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A unified AMR framework for multiphase flow and fluid-structure interaction problems with both non-subcycling and subcycling YADONG ZENG, LIAN SHEN, University of Minnesota — In the present work, we developed a unified structured adaptive mesh refinement (SAMR) framework for multiphase flow and fluid-structure interaction problems. The coarsest grid covers the whole computational domain, and is dynamically refined onto higher levels to obtain higher resolution in local regions. Both non-subcycling, where a uniform time step is employed for all variables on composite levels, and subcycling, in which variables on different levels advance via different time steps, are embedded in the SAMR framework. While the former is easier to implement, the latter can significantly reduce the computational time while maintaining the same order of accuracy. For multiphase flow problems, the level set function is used to capture the interface, and re-initialization across different levels is applied. For fluid-structure interaction problems, a direct forcing immersed boundary method is coupled with SAMR. Validation cases are presented to demonstrate the accuracy and robustness of the proposed computational framework.

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