

MULTIPHASE CFD MODELLING: STATE-OF- THE-ART APPLICATIONS AND CHALLENGES

Institution of
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ENGINEERS**

19 May 2016
Institution of Mechanical Engineers,
One Birdcage Walk, London

Thermofluids Group
Seminar

More details available at
www.imeche.org/cfdmodelling

KEY SPEAKERS INCLUDE:

Dimitris Drikakis
Executive Dean
Faculty of Engineering;
Professor of Engineering Science
University of Strathclyde

William Jones
Department of Mechanical Engineering
Imperial College London

Helen Brocklehurst
Chief of Computational Fluid Dynamics
Rolls Royce

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MULTIPHASE CFD MODELLING STATE-OF-THE-ART APPLICATIONS AND CHALLENGES

19 May 2016,
Institution of Mechanical Engineers, London



INCREASING YOUR UNDERSTANDING OF STATE- OF-THE-ART MULTIPHASE MODELLING.

This one-day event will provide a crucial opportunity to hear how engineers can support the advancement of computational fluid dynamics (CFD) for multiphase flows.

The models dealing with multiphase flows are continuously evolving and the complexity of tackled problems has notably increased of late.

Join us to reflect on progress and developments in multiphase flow modelling, allowing you to remain up-to-date with current trends and state-of-the-art technologies.

Key topics:

- Modelling and stimulation of multi-component compressible flows
- Multiphase CFD modelling for safety and performance engineering
- Implementation of flocculation and break-up models in CFD for particulate systems
- Challenges of multiphase flow modelling in gas turbine engines
- Multiphase flow modelling with the Lattice Boltzmann method: An alternative CFD approach

KEY TAKEAWAYS INCLUDE:

- **Increasing your knowledge** of state-of-the-art multiphase CFD modelling
- **Networking opportunities** with practitioners in the field
- **Interdisciplinary exchange** on challenges faced in different fields
- **A greater awareness** of recent developments, current trends, capabilities and limitations for models

Who should attend?

- Principal Engineers
- Design Engineers
- Research Engineers
- Consultants
- Innovators
- Software Designers
- Academics
- University Research Leads
- Students

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PROGRAMME

THURSDAY 19 MAY 2016	
08:30	REGISTRATION AND REFRESHMENTS
09:00	CHAIR'S OPENING REMARKS Carola König, Institute of Environment, Health and Societies and College of Engineering, Design and Physical Sciences, Brunel University London
09:10 Keynote	MODELLING AND SIMULATION OF MULTI-COMPONENT COMPRESSIBLE FLOWS Dimitris Drikakis, Executive Dean, Faculty of Engineering; Professor of Engineering Science, University of Strathclyde • Implicit Large Eddy Simulation (ILES) of compressible turbulent mixing • Engineering turbulence models for multi-component flows • High-order CFD methods • Hybrid compressible-incompressible methods
09:40	MULTIPHASE CFD MODELLING FOR SAFETY AND PERFORMANCE ENGINEERING Marco Buonfiglioli, Principal Engineer, Fluid Mechanics, Atkins Global • Safety: Behaviour of cryogenic spills on FLNG process facilities, including liquid spray, VOF, liquid film and conjugate heat transfer to structures • Performance: Prediction of design behaviour for waste water vortex drops, including comparison to experimental data • Performance: Prediction of erosion, heat transfer and multiphase flow slugging in upstream oil and gas equipment
10:10	TOWARDS ACCURATE PREDICTION OF GAS-LIQUID TWO-PHASE FLOWS Alan Burns, Associate Professor, School of Chemical and process Engineering, Leeds University and Senior Developer, ANSYS UK • Development and experimental validation of models for gas-liquid flows: A collaboration with ANSYS Germany and the Helmholtz Zentrum Dresden Rossendorf (HZDR)
10:40	QUESTIONS AND ANSWERS
11:00	NETWORKING REFRESHMENT BREAK
11:30 Case Study	OPENFOAM AND INDUSTRY Gavin Tabor, Associate Professor of CFD/Director of Education (Engineering) CEMPS, University of Exeter • Introducing OpenFOAM as a flexible and cost-effective solution to CFD requirements • Demonstrating how the code has been used in conjunction with an SME in sustainable urban drainage to develop new products • Current work on reacting flow, particle separation and optimisation through the Adjoint Method
12:00	IMPLEMENTATION OF FLOCCULATION AND BREAK UP MODELS IN CFD FOR PARTICULATE SYSTEMS Darrell Egarr, Senior Engineer, MMI Engineering • Development and validation of OpenFOAM for solving the transport of multiple particle size groups using an algebraic slip formulation • Motivation of the development with respect to applications in the nuclear and water industry • Implementation of flocculation and breakup models with results presented from test cases applicable to the water industry
12:30	QUESTION AND ANSWER SESSION
12:50	NETWORKING LUNCH
13:50	LARGE EDDY SIMULATION OF SPRAY FUELLED FLAMES William Jones, Department of Mechanical Engineering, Imperial College London • Droplet dispersion • Droplet evaporation • Secondary droplet breakup

For the most up-to-date and detailed programme for the event, please visit www.imeche.org/cfdmodelling

- This programme is subject to change.
- The Institution is not responsible for the views or opinions expressed by individual speakers.

