

## **Best Practices in Combustion CFD, Flame Stabilization, & Combustion Instabilities**

**Delft University of Technology, Delft, Netherlands**

**3-4 November 2015**

**Coordinators: Profs Luc Vervisch & Dirk Roekaerts**

**Organiser: Dr Richard E. Seoud**

**registration [richard.seoud-ieo@ercoftac.org](mailto:richard.seoud-ieo@ercoftac.org)**

### **Background and objectives**

Design and operation of modern combustion systems faces the need to combine high efficiency with low emissions and good flame stability. Computational Fluid Dynamics has become a powerful tool in design and analysis of a wide range of combustion systems (furnaces, gas turbines, engines, ..). It describes the combination of turbulent flow, chemical reactions and radiative heat transfer, but it is not a unique modeling method. Many models are available each having a range of applicability, computational cost and accuracy. Consequently, CFD experts doing turbulent combustion simulations, in addition to usual CFD skills, need insight and skills in combustion modeling in order to do the analysis correctly. The present course addresses this need.

In this course **the participants will learn** *the best practices in CFD of combustion systems. They will learn how to select models, how to validate models, and which accuracy to expect. Flame stabilization and combustion instability caused by two-way coupling between acoustic waves and unsteady heat release, are critical issues in design of clean combustion systems and a major part of the course is devoted to them.*

The lectures of this course, all by well-known experts in the field, cover from basics to applications with focus on model selection and validation, radiative heat transfer, gas turbines and flame stability.

***The course is held at the occasion of the publication of the ERCOFTAC Best Practice Guide on CFD of combustion, a copy of which will be provided to the participants.***

In the course also the link will be made with the CFD programs and cases of interest for the participants. As a result, the course provides the means for CFD analysts to significantly enhance their use of commercial and open-source CFD software for combustion engineering applications.

### **Lecturers:**

Prof. P.J. Coelho (Instituto Superior Técnico, Universidade de Lisboa)

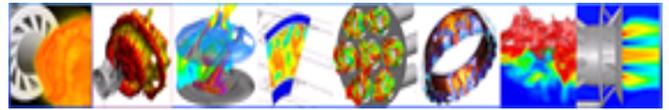
Dr. S. Ducruix (EM2C, Ecole Centre Paris)

Dr. L. Gicquel (CERFACS, Toulouse)

Prof. M. Pfitzner (Universität der Bundeswehr, München)

Prof. D. Roekaerts (Delft University of Technology)

Prof. L. Vervisch (INSA de Rouen and Normandie Université)



**November 3, 2015**

## **Best practices in combustion CFD and modeling thermal radiation**

**8:30-9:00 Welcome**

**9:00-10:00 Best practices for combustion CFD I**

- Lecture 1: Luc Vervisch

Principles underlying combustion CFD model construction and selection

**10:00-12:00 Best practices for combustion CFD II**

Lectures 2+3 : Michael Pfitzner

- Lecture 2: LES and RANS best practice for model validation part 1

- Lecture 3: LES and RANS best practice for model validation part 2

**12-12:30**

Discussion

**12:30-13:30 Lunch**

**13:30-15:30 Best practices for modeling thermal radiation**

Lectures 4+5 : Pedro Coelho

- Lecture 4: Modeling thermal radiation part 1 : radiative heat transfer equation

- Lecture 5: Modeling thermal radiation part 2 : radiative properties

**15:30-16:00 Break**

**16:00-17:00**

**Overview of the ERCOFTAC combustion BPG**

Dirk Roekaerts

**17:00-17:30 Final discussion and closing first day**

**Evening: course dinner**

**November 4, 2015**

## **Flame stabilisation and combustion instabilities**

**9:00-11:00 Best practice for modeling combustion instabilities**

Lectures 1 + 2 : Sébastien Ducruix

- Lecture 1: Flame stabilisation and combustion instabilities. Background and perspectives

- Lecture 2: CFD and related methods for controlling combustion instabilities

**11:00-11:30 Break**

**11:30-12:30 Best practice guidelines for modeling combustion instabilities**

Lectures 3 + 4 : Laurent Gicquel

- Lecture 3: Best practice guidelines for LES of gas turbine combustion - Part 1

**12:30-13:30 Lunch**

**13:30-14:30**

- Lecture 4: Best practice guidelines for LES of gas turbine combustion - Part 2

**14:30-16:00 Mini workshop on combustion CFD applications**

Participants and lecturers are invited to give a short presentation on a combustion CFD application using the CFD tools of their interest, with emphasis on challenging issues.

The discussion will focus on which best practices can be identified for the presented cases.

**16:00-16:30 Final conclusions and closure**