

OpenFOAM & Combustion Simulation



Reactor-Based Modelling of MILD Combustion in OpenFOAM

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Host: Prof. Wang Han (Beihang University)

Register: https://nus-sg.zoom.us/webinar/register/WN_ge3Mn5fQQ5qUX1N7UZD9Xg



Abstract

Moderate or Intense Low-oxygen Dilution (MILD) combustion has drawn increasing attention as it allows to avoid the thermo-chemical conditions prone to the formation of pollutant species while ensuring high energy efficiency and fuel flexibility. MILD combustion is characterised by intense competition between turbulent mixing and chemical kinetics so that turbulence-chemistry interactions are naturally strengthened. In this context, modelling MILD combustion systems has proven to be a challenging task for the necessity of incorporating finite-rate chemistry effects and detailed chemical mechanisms. Reactor-based models are based on the hypothesis that a portion of the computational cell behaves like an ideal reactor (e.g., perfectly-stirred reactor or plug-flow reactor), providing a model to estimate the sub-grid quantities required to close the mean/filtered reaction rates. Modelling challenges associated with reactor-based models are then related to the sub-models used to determine the reacting fraction of the computational cell. The implementation of the partially-stirred reactor model in OpenFOAM and its application in the context of MILD combustion is presented. Future perspectives on the improvement of the model using data-driven methods are discussed.

About the Speaker

Prof. Alessandro Parente obtained his Master's Degree in Chemical Engineering at the Università di Pisa in 2005. He then carried out a PhD at the same University in collaboration with the University of Utah, where he served as a Research Associate from November 2007 to December 2009. In April 2009, Prof. Parente started working at the von Karman Institute of Fluid Dynamics. In October 2010, he was appointed Assistant Professor at the Aero-Thermo-Mechanical Department of Université Libre de Bruxelles. Since 2019, he has been Professor at the same Institution. In January 2015, Prof. Parente founded the BURN joint research group on combustion and robust optimisation, involving seven full-time professors and around 40 researchers. He is currently the co-director of BRITE, the Brussels Institute for thermal-fluid systems and clean energy. Prof. Parente's research interests have been in turbulent/chemistry interaction in turbulent combustion, reduced-order models, non-conventional fuels and pollutant formation in combustion systems, novel combustion technologies, numerical simulation of atmospheric boundary layer flows, and validation and uncertainty quantification. He is the author and co-author of more than 100 papers in International Archival Journals.

