OpenFOAM & Combustion Simulation

Simulation of Turbulent Premixed Flames using Conditional Source-Term Estimation in OpenFOAM

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Host: Dr Xiaohang Fang (University of Calgary and University of Oxford)

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Abstract

Conditional Source-term Estimation (CSE) is a turbulence-chemistry interaction model to simulate reacting flows. This model is similar to the Conditional Moment Closure (CMC) approach in using the conditional scalar field to calculate the conditional reaction rates. However, unlike CMC, where transport equations are solved for the conditional scalars, an integral equation is inverted in CSE to estimate the conditional scalars. The model has been developed and applied to a wide range of combustion regimes, tested against several Direct Numerical Simulation (DNS) databases in a priori analyses and used in the simulation of laboratory scale and practical combustion devices. In this talk, the fundamental basis of the CSE model is first presented, and the model's limitations and strengths are described. Next, the mathematical, numerical and implementation challenges of the model to premixed combustion regime are discussed. Finally, recent advances of the model in Reynolds-Averaged Navier-Stokes (RANS) modelling and Large-Eddy Simulation (LES) of turbulent premixed flows are presented. In addition to CSE, a similar model called Laminar Flamelet Decomposition (LFD) model is also introduced, and some a priori results are discussed and presented.

About the Speaker

Mahdi Salehi is an assistant professor in the Aerospace Engineering Department at Sharif University of Technology (SUT). Before joining SUT, he was a Post-Doctoral fellow at the Center for Interactive Research on Sustainability at the University of British Columbia (UBC). He received his Ph.D. in Mechanical Engineering from UBC and his B.Sc. and M.Sc. in Aerospace Engineering from SUTMahdi's primary research interest is turbulent combustion modelling. He developed OpenFOAM solvers for turbulent reacting flow simulation using flamelet and CSE combustion models. He teaches thermodynamics, combustion, numerical methods and aerospace and the environment course at the undergraduate level and computational fluid dynamics, combustion and viscous flow at the graduate level.