Coupling algorithm for finite volume and smoothed particles methods

Nimakov A N[@] and Dyachkov S A

Dukhov Research Institute of Automatics (VNIIA), Sushchevskaya 22, Moscow 127055, Russia

[@] nimakov96@mail.ru

Numerical methods for mesh and meshless ones used for solving continuum mechanics equations have their advantages and disadvantages which determines their region of applicability. The software package, being developed by the authors, has several implemented numerical methods for solving problems of hydrodynamics: the finite volume method (FVM) for static mesh [1], the finite difference method (FDM) for moving mesh [2], as well as the meshless smoothed particles hydrodynamics method (SPH) [3]. The latter makes it possible to model problems with free boundaries, loss of continuity, and fragmentation, but it is practically inapplicable for modeling unstable flows and mixing, which are better simulated using FVM.

To extend the range of problems to be solved, it is proposed to use a coupling algorithm for FVM and SPH methods [4], which would allow simultaneous simulation with these methods in different spatial areas joined with the coupling interface. Our coupling algorithm allows to transfer data accurately between SPH and FVM, ensuring stability and preservation of physical parameters in dynamically changing conditions. The result of the algorithm application is demonstrated on a series of tests showing sufficient accuracy of conservation of mass, momentum and energy of the flow at the transition of a substance through the interface area.

[1] Menshov I S and Zakharov P P 2014 *Int J Numer Methods Fluids* **76** 109–127
[2] Wilkins M L 1999 *Computer Simulation of Dynamic Phenomena* (Springer-Verlag Berlin Heidelberg)
[3] Parshikov A N and Medin S A 2002 *J. Comput. Phys.* **180** 358–382
[4] Chiron L, Marrone S, Di Mascio A and Le Touzé D 2018 *J. Comput. Phys.* **364** 111–136