2018-00885 - Postdoctoral fellow / Numerical simulation of compressible multiphase flows with high order methods

Contract type : Public service fixed-term contract
Level of qualifications required: PhD or equivalent
Function: Post-Doctoral Research Visit
Level of experience: Recently graduated

About the research centre or Inria department

CAGIRE brings together since May 2016 researchers coming from different horizons and backgrounds (turbulence modelling, applied mathematics, experiment) who elaborated since 2011 a common vision of what should be the simulation tool of fluid dynamics of tomorrow. If not entirely application-driven, this project is based on the will for developing tools that could be useful in a way or another to the companies (big but also small !) that are active in the competitive fields of aviation/automotive propulsion and energy production. The targeted flows are (mostly) wall bounded and turbulent. As a consequence, they feature a multiplicity of time and space fluctuations that renders their simulation extremely challenging. The team’s motto is agility or equivalently a clever use of adaptivity in the developed simulation suite based on i) The capability of being run on any present or future new supercomputer in a way that fully benefits from the hardware evolution while limiting the painful and time consuming phase of machine adaptation by the recourse to an efficient runtime, ii) A high level of accuracy and robustness permitting the use on a large range of flow configurations ranging from the generic lab scale geometry to that of a practical interest, iii) The capability of extending the fly the physical modelling by recourse to dynamic hybridization of the most relevant models of a given class with a focus on the turbulence modeling.

Context

In the framework of a partnership including CEA CESTA, INRIA Bordeaux Sud Ouest, and the Pprime institute, the aim is to improve the knowledge of the interaction between a shock a liquid droplet, by comparing the experimental, modeling, and numerical simulation approach.

Assignment

Within the SEIGLE project, the aim of the INRIA team-project CAGIRE is to perform a very precise direct numerical simulation in 3D of the interaction of a shock with a droplet, which is fundamental for understanding the atomization process. The high order (discontinuous Galerkin), massively parallel code Aerosol, able to deal with single phase flows, but currently unable to deal with shocks, will be used.

In this work, we propose to

(1) work on the stabilization of flows with shocks [1], especially to derive numerical methods that ensure the positivity of physical quantities (internal energy, density) [5], or the dissipation entropy [2], or to combine these methods,
(2) To extend the work done in [3,4] to viscous multiphase flows
(3) To extend the work done in step (1) to multiphase flows (and especially to ensure the positivity of the volume fraction).
(4) To perform large scale simulations of the interaction of a shock with a droplet.


Main activities

- State of the art of the existing methods
- Development of new numerical methods
- Implementation of these methods in the library Aerosol (in C++)
- Validation on academic test cases
- Dissemination of the results (conferences, publications)

Benefits package

- Subsidised catering service
- Partially-reimbursed public transport

Remuneration

2653 € / month (before taxs)