Nonlocal fluid method for 2D underwater explosion

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Abstract

Underwater explosion phenomena are governed by complicated physical laws and conditions at the interface of the explosive gas and the surrounding water, which is quite a challenge for numerical simulation. A new nonlocal peridynamic based method is used here to simulate phenomena of underwater explosion in two dimensions. Firstly, the non-local differential operators in current configuration are introduced based on the new fluid Peridynamics method. A mathematic derivation shows that both the spatial gradient operator and the spatial divergent operator are convergent; Secondly, the main governing equations, Navier-Stocks equation, are discretized based on the mass and momentum conservation principles by using the non-local differential operator; Thirdly, the multiphase interface treatment, the viscous and surface force, the numerical integration scheme, and the boundary implementation are all studied and optimized for the underwater explosion.