Eddy-resolving simulations of hydrodynamic and phase instabilities in engineering and biological systems

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Turbulence is a defining feature of the fluid flows that occur in our energy sector, transportation systems, in and through our buildings, and also in our health. As computational power grows, numerical simulations are increasingly able to resolve the minute features of turbulence in these settings. This includes the rich spectrum of energy-containing fluctuations or “eddies” that are responsible for transferring mass, heat, and momentum across the broad ranges of length and time scales found in such flows. So-called “eddy resolving” simulations are shedding new light on how turbulent flows behave and the ways that turbulence affects the performance of our energy, transportation, and building systems. This talk will explore the development and application of eddy resolving numerical simulations of turbulent flows undertaken in the UBC Okanagan Computational Fluid Dynamics Lab. In particular, it will explore how eddy-resolving turbulence simulations are contributing to a richer understanding of hydrodynamic instabilities which lead to the growth and evolution of turbulence in several engineering and biological applications. Snapshots of recent studies in wastewater treatment, biofluid dynamics, wind energy, ethylene production, passively ventilated buildings, and hydrogen storage and safety will be presented. The talk will aim to describe recent advances in solution methodologies, novel applications, and recent fundamental insights.

Dr. Joshua Brinkerhoff completed his B.Eng. and PhD at Carleton University in 2007 and 2014, respectively. Now an Associate Professor of Mechanical Engineering at UBC Okanagan’s School of Engineering, he leads the UBC-Okanagan Computational Fluid Dynamics (CFD) Lab, with research focused on eddy-resolving numerical simulations of turbulent flows, with applications in wind turbine aerodynamics, atmospheric boundary layers, laminar-to-turbulent transition, cavitation and pool boiling in cryogenic liquids, multiphase flows, and hydrogen storage, blending, and safety. Since 2014, he has published over 30 refereed journal publications and 50 peer-reviewed conference papers, in addition to receiving over $3.6M in external funding. Dr. Brinkerhoff serves the School of Engineering as the Associate Director—Research and Industry Partnerships and also serves as the Treasurer and Secretary of the Computational Fluid Dynamics Society of Canada.

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