COMBUSTION WEBINAR

Multi-resolution Analysis for Assessment of Turbulent Combustion Models for LES

Speaker: Jack R. Edwards, North Carolina State University

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Abstract: This talk will outline the development of a Multi-Resolution Analysis (MRA) framework for evaluating subgrid models for turbulent combustion. The main premise of MRA is to evolve simultaneous large-eddy solutions on a set of nested meshes. The finest mesh allows for the most accurate, near DNS level capturing of the scales of turbulence and their effects on mixing and flame propagation. The velocity field calculated at the finest level is filtered to the coarser mesh levels and is used to constrain the velocity fields obtained at these levels. Multiple mesh levels can be utilized in this fashion to form a hierarchical structure of solutions. Interactions among scales resolved at each level can be quantified and used to assess the efficacy of subgrid models (implemented on the coarser meshes) in their ability to account for the effects of the unresolved scales. Applications to two classes of subgrid models, NCSU's least-squares minimization (LSM) techniques and algebraic PaSR models, will be presented.

Biography: Dr. Jack R. Edwards holds the Angel Family Professorship of Mechanical and Aerospace Engineering (MAE) at North Carolina State University and currently serves as Director of Aerospace Research. Dr. Edwards received his B.S (1988), M.S. (1990) and Ph.D. (1993) degrees from NC State and joined the faculty in 1994. From 2016-2020, he served as Associate Department Head and Director of Undergraduate Programs in MAE. He is an expert in computational fluid dynamics algorithm development, simulation and modeling of turbulent flows, and simulation and modeling of reacting and multi-phase flows. His current research thrusts include large-eddy simulations of turbulent combustion within high-speed aero-propulsion devices, modeling of hypersonic wall-bounded flows, scramjet fuel-injection processes, contaminant transport due to human motion, and GPU-based high-performance computing. He is a Fellow of AIAA and is the author or co-author of over 250 technical publications. His research efforts have been supported by AFOSR, ARO, ONR, U.S. EPA, DARPA, DTRA, NSF, Sandia National Labs, and AFRL, among others.

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