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Effect of Temperature Gradient within Solid Particles for Dispersed Two-Phase Flow and Heat Transfer

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Liquid-solid two-phase flow with heat transfer is directly simulated to investigate the effect of temperature gradient within solid object. The interaction between fluid and particles is solved by our original immersed solid approach on a rectangular grid system. And a discrete element model with soft-sphere collision is applied for particle-particle interaction. A new heat conduction model is proposed for the heat conduction at the solid-liquid interface by considering the interface direction. The method is applied to liquid-solid two-phase flow in a confined square domain under a relatively low Rayleigh number. In dense condition, the particles of high heat conductivity induce strong convection and promote the heat transfer, while the particles of low heat conductivity interrupt the inflow of heat , resulting in low Nusselt number. The above simulation results highlight the importance of temperature distributions within the particles and liquid.

Keywords: Multiphase flow, Solid dispersion, Immersed solid object, Thermal flow, Heat conductivity