PROGRAMME

THURSDAY 19 MAY 2016 (CONT.)	
14:20	CHALLENGES OF MULTIPHASE FLOW MODELLING IN GAS TURBINE ENGINES Helen Brocklehurst, Chief of Computational Fluid Dynamics, Rolls Royce • Introducing the range of different multiphase phenomena encountered in gas turbine engines, including hail ingestion, ice accretion, fuel injection, atomisation and oil in bearing chambers • Modelling approaches adopted to predict these environments • Examples of multiphase CFD predictions for engine design
14:50	MODELLING LIQUID FUEL CASCADES WITH OPENFOAM Jennifer Wen, Professor of Engineering, University of Warwick • Evaporating fuel cascades resulting from tanks overfilling or rupture of elevated pipes creating a source of flammable vapour cloud • Development of a modelling approach within the frame of the open source CFD toolbox OpenFOAM giving consideration to vapour production • Comparison with the experimental measurements conducted by the Health and Safety Laboratory (HSL)
15:20	QUESTION AND ANSWER SESSION
15:40	NETWORKING REFRESHMENT BREAK
16:10	WORLD OF MULTIPHASE FLOWS AT ULTRA-HIGH RESOLUTION: PHASE CHANGE APPLICATIONS AND STRATIFIED FLOWS Prashant Valluri, Deputy Head of Grad School, IMP, School of Engineering, University of Edinburgh • State-of-the-art indirect numerical simulations of two phase flows • Advanced theoretical analysis such as linear/non-linear stability analysis • Advanced high-resolution experiments: Informing the modelling as well as validation
16:40	MULTIPHASE FLOW MODELLING WITH THE LATTICE BOLTZMANN METHOD (LBM): AN ALTERNATIVE CFD APPROACH Mark Wilson, School of Mechanical Engineering, University of Leeds • Key concepts and key benefits • Multiphase flow models • Solid/liquid/fluid systems: Modelling wetting and contact line dynamics • Example applications: Fuel/water separation; printing and droplet interactions with complex surfaces
17:10	INDUSTRIAL MULTIPHASE FLOW SIMULATION USING THE LATTICE BOLTZMANN METHOD (LBM) Daniel Lycett-Brown and Nicolas Delbosc, Senior CFD Research and Development Engineer, XFlow, NextLimit Dynamics • LBM models for multiphase flow • Examples of industrial applications • LBM on Graphics Processing Unit: The road towards real-time fluid simulation
17:40	QUESTION AND ANSWER SESSION
18:00	CHAIR'S CLOSING REMARKS
18:10	END OF SEMINAR

ORGANISING COMMITTEE

Thermofluids Group, Institution of Mechanical Engineers

Member Credits:

Dr Carola König
Institute of Environment, Health and Societies and College of Engineering,
Design and Physical Sciences, Brunel University London

Dr Mark Wilson
School of Mechanical Engineering, University of Leeds

Dr Chris Robinson
Principal, MMI Engineering

SPEAKERS AND CONTRIBUTORS

KEYNOTE SPEAKER

**PROF DIMITRIS DRIKAKIS,
EXECUTIVE DEAN, FACULTY OF ENGINEERING, PROFESSOR OF
ENGINEERING SCIENCE, UNIVERSITY OF STRATHCLYDE**

Dimitris Drikakis is the Executive Dean of the Faculty of Engineering and Professor of Engineering Science at the University of Strathclyde, Glasgow. He was previously Head of the Institute of Aerospace Sciences at Cranfield University. Professor Drikakis held positions at Queen Mary University of London, the University of Manchester and the University of Erlangen-Nuremberg, Germany. His expertise is in fluid mechanics, CFD and nanotechnology (fluid/material interface). He has received twice (2008 and 2011) the William Penney Fellowship Award by AWE Plc in recognition of his contributions to compressible fluid dynamics. Prof Drikakis also received the 2014 Innovator of the Year Award by the Innovation Institute for a new generation carbon capture technology.

