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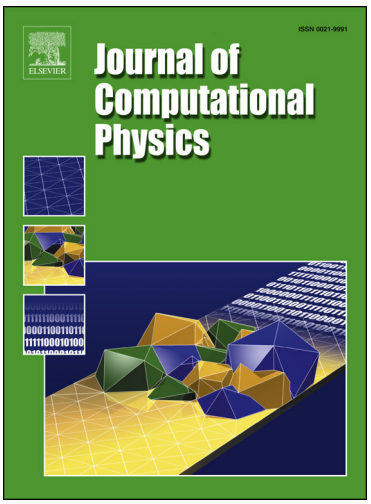

A space-time fractional phase-field model with tunable sharpness and decay behavior and its efficient numerical simulation

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A space-time fractional phase-field model with tunable sharpness and decay behavior and its efficient numerical simulation

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Abstract

We present a space-time fractional Allen-Cahn phase-field model that describes the transport of the fluid mixture of two immiscible fluid phases. The space and time fractional order parameters control the sharpness and the decay behavior of the interface via a seamless transition of the parameters. Although they are shown to provide more accurate description of anomalous diffusion processes and sharper interfaces than traditional integer-order phase-field models do, fractional models yield numerical methods with dense stiffness matrices. Consequently, the resulting numerical schemes have significantly increased computational work and memory requirement. We develop a lossless fast numerical method for the accurate and efficient numerical simulation of the space-time fractional phase-field model. Numerical experiments shows the utility of the fractional phase-field model and the corresponding fast numerical method.

Keywords: fast solution method, fractional partial differential equation, fractional phase-field model, tunable decay behavior, tunable sharpness

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