An ALE particle method using WENO interpolation

†*Hu Fangyuan [1], Koshizuka Seiichi [1]

[1]Department of Engineering, the University of Tokyo, Japan.

*Presenting author: hfy8373@mps.q.t.u-tokyo.ac.jp
†Corresponding author: hfy8373@mps.q.t.u-tokyo.ac.jp

Abstract

In this research, an arbitrary-Lagrangian-Eulerian (ALE) particle method that use weighted essentially non-oscillatory (WENO) interpolation scheme as a compensation for the convection term is proposed.

Conventional particle methods in Lagrangian description usually face problems like particle clustering or scattering, which leads to difficulty in achieving high accuracy. Moreover, the calculation of particle position, which corresponds to the integration of particle velocity, leads to error accumulation.

In this research, the above two issues are addressed. The developed ALE particle method is able to move particles to arbitrary positions in the vicinity with an interpolation. In our previous research [1], a semi-Lagrangian-like upwind interpolation was proposed. The compensation of flow convection is computed in a simple way that gives zero weight to particles on the downwind side. In this research, in order to increase the accuracy of interpolation, the WENO scheme is adopted. The division of stencils and computation of their weight is implemented in a similar way described in MLS-WENO-SPH [2].

Additionally, the proposed ALE particle method moves particles in a way that is apt to reduce the velocity integration.

The proposed method applies least squares moving particle semi-implicit method (LSMPS) [3] for spatial and temporal discretization, and is tested against lid-driven cavity flow problems with a wide range of Reynold's numbers, and problems with moving boundaries.

Keywords: particle method, ALE, WENO, ALE, WENO.

References

[1] Hu Fangyuan. ALE particle method using upwind interpolation. Master thesis of the University of Tokyo, 2015.
[2] Diego Avesani, Michael Dumbser, Alberto Bellin. A new class of Moving-Least-Squares WENO-SPH schemes. J. Comput. Phys, 270, 278-299, 2014.
[3] Tasuku Tamai and Seiichi Koshizuka. Least squares moving particle semi-implicit method. Comp. Part. Mech., 1:441, 2014.