Date: October 14th, 2005

Time: 11:00 AM

Location: Maryland Hall 110

Speaker: Dr. Ken Kiger
Department of Mechanical Engineering
University of Maryland

Title: "Two-phase PIV and Particle Kinetic Stress Measurements in a Solid-liquid Horizontal Turbulent Channel Flow"

Abstract

One of the important objectives in the science of sediment transport is to be able to predict the evolution of the sediment flux suspended within a turbulent carrier fluid. Unfortunately, this task is complicated by a multitude of difficulties that stem from how the particles are organized within the flow structure, and how the dynamics of the particle feedback alters the turbulence characteristics of the carrier flow. The goal of the current work is to utilize novel optical methods to experimentally characterize the instantaneous interaction between the particles and the fluid within a prototypical, fully developed, turbulent channel flow. This information can then be used to understand how the particle/turbulence interaction is manifested within such flows and to act as a database for comparison with model development and simulation within a well-posed and controlled environment.

Towards this end, a simultaneous two-phase PIV technique using median filter algorithms has been developed to capture the dynamics of heavy particle suspension and interaction within the instantaneous flow structure of a solid-liquid two-phase turbulent channel flow. This talk will focus on the development of the experimental technique and the details of the particle/turbulence interactions that were measured. More specifically, measurements of the carrier fluid and particulate velocities have been recorded to document the sediment behavior and its effect on the evolution of the fluid turbulence, indicated by a measurable change in the near-wall turbulence properties and an effective increase in the friction velocity of the channel. In addition, the nature of the flow structure responsible for the particle suspension is elucidated and compared with the case for particle settling. Finally, conditionally-averaged measures of the carrier fluid flow statistics based on sampling at the particle location were used to calculate several closure terms of the particle kinetic stress equation. Qualitatively, the calculated results showed similar trends to those observed in numerical simulations of gas-solid channel flow, and simple closure models based on the particle response time also compared favorably with the measurements.