the discontinuous Galerkin method. High order methods tend to amplify the formation of spurious oscillations (Gibbs phenomenon) around the discontinuities/shocks, associated to the relative importance of higher-harmonics resulting from nonlinear propagation (in our case). To handle this critical issue, a new shock sensor is introduced for the sub-cell shock capturing. Thereafter, an *element-centered smooth artificial viscosity* is introduced into the system wherever an acoustic shock wave is sensed. Validation tests in 1D and 2D configurations show that the method is well-suited for the propagation of acoustic shock waves along with other physical effects like geometrical spreading and diffraction.

Keywords: Discontinous Galerkin, Shock capturing, Artificial viscosity, Nonlinear acoustics

1. Introduction

One of the most spectacular features of nonlinear acoustics is the generation of shock waves along the propagation. In this case, the speed c of finite amplitude sound waves is not strictly constant, even in homogeneous fluids. It is dependent on the wave instantaneous pressure amplitude p_a. At first order,