CHAIR

**DR CAROLA KÖNIG,
INSTITUTE OF ENVIRONMENT, HEALTH AND SOCIETIES AND COLLEGE
OF ENGINEERING, DESIGN AND PHYSICAL SCIENCES, BRUNEL
UNIVERSITY LONDON**

Carola König is a Research Fellow at the Institute of Environment, Health and Societies and an Associate Lecturer in the College of Engineering, Design and Physical Sciences, both at Brunel University London. She obtained the degree of Dipl-Ing in Mechanical Engineering from the University of Stuttgart, Germany in 1992 and a PhD from Brunel University in 1998. Her expertise is in Computational Fluid Mechanics involving fluid flow with and without heat transfer within a variety of multi-disciplinary environments (e.g. engineering interface with biology, medicine, chemistry, arts). She is a Member of the Institution of Mechanical Engineers and is currently Co-Chair of the Institution's Thermofluids Group. She is also the Scientific Secretary of the Micro and Nano Flows Conference series and a Fellow of the Institute of the Higher Education Academy.

SPEAKERS

**MARCO BUONFIGLIOLI,
PRINCIPAL ENGINEER, FLUID MECHANICS, ATKINS GLOBAL**

Marco Buonfiglioli is the Head of Fluid Mechanics at Atkins, managing a team specialised in fluid dynamics and heat transfer modelling. Marco has 15 years' experience as technical lead and project manager in the field of fluid mechanics applied to a wide variety of problems. He has managed and undertaken projects in ventilation, spray and combustion, free surface flows and heat transfer in sectors as diverse as process, oil and gas, nuclear and automotive. He is an experienced user of CFD software and has experience in using and writing 1D gas dynamics software.

**DR ALAN BURNS,
ASSOCIATE PROFESSOR, SCHOOL OF CHEMICAL AND PROCESS
ENGINEERING, LEEDS UNIVERSITY AND SENIOR DEVELOPER, ANSYS UK**

Alan Burns started his working career at the UKAEA Harwell Laboratory in 1984, where he made the first steps in developing the commercial CFD codes CFX-4 and CFX-5 which were owned by AEA Technology. Since their acquirement by ANSYS Ltd they have evolved into the current commercial CFD code, ANSYS CFX. During this period, he has acted as a consultant to AEA Technology and to ANSYS, taking a leading role in the early design and development of ANSYS CFX, and most recently in the development of numerical algorithms and models for multiphase flows. Since October 2014, he has been an Associate Professor of CFD in the School of Chemical and Process Engineering at Leeds University. His current research interests include applications of Computational Multiphase Flow in Geophysical Fluid Dynamics, and in various areas of Sustainable Energy such as Nuclear Power, Biofuels, Solar Power and Wind Energy.

SPEAKERS

DR DARRELL EGARR, SENIOR ENGINEER, MMI ENGINEERING

Darrell Egarr joined MMI Engineering as a Project Engineer in the company's Bristol office in January 2006 after completing a PhD at Cardiff University. Dr Egarr was elected a full member of the Institute of Mechanical Engineers and a Chartered Engineer in 2009 and was promoted to Senior Engineer in 2011. Dr Egarr has worked for customers in the Water, Nuclear, Aerospace and Defence industry sectors and has specialised in the field of CFD.

PROF WILLIAM P JONES, DEPARTMENT OF MECHANICAL ENGINEERING, IMPERIAL COLLEGE LONDON

William Jones is Professor of Combustion in the Department of Mechanical Engineering at Imperial College London. He completed his PhD in Imperial College and successively became an Alexander von Humboldt Research Fellow in the Technische Hochschule, Aachen, a section leader in the Combustion Department of Rolls-Royce Ltd and, from 1977, a member of the teaching faculty of Imperial College. Bill has been active in Combustion and Turbulence Research for many years and has published extensively in the fields of turbulence, combustion modelling and CFD. The current activities of Bill and co-workers include Combustion Large Eddy Simulation (LES), the development of PDF transport equation methods for turbulent combustion, the development of CFD tools for practical combustion systems and the modelling of turbulence. He is an active participant in two UK EPSRC consortia, UKTC "Turbulence Consortium" and UKCTRF "Consortia for Turbulent Reacting Flows".

PROF JENNIFER WEN, PROFESSOR OF ENGINEERING, UNIVERSITY OF WARWICK

Jennifer Wen established and currently leads Warwick Fire, a multidisciplinary research laboratory for both fundamental and applied research related to fire and explosions as well as accidental releases of hazardous materials. As Principal Investigator, Jennifer is managing and leading a grant portfolio of over £3M. The work presented here is supported through a €1.77M Innovative Doctoral Training Programme funded by the European Commission. Previously, Jennifer held a number of positions with CD-ADAPCO, British Gas, South Bank and Kingston University London. She sits on the Steering Committee Member of various professional bodies. Organising/scientific committee member, session chairs of numerous international conferences.

BOOKING FORM

EVENT CODE: SEM6358

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