OpenFOAM & Combustion Simulation

mmcFoam – A Stochastic Multiple Mapping Conditioning Computational Model in OpenFOAM for Turbulent Combustion

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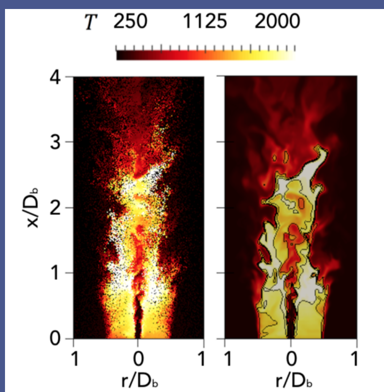
Host: Prof. Huangwei Zhang (National University of Singapore)

Register: https://nus-sg.zoom.us/webinar/register/WN_je74lDJKQm2GdKMXKnj98Q

Abstract

Computational models for combustion must account for complex and inherently interconnected physical processes including dispersion, mixing, chemical reactions, particulate nucleation and growth and, critically, the interactions of these with turbulence. The development of affordable and accurate models that are widely applicable is a work in progress. Stochastic multiple mapping conditioning (MMC) is a fast-emerging approach that has been successfully applied to a wide range of combustion problems. The method solves the conventional probability density function (PDF) transport equation but incorporates an additional constraint in that the mixing is localised in a reference space. This seminar describes the numerical implementation of stochastic MMC in an OpenFOAM compatible code called mmcFoam and provides demonstrations of consistency and numerical convergence. Recent applications to sprays, premixed and partially premixed combustion, soot formation and supersonic combustion are discussed in detail.



Instantaneous turbulent temperature fields in a swirl flame by a sparse stochastic Monte Carlo method (left) and a finite volume method (right).

About the Speaker

Associate Professor Matthew Cleary's research interests are in the computational modelling of turbulent combustion and two-phase flows. His work focuses on stochastic models for large eddy simulations and is best known for co-developing the sparse-Lagrangian multiple mapping conditioning method (MMC-LES). This is a probability density function model that draws upon concepts that originated in conditional moment closure and flamelet approaches to achieve closed, accurate and affordable solutions for turbulent reacting flows including those involving complex chemistry, multiple phases and nanoparticle formation. Through the development and dissemination of the opensource software called mmcFoam, the MMC-LES model has been widely adopted by researchers at various international institutions. Cleary's recent research has focused on supersonic combustion and rotating detonation engines, soot formation and a new, accurate and uniquely convergent volume of fluid method for interfacial LES called the explicit volume diffusion model. He teaches fluid mechanics, dynamics, energy and propulsion courses at the School of Aerospace, Mechanical and Mechatronic Engineering at the University of Sydney.