＜第 11 回　CEIST セミナー＞

タイトル:
Lattice Boltzmann simulation of turbulent flows laden with finite-size particles

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日時　：平成 27 年 6 月 8 日（月）　14 時 00 分～15 時 00 分
場所　：横浜研究所　シミュレータ研究棟 1 階　会議室
使用言語　：English

要旨　：
Modulation of the carrier phase turbulence by finite-size solid particles is relevant to many industrial (e.g., particle transport in pipeline and drag reduction) and environmental applications (e.g., effect of sea-spray droplets on hurricane development). The nature and level of modulation depend on many factors including scales and geometric configurations of the carrier phase flow and particle characteristics such as size, density, and volumetric loading. Finite-size particles may introduce both local viscous dissipation and kinetic energy production.

In this talk, I will discuss our on-going work to develop a particle-resolved simulation of turbulent particle-laden flows using the mesoscopic lattice Boltzmann (LB) approach. The talk consists of two parts. The first part concerns implementation details, specifically, the treatments at the fluid-moving particle interfaces within the LB approach and careful validation of the approach. In the second part, we study flow modulation by finite-size particles in both homogeneous turbulence and in a turbulent channel flow. Results of single-phase turbulent flows are first compared to published benchmark DNS results to validate the lattice Boltzmann approach. In homogeneous turbulence, the presence of finite-size inertial particles enhances dissipation at small scales while reducing kinetic energy at large scales. The statistics conditioned on the surface of a solid particle are analyzed to better understand the two-way interactions. For the particle-laden channel flow, the relative changes due to the presence of solid particles, of the mean flow velocity and r.m.s. velocity fluctuations are compared to results from a finite-difference direct-forcing (i.e., macroscopic) approach. The nature of flow modulation depends on the spatial location relative to the wall as well as the particle size. The particle concentration distribution across the channel shows that there is a dynamic equilibrium location resembling the Segre-Silberberg effect known for a laminar wall-bounded flow.

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