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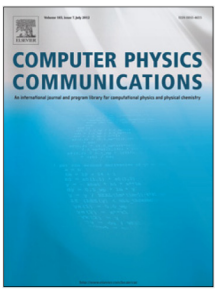

High-resolution method for evolving complex interface networks

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High-resolution method for evolving complex interface networks

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Abstract

In this paper we describe a high-resolution transport formulation of the regional level-set approach for an improved prediction of the evolution of complex interface networks. The novelty of this method is twofold: (i) construction of local level sets and reconstruction of a global level set, (ii) local transport of the interface network by employing high-order spatial discretization schemes for improved representation of complex topologies. Various numerical test cases of multi-region flow problems, including triple-point advection, single vortex flow, mean curvature flow, normal driven flow, dry foam dynamics and shock-bubble interaction show that the method is accurate and suitable for a wide range of complex interface-network evolutions. Its overall computational cost is comparable to the Semi-Lagrangian regional level-set method while the prediction accuracy is significantly improved. The approach thus offers a viable alternative to previous interface-network level-set method.

Keywords: multi-region problem; interface network; level-set method; interface capturing; high-order scheme; multiphase flow

1. Introduction

Multi-region problems can occur when the motion of more than two immiscible fluids is to be described. In this case the interface network, separating the different fluid regions, evolves in time due to interactions of the different fluids across interface segments. These interactions often can be described by local