

# ***Plenary Lecture***



## **Dr. Elaine Oran**

Senior Scientist, Laboratory for Computational  
Physics & Fluid Dynamics  
US Naval Research Laboratory  
Washington, DC

### ***Title: Turbulence, Stochasticity, and the Navier-Stokes Equations***

There have been many discussions of turbulence and the fact that it is a stochastic process. There have been significantly fewer discussions of what this means in a practical sense of predictability and the consequences for risk assessment. Now we have begun to address these issues as they arise in chemically reactive flows in which there are multiple interacting stochastic processes, including flow instabilities, turbulence, many interactions between shocks, flames, and vortices, and the resulting formation of ignition centers (hot spots). One such flow is the apparently simple situation of an initially laminar flame propagating down a channel containing a series of obstacles. This is illustrated visually by movie made from a multidimensional, unsteady, deterministic solution of the Navier-Stokes equations. Stochastic properties of the system are evaluated using multiple simulations for the same configuration. We discuss how this is done, how it is related to experimental results, and how we can use this process to evaluate the effects of multiple, interacting stochastic processes.

#### **Brief Biography:**

Dr. Elaine S. Oran is the Senior Scientist for Reactive Flow Physics at the Naval Research Laboratory (NRL). She received an A.B. in chemistry and physics from Bryn Mawr College and both a M.Ph. in Physics and a Ph.D. in Engineering and Applied Science from Yale University. At NRL, she is responsible for carrying out theoretical and computational research on the fluid and molecular properties of complex dynamic systems. Active research topics include: chemically reactive flows, turbulence, numerical analysis, high-performance computing and parallel architectures, shocks and shock interactions, rarefied gases, and microfluidics, with applications to combustion, propulsion, astrophysical explosions, and micro-sensor design. In addition to her position at NRL, she is currently an adjunct professor of Aerospace Engineering at the University of Michigan and Editor-in-Chief of the AIAA Journal. She is a member of the NAE and a Fellow of both the APS and AIAA.