Two-way Interactions in Particle-Laden Turbulent Channel Flow: Results from Interface-Resolved Simulations

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Date: Friday, April 1, 2016
Time: 9:00 – 10:00 AM
Location: 358 Willard Blg.

Coffee and donuts will be provided

Abstract:

Modulation of the carrier phase turbulence by finite-size inertial 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, mass 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 wall-bounded, turbulent particle-laden flow 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 a particle-laden turbulent channel flow. Results of single-phase turbulent channel flows are first compared to published benchmark DNS results to validate the lattice Boltzmann approach. In this talk, particles are assumed to have a same density as the fluid, and two different particle sizes of the order 10 to 20 wall units are considered. 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. Phase-partitioned statistics are compared to reveal some local dynamics within each phase. 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.

**Bio:**

Lian-Ping Wang is a professor of Mechanical Engineering and Professor of Physical Ocean Science and Engineering at the University of Delaware. Dr. Wang received his B.S. in Mechanics from Zhejiang University, China in 1984, Ph.D. in Mechanical Engineering from Washington State University in 1990 and did post-doctoral work in turbulent dispersed flows and turbulence physics at Brown University and Pennsylvania State University before joining University of Delaware in 1994. He held visiting appointments at National Center for Atmospheric Research in the US, Chinese Academy of Sciences, Peking University, and is currently a Chang Jiang Visiting Professor of Huazhong University of Science and Technology and Affiliate Scientist of the U.S. National Center for Atmospheric Research.

Dr. Wang uses advanced simulation tools and theoretical methods to study multiphase flows and transport in engineering applications and environmental processes. His research covers direct and large-eddy simulations of turbulence and particle-laden flows, modeling and parameterizations of dispersion and turbulent collision of inertial particles, and simulation of interfacial multiphase flows. He explores the use of lattice Boltzmann, pseudo-spectral, and finite-difference / finite-volume methods for a variety of applications, as well as their scalable implementations on Petascale computers. Dr. Wang is a Fellow of American Physical Society.