MAE Praxair Seminar

Modeling & Simulation of Turbulent Reacting Multiphase Flows: From the Nanoscale to Microscale

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Abstract:
Nanoparticles are considered to be one of the building blocks to the formation of nano-structured materials. The economical and efficient production of nanoparticles with prescribed/desired properties is a critical element to the implementation of nano-structured materials. For example, the most common method for large-scale production of nanoparticles is combustion synthesis. This is due, in part, to its overwhelming cost and control advantages over other methods when scaled-up for the production of bulk quantities. Unfortunately there is little understanding of the underlying phenomena due to the complex nature of the process, which ultimately hampers further refinements. The difficulties, both experimentally and computationally, result from the vast range of length (and time) scales encompassing particle growth - from less than 1nm (a few atoms) to 100nm where processes transition from a molecular, to clusters, to bulk, to integral length- scales found in fluid processes. Professor Garrick's work utilizes theory, numerical methods and experimental observations in the areas of fluid dynamics, combustion, and particle formation & growth processes to create computational tools that describe nanoparticle dynamics in a wide variety of flow-regimes, with a goal characterizing and controlling the properties and morphology of particles given thermo-chemical and thermo-physical histories. This seminar will feature recent work on particle nucleation, flame synthesis as well as the effects of fluid turbulence on particle formation and growth.

Bio:
Sean Garrick is an Associate Professor in the Department of Mechanical Engineering at the University of Minnesota. He was an Office of Naval Research - Future Faculty Fellow at the State University of New York at Buffalo and received his PhD from the Department of Mechanical & Aerospace Engineering in 1998. He joined the faculty of the University of Minnesota in Fall 1998 as the Nelson Assistant Professor. Professor Garrick teaches courses in thermodynamics, fluid dynamics, turbulence modeling and computational methods and has research interests in physical and mathematical modeling, numerical simulation of transport phenomena in turbulent flows, and scientific visualization. Professor Garrick's research is funded by the Army Research Office, the National Science Foundation, the Army Research Laboratory and current projects include the modeling of turbulent reacting flows, formation and growth of nanoparticles, and the effects turbulence on bio-compatible particles and pharmaceuticals. Awards include best paper awards from AIAA and National Society of Black Engineers, a Department of Defense "Success Story." His research in large-scale visualization of turbulent reacting flows was featured in the November 2000 issue of Computer Graphics World magazine and his work in visualizing the growth of nanoparticles in turbulent flows won the Best Scientific Image award from the Visualization Society of Japan - Silicon Graphics Inc.

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