UNIVERSITY OF MARYLAND

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THE FLUID DYNAMICS REVIEWS SEMINAR SERIES

NUMERICAL SIMULATION OF SCRAMJET COMPONENT FLOWFIELDS

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Aerospace Engineering Conference Room
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Speaker

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ABSTRACT

The flow within high-speed engine concepts (scramjets, ramjets) is affected by strong compressibility effects, high turbulence intensity levels, finite rates of reaction, incomplete mixing, and core-flow blockage due to growth of turbulent shear layers. Scale-resolving techniques, such as large-eddy simulation, offer several advantages over state-of-the-practice Reynolds-averaged Navier-Stokes (RANS) methods in capturing these interactions, as they are able to directly capture larger turbulent structures and their corresponding effects. Since molecular mixing and combustion take place at the unresolved subgrid scales, there is still a need to model the effects of reactivity as expressed at the resolved scales and to account for two-phase fluid dynamics associated with the injection of liquid fuels. This talk surveys efforts undertaken at NCSU to model scramjet component flow fields, referenced to experiments conducted at the University of Virginia, the University of Illinois, AFRL, and NCSU and considering both facility-specific influences and large-scale interactions among engine components. Numerical methods and physical modeling strategies used at NCSU will be discussed, as will new forays into the use of 'data-driven' techniques to improve RANS and LES models. Directions for future work will be presented, as will a brief overview of the Army Research Office's Fluid Dynamics program.

BIO

Dr. Jack R. Edwards holds the Angel Family Professorship of Mechanical and Aerospace Engineering at North Carolina State University. Dr. Edwards received his B.S (1988), M.S. (1990) and Ph.D (1993) degrees from NC State and joined the faculty in 1994. He served as Associate Department Head and Director of Undergraduate Programs from 2016-2020 and as Director for Aerospace Research from 2020-2022. He will be starting an IPA appointment as Program Manager for the Army Research Office's Fluid Dynamics program in Fall, 2022. He is a Fellow of the American Institute of Aeronautics and Astronautics and is an expert in computational fluid dynamics algorithm development, modeling of turbulent flows, 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, unsteady aerodynamics, contaminant transport due to human motion, supercritical fluids and multi-phase flows He is the author or co-author of over 250 technical publications, and 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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