COLLOQUIUM
MECHANICAL ENGINEERING

The Department of Mechanical Engineering presents:

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The Role of Asymptotic Analysis in Combustion Theory

Abstract: Combustion is science of fluid flow with chemical reactions. Current research in combustion is focusedon computations of combustion processes in practical systems. Examples are computations of combustion processes in spark-ignition engines, gas turbines, furnaces, and compression ignition engines. In practice combustion takes place in a turbulent flow-field. Models of turbulent combustion require input from two areas—theory and modeling of turbulence, and asymptotic flame theory. The focus of this presentation is on asymptotic analysis of reactive flows. Asymptotic analysis attempts to obtain approximate solutions to describing equations. Analysis of this type improves understanding of the processes, and provides simplified equations for use in computations. There are two types of asymptotic analysis—activation-energy asymptotic (AEA) analyses, and rate-ratio asymptotic (RRA) analyses. AEA describe chemistry by one-step overall reaction with a large activation energy while RRA employs reduced chemistry deduced from elementary chemical-kinetic mechanisms. Both analyses use singular perturbation techniques to demonstrate the existence of a thin reaction zone, comprising several reaction layers, where the chemistry takes place. Aspects of AEA and RRA analysis will be described with application to methane flames.

Bio: Dr. K. Seshadri is a Professor of Fluid Mechanics at the University of California at San Diego. His research is in the area of combustion. He is currently carrying out experimental, computational and analytical studies on combustion of jet fuels, and propellants.