

OpenFOAM in Combustion Research



Developing OpenFOAM for Safety Related Reactive Flows from Underpinning Physics to Applications

Prof. Jennifer X. Wen

Warwick FIRE, School of Engineering, University of Warwick, UK

Time: April 8, 2022, 18:00 Singapore/Beijing | 11:00 London | 06:00 New York

Register: https://nus-sg.zoom.us/webinar/register/WN_XhpJhAVvRiey-i71eDbNnw



Abstract

The presentation will start with an overview of the systematic approach my team has followed since 2008 to develop, validate and apply in-house version of OpenFOAM for safety related reactive flows. For applications related to fire, explosions and/or deflagration to detonation transition (DDT), our activities have spanned across conventional gaseous, liquid and solid fuels to syngas, hydrogen and lithium ion batteries. The physical scales of our simulations range from millimeter, centimeter to hundred meters. As such, we use detailed physics-based models as well as some simplified approaches depending on the scope of the projects and aspiration of the researchers. As a team which is focused on modelling, we use a wide range of experimental data for model validation from published literature as well as collaborators from academia and industry.

The main contents of the presentation will include snapshots of our endeavour in the following topics: (1) Mechanisms and characteristics of flame spread over liquid fuel at sub-flash temperatures; (2) DNS with multi-component transport model and mixture-averaged diffusion coefficients; (3) Extension of the eddy dissipation concept and smoke point soot model for large eddy simulation of fires; (4) Ignited releases of hydrogen jets at atmospheric and cryogenic conditions; (5) DDT in hydrogen-air mixtures with and without concentration gradients; (6) Vapour cloud explosions from instantaneous large-scale releases of liquid hydrogen; (7) Sparks and fires induced by thermal runaway of lithium ion batteries.

About the Speaker

Professor Jennifer Wen joined the School of Engineering at the University of Warwick in May 2013. She established and currently leads Warwick FIRE, a multidisciplinary research laboratory for both fundamental and applied research in fire, explosions and other safety related reactive and non-reactive flows. Jennifer holds a BSc from Shanghai Jiaotong University and a PhD from University of London. She has previously held positions at Computational Dynamics Limited (founding vendor of STAR-CCM), British Gas plc, South Bank University and Kingston University London.



Professor Wen's research focuses on numerical studies of safety related reactive and non-reactive flows. Her team specializes in the development of physics-based sub-models and modelling approaches to capture the underlying physics of complex safety problems. Most of the development has been conducted within the frame of OpenFOAM® to facilitate model validation and application.

Jennifer is a Fellow of the Institution of Mechanical Engineers. She is Vice-Chairman of the International Association for Fire Safety Science (IAFSS) and Chair of IAFSS "Research" sub-committee. She is a member and sub-task leader of the European Safety Panel on Hydrogen Safety (EHSP) established by the Fuel Cell and Hydrogen Joint Undertaking (now Clean Hydrogen Partnership) of the European Commission.