JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

SPRING 2021 CEAFM VIRTUAL SEMINAR

"Particle-Laden Flows, From Incompressible Turbulence to Supersonic Jets"

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Hosted by Rui Ni (MechE)

Heavier-than-fluid particles are found in most of the flows we rely on for purposes as diverse as flying, energy conversion, and sustaining our ecosystem. The presence of particles may alter the underlying flow dynamics, they may disperse non-homogeneously facilitating coalescence or chemical reactions, and they may lead to multi-physics phenomena that affects the overall system behavior. Whether the presence of particles is intentional or unavoidable, we need a better understanding of particle-laden flows that supports improved predictive capabilities across a range of regimes. We will discuss two distinct problems involving particle-flow interactions.

Preferential concentration arises due to the interaction of small inertial particles with turbulence and leads to fluctuations in system properties beyond those of the velocity field. Regions of large and small particle concentrations modulate direct transmission across the particle-fluid mixture of an electromagnetic wave. If the system is exposed to thermal radiation that is absorbed by the particles, preferential concentration also causes fluctuating fluid temperatures. Particle-turbulence-radiation interactions are important to solar energy harvesting, combustion systems and fires. We will show results from a fully developed turbulent flow laden with micron-size particles, and discuss some of the current challenges for experimentally characterizing and modeling turbulent particle-laden flows as well as ongoing research at UIUC.

The impingement of supersonic plumes onto a granular surface combines the challenges of time-varying flow characteristics as the surface morphology evolves, and those of fluid-particle interactions. Erosion of the granular surface, fluidization, and entrainment lead to a coupled fluid-surface-particle dynamics problem where the dominant physical mechanisms vary in space and time. The successful landing of a payload and the safety of surrounding assets critically relies on the understanding and prediction of those complex interactions. We will present ongoing efforts to experimentally study plume-granular surface interactions in conditions representative of Moon and Mars landings.

Friday, March 26, 2021 at 3:00 PM

https://wse.zoom.us/j/93762992307