

MECHANICAL ENGINEERING DEPARTMENT
ME/ISyE 8773-8774

*Progress on the Simulation and Modeling
of Turbulent Combustion at Large Pressure*

by

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Wednesday, September 19, 2007
3:15 p.m. — Refreshments before the seminar
3:30 p.m. — Graduate Seminar
Room 1130 ME

Abstract: Turbulent fluid mixing and combustion at elevated pressure are subjects receiving only relatively recent and limited scrutiny in the literature despite the fact that a variety of combustion devices operate at very large pressures, including, diesel engines, aircraft gas turbine engines, and rocket engines. Such combustion devices routinely operate above the thermodynamic critical point of relevant hydrocarbon fuels. Nevertheless, the majority of turbulent combustion model developments have been made using atmospheric pressure laboratory flames and research into the applicability and/or extension of these simulations and models for the high pressure regime is virtually non-existent. The subject of the seminar is the author's ongoing research into the simulation and modeling of high pressure combustion processes. It is shown that supercritical pressure combustion can markedly differ from low pressure processes in ways including; lack of phase change, real fluid behavior, pressure dependent kinetics, severe property variations, and enhanced Soret and Dufour cross diffusion. A detailed derivation of high pressure H₂/O₂, H₂/Air, CH₄/Air, and C₇H₁₆/Air combustion that includes all pertinent high pressure physics is presented. Results of direct numerical simulations of 1D, 2D, and 3D mixing and reacting flows are presented which illustrate the nature of the high pressure processes. Continuing challenges, relevance to engineering combustion modeling, and future research directions are also discussed.

Bio: Dr. Richard S. Miller received his B.S. (1992), M.S. (1993), and Ph.D. (1995) degrees from the State University of New York at Buffalo. He then worked as a Caltech Postdoctoral Scholar at NASA's Jet Propulsion Laboratory before joining

the Department of Mechanical Engineering at Clemson University in 1999. He is currently an Associate Professor and serves as the Chair of the Graduate and Research Committee as well as the Department's Graduate Program Coordinator. Professor Miller's research area is in the high fidelity simulation and modeling of turbulent mixing and combustion processes at both atmospheric and elevated pressures. He has authored over thirty journal articles and has received the National Science Foundation's Faculty Early Career Development Award, the National Abe. M. Zarem Award, and the International McCarthy Award for his research in these areas.

Informal Faculty Luncheon: Wednesday, September 19, 2007, 12:00 noon. Meet in 1100 ME and walk to lunch with other faculty. Prof. Richard Miller will be able to attend.