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Particle-Resolved Direct Numerical Simulation for Gas-Solid Flow Model Development

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Patrick F. Taylor Hall 1106
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Abstract:

The flow of a gas laden with inertial solid particles is commonly encountered in nature and industrial applications. In nature for example, debris and ash from volcanic eruptions is a potential hazard to aviation, and the suspension of sand and dust poses serious consequences for operation of helicopters in brownout conditions. Human endeavors to secure a clean environment and sustainable sources of energy through carbon-neutral or carbon-negative technologies such as biofuel production, chemical looping combustion and CO 2 capture are examples of gas-solid flows in the power generation industry.

Gas–solid flows are characterized by multiscale and nonlinear interactions that manifest as rich flow physics and pose unique modeling challenges. This talk will describe the use of particle–resolved direct numerical simulation (PR –DNS) of the microscale governing equations for understanding gas–solid flow physics, and for obtaining quantitative information that leads to the development of statistical models. This talk also summarizes selected recent insights into the physics of momentum, kinetic energy, and heat transfer in gas–solid flows obtained from PR –DNS . Applications of PR –DNS to granular filtration and study of particle clustering will also be described.

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Speaker's Bio:

Dr. Shankar Subramaniam is an Associate Professor in the Department of Mechanical Engineering at Iowa State University. He received his B. Tech. in aeronautical engineering from the Indian Institute of Technology, Bombay. He earned his PhD at Cornell University, subsequent to an MS in Aerospace Engineering at the University of Notre Dame. After his PhD he spent two years as a post-doctoral researcher at Los Alamos National Laboratory in the Theoretical Division's Fluid Dynamics Group. Prior to joining the ISU faculty in 2002, Subramaniam was an assistant professor at Rutgers University. His areas of expertise are in theory, modeling and computation of turbulent, multiphase reactive flows (including sprays and gas-solid/particle-laden flows); modeling granular rheology; simulation of aggregation and clustering using molecular and Langevin/Brownian dynamics, and general statistical mechanical coarse-graining approaches. He is a recipient of the DOE Early Career Principal Investigator Program award in 2002. He received the Outstanding Paper Award at the 2010 International Conference on Multiphase Flow.