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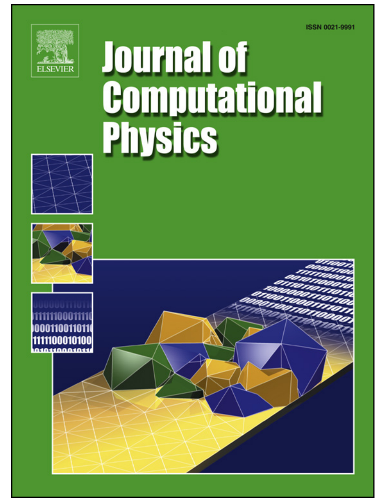

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Higher-Order Conservative Interpolation Between Control-Volume Meshes: Application to Advection and Multiphase Flow Problems with Dynamic Mesh Adaptivity

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Abstract

A general, higher-order, conservative and bounded interpolation for the dynamic and adaptive meshing of control-volume fields dual to continuous and discontinuous finite element representations is presented. Existing techniques such as node-wise interpolation are not conservative and do not readily generalise to discontinuous fields, whilst conservative methods such as Grandy interpolation are often too diffusive. The new method uses control-volume Galerkin projection to interpolate between control-volume fields. Bounded solutions are ensured by using a post-interpolation diffusive correction. Example applications of the method to interface capturing during advection and also to the modelling of multiphase porous media flow are presented to demonstrate the generality and robustness of the approach.

Keywords: Mesh adaptivity, mesh-to-mesh interpolation, Galerkin projection, conservative, interface capturing, viscous fingering

1. Introduction

Dynamic, adaptive meshing is often used during numerical simulations of transient fluid flows to improve accuracy [1, 2]. The mesh is refined in regions where properties are changing rapidly in space and (usually) coarsened in regions where the properties change more slowly in order to improve accuracy whilst minimising computational effort. The mesh may change every time-step depending on the error metrics used to control refinement and coarsening. This inevitably means that data must be mapped

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