Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Heat transfer and fluid flow of solid-liquid two-phase media of different heat conductivities TAKAAKI TSUTSUMI, SHINTARO TAKEUCHI, TAKEO KAJISHIMA, Department of Mechanical Engineering, Osaka University, Japan — A direct numerical simulation of particle-laden flows, which incorporates the effects of temperature gradient within solid object and heat conduction through moving boundaries, is applied to investigate the heat transfer in a dispersed two-phase media. The momentum exchange at the fluid-solid boundaries is treated by our immersed solid approach. A flux-decomposition scheme is proposed for the heat conduction at the interface. Then we developed an implicit scheme which has wide ranges of applicability for solid-fluid density and heat-conductivity ratios, Reynolds number and Rayleigh number. A two-dimensional natural convection of a mixture composed by liquid and dispersed circular particles of neutral density, confined in a square domain, is simulated. Influences of heat-conductivity ratio and volumetric fraction of solid in the liquid are particularly observed. In case of relatively low volume fraction of solid, the scale of circulating flows is dominated by the heat-conductivity ratio. In case of dense concentration of particles, the heat transfer due to inter-particle connections and/or vibratory motions of particles become pronounced. Overall, these findings highlight the importance of temperature distributions within the particles as well as in the liquid.

Takaaki Tsutsumi
Department of Mechanical Engineering, Osaka University, Japan

Date submitted: 09 Aug 2012 Electronic form version 1.4