DEPARTMENT OF MECHANICAL ENGINEERING

SEMINAR SERIES

An Integrated Experimental and Multiscale Modeling Framework for Droplet Breakup in Immiscible Fluid Flows

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Abstract

Droplet breakup in immiscible fluid flows is governed by complex interactions among interfacial tension, viscous stresses, inertia, turbulence, and density and viscosity contrasts between the phases. This seminar presents an integrated experimental and multiscale modeling framework for investigating these mechanisms across different spatial and temporal scales. Controlled experiments provide measurements of jet dynamics, interfacial deformation, breakup regimes, droplet size distributions, and flow conditions. At the microscale, high-resolution multiphase simulations based on the lattice Boltzmann method are used to examine interface evolution and the mechanisms leading to droplet formation and fragmentation. The experimental and numerical results are then combined to develop reduced-order and data-driven models capable of transferring microscale information to larger-scale simulations. Particular attention is given to the relationships among flow conditions, dimensionless parameters, breakup regimes, and the resulting droplet size distributions. The framework provides a general basis for understanding and predicting droplet breakup in immiscible multiphase systems, with applications in environmental, petroleum, chemical, and process engineering.

Speaker Bio

Luiz A. Hegele Jr. is a professor in the Department of Petroleum Engineering at Santa Catarina State University (UDESC), Brazil, and coordinator of the Geoenergia Lab. He received his Ph.D. in Mechanical Engineering from the Federal University of Santa Catarina and previously worked as a reservoir engineer at Petrobras. His research focuses on computational fluid dynamics, lattice Boltzmann methods, multiphase flow, porous media, and heat transfer. He currently coordinates research projects combining laboratory experiments, multiscale numerical modeling, and data-driven methods for fluid dynamics, geothermal energy, and carbon capture and storage.

Date: Thursday, August 27, 2026
Time: 2:00 PM
Location: Steinman 254
Host: Taehun Lee

Attendance open to all interested persons

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