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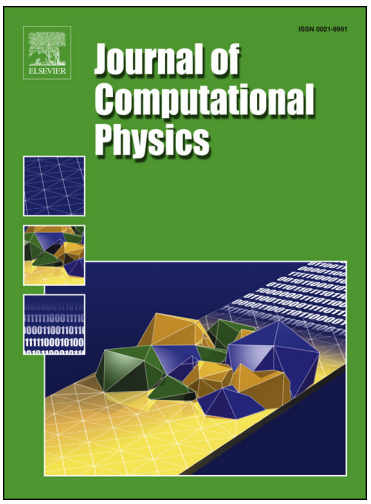

Discontinuous Galerkin methods for Hamiltonian ODEs and PDEs

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Discontinuous Galerkin methods for Hamiltonian ODEs and PDEs

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Abstract

In this article, we present a unified framework of discontinuous Galerkin (DG) discretizations for Hamiltonian ODEs and PDEs. We show that with appropriate numerical fluxes the numerical algorithms deduced from DG discretizations can be combined with the symplectic methods in time to derive the multi-symplectic PRK schemes. The resulting numerical discretizations are applied to the linear and nonlinear Schrödinger equations. Some conservative properties of the numerical schemes are investigated and confirmed in the numerical experiments.

Keywords: Discontinuous Galerkin method; Hamiltonian systems; Continuous-stage PRK method; Symplectic PRK scheme; Multi-symplectic PRK scheme; Conservation laws.

1. Introduction

Studying the geometric properties of dynamical systems and constructing the corresponding numerical algorithms based on these geometric properties have drawn much attention of mathematicians and scientists during these years. The numerical discretization which can inherit the geometric properties of the original systems is referred to as geometric numerical integration or structure-preserving algorithm in the literature

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