



DEPARTMENT OF MECHANICAL ENGINEERING Purdue School of Engineering and Technology

FALL 2004 SEMINAR SERIES

Date: **Tuesday, October 5, 2004**

Time: **11:00 am - 12:00 pm**

Room: **ET 137**

Everyone is invited

A Probability Density Function Based Monte Carlo Scheme for Two-Phase Flow Simulation (Thesis Defense)

Jie Huang

Graduate Student in Mechanical Engineering, IUPUI.

Abstract. Two-phase flow has applications to many natural and technological systems. There are two basic numerical methods used in solving the dispersed-phase for two-phase flows: the trajectory method and the two-fluid method. The trajectory method (also named Lagrangian method) follows the trace of each particle and predicts the characteristic of the individual particle. This method has the advantage of easy handling of different particle size groups but has the disadvantage of consuming a large computational time for both transient problems and problems using unstructured grid. The two-fluid method (or Eulerian method) considers the particle phase as a continuum and has high computational efficiency but it is not suitable for problems that involve particles of different sizes and particles whose size is changing. The objective of the present work was to develop a turbulent two-phase flow model based on the probability density function (PDF) method. The continuous gas phase turbulent flow was simulated using the standard Reynolds averaged Navier-Stokes equations with a $k-\epsilon$ model. A PDF transport equation for particle motion is derived from the Eulerian transport equation using Fourier transformations. Models were proposed for the unclosed correlation terms in the PDF equation. The influence of the particle phase on the fluid phase was neglected in the present study. The joint probability density function of the particle velocity and mass fraction was obtained by solving the PDF evolution equation using a Eulerian Monte Carlo scheme. The method developed in present study retains the computational efficiency of the two-fluid method as well as the ability to track individual particles of the trajectory method. The present model was calibrated and validated using two-phase flow experimental data and DNS results from several research groups and good agreement was obtained.

About the Speaker. Jie Huang is a Master's candidate at the CFD Laboratory of Mechanical Engineering Department, IUPUI. Her thesis advisors are Dr. Andrew Hsu (major advisor), Dr. Hasan Akay, and Dr. Sivakumar S. Krishnan.