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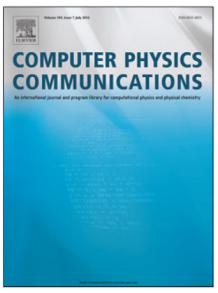

Single-step reinitialization and extending algorithms for level-set based multi-phase flow simulations

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Single-step reinitialization and extending algorithms for level-set based multi-phase flow simulations

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Abstract

We propose efficient single-step formulations for reinitialization and extending algorithms, which are critical components of level-set based interface-tracking methods. The level-set field is reinitialized with a single-step (non iterative) "forward tracing" algorithm. A minimum set of cells is defined that describes the interface, and reinitialization employs only data from these cells. Fluid states are extrapolated or extended across the interface by a single-step "backward tracing" algorithm. Both algorithms, which are motivated by analogy to ray-tracing, avoid multiple block-boundary data exchanges that are inevitable for iterative reinitialization and extending approaches within a parallel-computing environment. The single-step algorithms are combined with a multi-resolution conservative sharp-interface method and validated by a wide range of benchmark test cases. We demonstrate that the proposed reinitialization method achieves second-order accuracy in conserving the volume of each phase. The interface location is invariant to reapplication of the single-step reinitialization. Generally, we observe smaller absolute errors than

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