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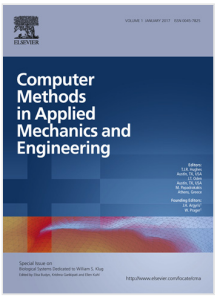

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A Multiphase MPS Solver for Modeling Multi-fluid Interaction with Free Surface and Its Application in Oil Spill

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ABSTRACT

Numerical simulation of free surface multi-fluid flow is a challenging problem owning to the interaction between deformed interface and free surface. In this paper, a multiphase particle solver (free surface multiphase moving particle semi-implicit method, FS-MMPS) is developed to predict the early spreading flow of spilled oil where exist the oil-water interface and air-oil/air-water free surface. First, a multiphase virtual particle model is proposed to substitute the inaccurate free surface boundary condition for multiphase flow in conventional MPS methods. Specifically, virtual particles of different liquid phases are compensated outside free surface so that the pressure of free surface particles can be solved from pressure Poisson equation, thereby improving the accuracy of multi-fluid interaction at free surface. Meanwhile, a pressure gradient model based on the coupling of Taylor series expansion and dynamic specification of particle stabilizing term (PST) is proposed to simultaneously enhance accuracy and depress instability caused by multiphase virtual particles. Experiments of early spreading of thick oil slicks and continuous oil spill from a damaged tank are conducted for validation and demonstration of the accuracy and stability enhancements in 2D. Finally, the effects of travelling wave and continuous