2018 Doctoral research projects for PhD recruitment
Institut P'

PROPAGATION MECHANISMS OF REACTIVE FRONTS IN TURBULENT FLOW

Institute/Department : FTC
Research team : Turbulent Combustion
Supervisor(s) : Vincent Robin
Co-supervisor(s) : Zakaria Bouali
Contact for information : vincent.robin@ensma.fr
3-year contract: 1768 € raw monthly salary (to be modified if complementary funding)
Key-words: Direct Numerical Simulations, Turbulent flames, Front propagation, Flame accélération

Framework and objectives.

In the context of aeronautical or space propulsion and industrial safety, flames always propagate in heterogeneous turbulent flows. The strong development of computational tools over the past few decades allows to perform realistic numerical simulations of these turbulent flows representative of practical combustion devices (engines, turbojets, rockets, etc.). Numerical simulations are now commonly used for applied and also fundamental researches on turbulent reactive flows. These simulations are able to take into account coupled physical phenomena: turbulence, two-phase flow, chemical reactions, shocks, etc. but some fundamental physical mechanisms are still not understood and theoretical analyses are required to propose accurate physical models.

Thus, the objective of this work is to use high performant computing tools to perform simple direct numerical simulations. The results will lead to a refined analysis of the propagation mechanisms of turbuelnt reactive fronts. The flows considered will not be representative of realistic conditions but will be imagined to isolate the most important physical parameters that have a significant impact on the front propagation and acceleration. This theoretical analysis will complement the recent description of the structure of turbulent flames [1] proposed in our team. This first study highlights that a refined description of the leading edge of turbulent flames is required to understand the propagation mechanism and the flame acceleration.

Work program and means.

The first case will be the numerical simulation of a passive interface (without coupling with density) propagating in a sustained-turbulent flow. The purpose of this first part is to analyse the motion of the leading points independently of the thermal expansion mechanism. The impact of heterogeneities, expansion, detailed chemistry will be studied afterwards.

Applicant profile, prerequisites.

The candidate must have a master's degree or equivalent, with knowledge in fluid mechanics, turbulence and, if possible, in numerical methods and combustion. Programming and computer science skills will be an additional asset. The work will take place at ENSMA, in the Fluid Thermal Combustion department of the Pprime Institute.

[1] K. Q. N. Kha, V. Robin, A. Mura, et M. Champion, « Implications of laminar flame finite thickness on the structure of turbulent premixed flames », *J. Fluid Mech.*, vol. 787, p. 116- 147, janv. 2016.