PhD, Lattice-Boltzmann modelling of combustion instabilities

Topic: Lattice-Boltzmann methods
M2P2 lab, Marseille. http://www.m2p2.fr/

Funding: EU commission, HESTIA project.

Background, Context:
The industry relies increasingly on numerical simulation for designing, improving, and even validating new combustion devices (engine, burner, furnace, etc.). Today, numerical combustion modelling relies almost exclusively on numerical codes solving the Navier-Stokes equations.
The Lattice Boltzmann solvers are very different from these codes, intending to solve a discrete variant of the Boltzmann equation. This type of flow solver is progressing rapidly, however, in turbulent flows configurations. The results obtained with Lattice Boltzmann methods (LBM) have shown to be excellent for aerodynamic applications, motivating intensive development of new methods.
Lattice Boltzmann methods applied to industrial applications are recent, however, and few models are able to deal with multiphase flows, and almost none with reactive (combusting) flows.
The development of combustion modelling within the LBM framework is the topic of this study, following our recent works.

Research subject, work plan:
Extending the LBM capabilities to combustion requires a profound rethinking of existing methods developed within the Navier-Stokes framework.

The team has recently made important steps in proving the LBM ability to tackle such flows, at a cost significantly reduced compared to classical results.

The team was awarded a PhD studentship as part of a major EU project with a large public/private consortium (including, e.g. Cerfacs, Coria, EM2C, GE Avio, Rolls Royce, Safran…)

The PhD candidate will develop models for the prediction of combustion instabilities in aeronautical combustion chambers, according to the following work plan:

- Assess via the ProLB code whether Lattice-Boltzmann methods (LBM) are suitable to predict thermo- acoustic instabilities.
- Perform assessment on academic elementary test case (forced flame, flame transfer function), acoustic boundary conditions
- Perform combustion instability study for an anchored Bunsen flame examining the reactive flows, and subsequently validated it on canonical combustion applications and a turbulent bluff-body flame
- Perform feasibility study on semi academic/industrial burner (e.g., Preccinsta)

The PhD candidate will also be part of the team developing the ProLB software at M2P2 (~25 full-time researchers, from PhD candidates to full Profs.) ProLB is a software codeveloped by

a strong academic/industrial consortium including Airbus, CS group, LMFA lab, M2P2 lab and Renault.

Contract:

- 3 years

Salary according to Aix-Marseille University standards.

Essential skills:
Strong background in scientific computing (c++ preferred), compressible flows, reactive flows. English.

Desired skills:
LBM, HPC, French.

Application:
Email CV, cover letter to pierre.boivin@univ-amu.fr.

Intended Start date: In 2021, negotiable depending on profile.

References:
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