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Parallel computation method for momentum and heat interactions between fluids and complicated-shaped solids

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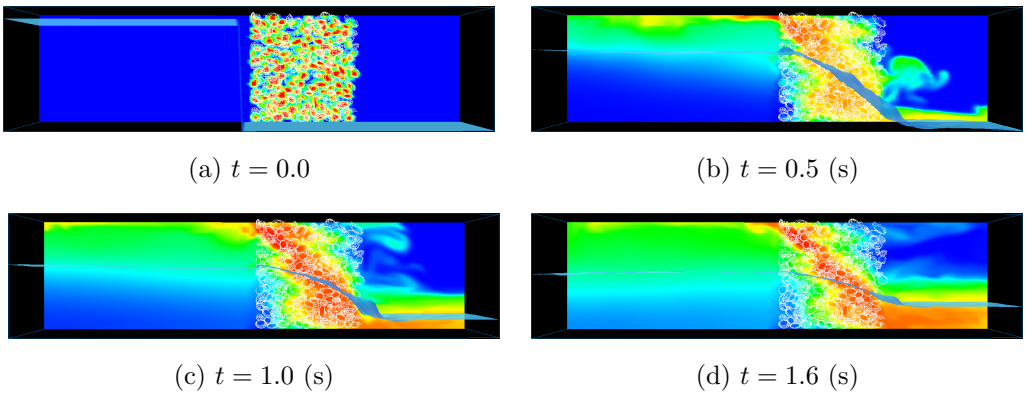
ABSTRACT A computational method is presented to predict momentum and heat interactions among multiphase field consisting of incompressible gas, liquid and complicated-shaped solid structures by extending our previous method for isothermal fields shown by Ushijima [2007]. Some advanced numerical procedures are employed in the proposed method, such as an implicit C-ISMAC method with a fifth-order TVD scheme and pressure computation C-HSMAC method to satisfy incompressible conditions accurately as well as the parallel computations with flat MPI. The basic validity of the present method was first confirmed by applying it to natural convection flows in 3D cavity and to dam-break flows through isothermal porous dam conducted by Liu et al. [1999]. In addition, the present method was applied to the free-surface flows through the higher-temperature porous dam consisting of the non-uniform particles represented by multiple tetrahedron elements as shown in Fig.1. As a result, it was demonstrated that the heat transfer from the particles to gas and liquid flows is reasonably predicted.



(a) $t = 0.0$ (b) $t = 0.5$ (s)

(c) $t = 1.0$ (s) (d) $t = 1.6$ (s)

Figure 1 Free-surface profiles and temperature distributions on the vertical section at $x_2 \approx 75$ [mm] (Particles located only near the section are shown by wireframes.)

Liu, P. L., Lin, P., Chang, K.-A. and Sakakiyama, T. [1999], 'Numerical modeling of wave interaction with porous structures', *Journal of waterway, port, coastal, and ocean engineering* pp. 322–330.

Ushijima, S. [2007], 'Multiphase-model approach to predict arbitrarily-shaped objects moving in free surface flows', *Proc of APCOM'07 – EPMESC XI* pp. MS41–3–1.