ONLINE COURSE ON COMBUSTION INSTABILITIES AT CERFACS

APRIL-MAY 2024

Overview
Coupling between acoustic waves and flames has become a central issue in the development of many modern combustion systems, especially using hydrogen. This course presents the theoretical background needed to tackle such problems.

Next sessions
--From Monday, April 29th, 2024 to Sunday, 26th May 2024.
--Price: students : 240 € – Cerfacs shareholders : 360 € – others : 480 € (TTC)

Context
Coupling between acoustic waves and flames has become a central issue in the development of many modern combustion systems because of both environmental issues (noise) and the destructive interactions which acoustics can generate in combustors. This is a major issue for hydrogen flames. Numerical tools are essential in many flames/acoustics studies but a theoretical background in acoustics and especially in acoustics for reacting flows is mandatory to tackle such problems.

Scientific content
This online training course presents the fundamental concepts of thermo-acoustic instabilities. The course content itself is divided in 3 consecutive weeks:
--**Week 1:** Introduction of the phenomena
--**Week 2:** Laws of 1D acoustic in tubes
--**Week 3:** Interaction between a flame and acoustic
An interactive live conference will close the session during week 4 and will deal with an application case where you will try to predict the stability of a system.

Learning outcomes
At the end of this training, you will be able to:
--Explain the origin of thermo-acoustic instabilities in a combustor,
--Evaluate the natural frequency of a combustor,
--Make recommendations to make an unstable system become stable.

Organization
This is a **fully online** training session. It is divided into **4 consecutive weeks**, based on learning activities delivered each week.

--Weeks 1 to 3 require around **2 hours of work per week**. Learning activities are released on Monday of each week and you have 7 days to complete each week's activities. The 2 hours of work can be distributed over the week, depending on your schedule.

--A **1 hour live interactive session** will take place during week 4. This live session will deal with an applicative case. It will also be recorded and can be followed later by participants.

--Last week is dedicated to revising and a **final exam**, leading to a certificate of learning.

Our pedagogical principles
All our learning sessions are built upon evidence-based principles from cognitive psychology and learning research:
--**concepts first:** the course is focused on conceptual understanding of the meaning of equations and how they apply in practical cases (Van Heuvelen, 1991).
--**active learning:** the course is organized around activities especially designed to make participants interact between each other, involving a deep processing of the scientific content previously shown in short videos (Salmon, 2013).
--**long-term retention and transfer:** because you need to apply what you will learn during this session in the future and in various contexts, our courses are designed using the 10 laboratory-tested principles drawn from cognitive psychology (Halpern and Hakel, 2003).
Be prepared to be engaged and to interact with a **community** sharing a common goal: learning the scientific content of this course.
Requirements
While this course is not focused on mathematical aspects, **you need to have a clear understanding of Navier Stokes equations and a background in mathematical analysis, in particular with complex number notation**.

Contact
Registration is open here: https://cerfacs.fr/en/fundamentals-of-thermo-acoustic-instabilities/

The list of all online courses given at CERFACS is here: https://cerfacs.fr/en/online-traning-sessions/