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NUMERICAL SIMULATION OF PARTICLE SET EVOLUTION IN OSCILLATING FLUID IN MICROGRAVITY CONDITION

Abstract

Investigations of different mechanical, physical and chemical processes in microgravity conditions, which play a very important role in modern space science, often require in calculation of evolution of particle set weighted in surrounding liquid. Such situations can be observed not only onboard space vehicles in free flight. Effective microgravity takes place in case of weighted enough small particles in any conditions, if surface forces acting on them are sufficiently more than mass (for example, gravitational) forces. Thus investigations of the considered particle systems are actual for many fields of science. A specific feature of the microgravity condition differs it from any other multiphase media; in particular, the considered particles can be not so small as for usual disperse phase objects. As a result, hydrodynamic interaction force can influence more sufficiently on the particle motions under host fluid flow than in traditional multiphase flow with extremely small particles. It was shown in previous work of the authors, that the hydrodynamic interaction forces bring together the particles in direction perpendicular to fluid motion and push apart the particles in direction of fluid flow velocity. For enough high frequency oscillating fluid flow, an ideal fluid flow model can be used for the flow calculation and, correspondingly to quantitatively determine the considered hydrodynamic interaction forces. Boundary element method is applied as numerical tool for flow calculation in the present work. All particles in calculations here are assumed spherical. Motion of any particle is described by Cauchy problem for material point motion equations (second order ordinary differential equations), which are solved numerically by Euler scheme. The hydrodynamic interaction forces at every time step is calculated using Cauchy-Lagrange integral. Several examples are calculated numerically to illustrate the considered problem. Different positions of particles in translational oscillating fluid motions and fluid motions due to oscillating point source are analysed. An opportunity to use the oscillating flows as control tool for multiphase media in microgravity conditions is discussed as item of future investigations.