ME Seminar

Large-Scale Computations of Transport Phenomena for Thermo-Chemical Engineering Applications

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ABSTRACT

At the heart of the operational principle of any system or device are conservation laws that govern the conservation of mass (overall and individual components or species), momentum (linear and angular), energy, and charge. The movement of these quantities due to various mechanisms is broadly referred to as transport phenomena. The behavior of most engineering systems is dictated by the complex coupling between various transport processes. While transport processes are often described by macroscopic constitutive relationships, depending on the length and times scales, macroscopic laws may be invalid, and one may have to rely on more fundamental theories, such as Boltzmann's particle theory to model transport phenomena. In this seminar, the benefits of large-scale computations of coupled transport phenomena will be demonstrated through selected engineering applications: fuel cells and batteries (mass, energy, charge), chemical vapor deposition of semiconductors (mass, momentum, energy), catalytic reactors (mass, momentum, energy), thermal transport in semiconductors (energy, charge), solid-state Peltier coolers (energy, charge), and sunlight capture (energy).

ABOUT THE SPEAKER

Dr. Mazumder is a Professor and Associate Chair of Mechanical and Aerospace Engineering at The Ohio State University. He received his B.Tech. in Mechanical Engineering from IIT-Kharagpur in 1991 and his Ph.D. from Penn State University in 1997. He joined the Ohio State University (OSU) in March of 2004. Prior to joining OSU, he was employed at CFD Research Corporation in Huntsville, AL for 7 years. He is one of the architects and early developers of the commercial code CFD-ACE+™. His research is computational in nature and spans three main areas: (1) computational fluid dynamics and heat transfer emphasizing on chemical reactions with applications in combustion, catalytic conversion, fuel cells, batteries and chemical vapor deposition, (2) thermal radiation and its applications, and (3) non-equilibrium transport phenomena as occurring in nanoscale systems. Dr. Mazumder is the author of two graduate-level textbooks and more than 140 papers. He is the recipient of the McCarthy award for teaching and the Lumley award for research from the OSU College of Engineering among other awards and is also a Fellow of the American Society of Mechanical Engineers (ASME) since 2011. In 2024, he received the Fulbright-Kalam climate science award, and is currently engaged in research and teaching on global warming.

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