

From Energy to Medicine: Multiphase Flow Insights with Lattice Boltzmann Methods

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Dr. Travis Mitchell is a Lecturer (eq. Assistant Professor) at The University of Queensland (UQ). He has a range of research interests covering various areas in computational fluid dynamics, with an emphasis on lattice Boltzmann methods and multiphase flow. Dr. Mitchell holds a PhD in Mechanical Engineering from UQ as well as a dual Bachelor degree in Engineering (Honours) and Science with an extended major in mechanical engineering and a major in mathematics. His current research focuses include the analysis of bubble-particle dynamics in molten-salt reactors for hydrogen production, multiphase flow in fractured subsurface media for storage and or production purposes, and modelling of gas diffusion electrodes (GDEs) to optimise the performance and reliability of electrochemical devices.

This seminar will present recent research advancements from Dr. Mitchell's team in the field of multiphase flow modelling, with a specific focus on applications in energy and biomedical engineering. The seminar will cover the following key topics:

1. Phase-field lattice Boltzmann modelling (LBM): An overview of the phase-field method integrated with lattice Boltzmann techniques to simulate complex liquid-gas interactions, relevant for various industrial applications.
2. Relative permeability estimates for enhanced natural gas extraction: An introduction of high-fidelity simulation approaches to derive accurate relative permeability estimates, which are crucial for improving the extraction efficiency of natural gas.
3. Modelling gas diffusion electrodes for CO₂ electrolysis: Discussions into the development and application of lattice Boltzmann models to enhance the efficiency and reliability of CO₂ electrolysis, a technology with strong potential in assisting the transition towards sustainable societies.
4. Respiratory dynamics for targeted drug delivery: This section will explore how advanced simulations can optimise drug delivery mechanisms in the respiratory system, ensuring higher efficacy and precision in treatment.

Dr. Mitchell's work aims to bridge the gap between theoretical modelling and practical applications, providing innovative solutions to pressing challenges in energy and healthcare. By leveraging advanced computational techniques and state-of-the-art compute facilities, Dr. Mitchell's team strives to enhance the understanding and optimisation of complex flow systems.

Keywords: Multiphase Flow, Lattice Boltzmann Method, Natural Gas Extraction, CO₂ Electrolysis, Drug Delivery, Computational Fluid Dynamics