Abstract

Combustion instabilities (CI) result from the constructive coupling between combustion and acoustic waves. They can lead to reduced performance, flame blow-off, excessive vibrations and catastrophic failure. CI have plagued the development of most high-performance engines since the early days of rocket science. Despite over 70 years of active research, predicting their occurrence is still a major scientific and technical challenge.

Part I: The unsteady numerical simulation of a full 42-injector engine using Large-Eddy Simulation will be presented. The specific challenges of real-gas thermodynamics, combustion models and numerics will be discussed.

Part II: An academic experimental configuration with laminar flames will also be scrutinized in order to highlight the multi-physics nature of CI and elucidate some of the intricate mechanisms that trigger them.

Bio

Dr. Laurent Selle is a Researcher at CNRS, the French National Research Center, and works at the Institut de Mécanique des Fluides de Toulouse (IMFT) in Particles, Sprays, and Combustion. Dr. Selle is also a consultant to ONERA, the French Aerospace Laboratory. He received his PhD at CERFACS under the direction of Thierry Poinsot, and spent two years as a post-doctoral researcher with Josette Bellan at Cal Tech. Dr. Selle is a major contributor to the INTECOCIS project, a European Research Council advanced grant dedicated to the study of combustion instabilities using massively parallel computing on the world’s largest systems. The target is to build simulation tools that can predict the occurrence of CI in future combustors before they are built. To achieve this goal, the simulation tools used today must be revolutionized to integrate recent HPC capacities and have the capability and brute power required to compute, understand, and control CI phenomena. A second objective is to add Uncertainty Quantification methods to CI tools. In his seminar, Dr. Selle will present recent work conducted at IMFT on CI.