ME Seminar

Machine Learning for Unprecedented Advances in Multiscale Modeling of Multiphase Flows

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ABSTRACT

Euler-Lagrange (EL) and Euler-Euler (EE) techniques have been widely employed for solving particle, droplet, and bubble-laden flows of engineering and environmental importance. Since flow around individual particles is not resolved at the microscale, the accuracy of the technique depends on the fidelity of the force laws and Reynolds stress models employed. As a result, their predictive capability EL and EE approaches are often severely restricted by the serious limitations of the closure models employed. We still simulate real-world problems in much the same way we did four decades ago, perhaps with much larger supercomputers, substantially improved numerical methods, but only with incrementally better closure models. The main focus of this talk is about how we can leverage emerging machine learning and other AI techniques to our advantage. This will require us to use these powerful techniques as very sophisticated instruments (as opposed to blunt tools) and integrate them with our decades of physical insight. Ultimately, can we develop best-possible closure models, which will allow reduced-order EL and EE techniques to recover fully-resolved-like accuracy at orders of magnitude lower cost.

ABOUT THE SPEAKER

Pro. S. "Bala" Balachandar got his undergraduate degree in Mechanical Engineering at the Indian Institute of Technology, Madras in 1983 and his MS and PhD in Applied Mathematics and Engineering at Brown University in 1985 and 1989. From 1990 to 2005 he was at the University of Illinois, Urbana-Champaign. From 2005 to 2011 he served as the Chairman of the Department of Mechanical and Aerospace Engineering at the University of Florida. Currently he is a distinguished professor at the University of Florida. He is the Newton C. Ebaugh Professor of Mechanical & Aerospace Engineering and the Director of College of Engineering Institute for Computational Engineering. He is Fellow of ASME, APS-DFD, and ASTFE. He was the recipient of Francoise Frankiel Award from APS, ASME Freeman Fellowship Award (2017), Gad Hetsroni Senior Researcher Award from ICMF (2019), Outstanding Alumnus Award from the Indian Institute of Technology, Madras (2019), Outstanding Doctoral Mentoring Award from the University of Florida (2020), Thermal Fluids Engineering Award from the American Society of Thermal Fluids Engineers (2022), University of Florida Research Foundation Professorship (2023), Fluids Engineering Award from ASME (2024). He is currently the co-editor-in-chief of the International Journal of Multiphase Flow.

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