Dee Howard Lecture Series

DEPARTMENT OF MECHANICAL ENGINEERING,
AEROSPACE & INDUSTRIAL ENGINEERING

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UT Austin

MACHINE LEARNING OF TURBULENCE CLOSURES FOR THE SIMULATION OF THE DYNAMICS OF TRANSITIONS BETWEEN METASTABLE STATES

Sponsored by the:
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May 4, 2026

1:00 pm BSE 2.102

Zoom option
https://utsa.zoom.us/s/95527114485

ABSTRACT

Dr. Bisetti will present an overview of and select technical results from an ongoing DARPA project that seeks to develop and demonstrate a novel approach that discovers stochastic sub-grid scale (SGS) models for large-eddy simulation (LES) of meta-stable state transitions in a classical-fluid turbulent flow, using a newly proposed scientific multi-agent reinforcement learning framework. Our approach is unique in that it uses laboratory data from a compact tabletop turbulence simulator that is tunable over 4 orders of magnitude in the controlling parameters, e.g., the Reynolds number, and is characterized via non-intrusive optical measurements, including of multi-point/multi-time statistics of velocity.

Decades-long pursuits of models for multiscale systems such as turbulent flows have received a new boost from machine learning (ML). In this project, we aim to improve SGS models towards the simulation of turbulent flows that display switching between asymmetric meta-stable states and that are relevant to vehicles, ships, and propulsion systems of interest to the U.S. Department of Defense, e.g., wakes and separated & recirculating flows. Because those meta-stable states differ in topology, prediction of kinetic energy, mixing, and drag requires accurate simulation of transition frequency and state features. Transitions occur with relatively low frequency and are affected by small and large scales, which are distributed broadly in turbulent flows, necessitating closure approaches to model unresolved spatio-temporal scales and overcoming key challenges, i.e., a high Reynolds number and coherent broadband dynamics.

BIOSKETCH

Fabrizio Bisetti is an Associate Professor in Aerospace Engineering at the University of Texas at Austin, where he moved in late 2016. Prior, Prof. Bisetti held a faculty appointment at King Abdullah University of Science and Technology (KAUST), where he joined the Clean Combustion Research Center (CCRC) in July 2009 as a founding faculty.

Prof. Bisetti's research interests are in turbulent combustion, soot formation in turbulent flames, turbulent aerosols, turbulent mixing, low-temperature plasmas, and numerical methods for reactive and plasma flows. His research activities combine High Performance Computing (HPC) and theory to understand complex multi-physics/multi-scale processes in turbulent flows, e.g. aerosol/turbulence interaction, turbulent combustion, and plasma-assisted ignition.

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