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THESIS PROPOSAL - Fixed-term contract

Multi-phase turbulent reacting flow modeling and its impact on the thermo-acoustic stability of next generation of aero-engines

Reference: CFD-2023-GICQ-02
Team: CFD
Research unit: Energetics and propulsion
Salary: > 21 600 €/year (gross)
Starting date: sept 2023

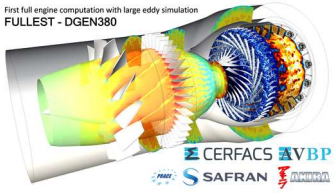
Location: 42 avenue Gaspard Coriolis – 31057 Toulouse
Contact person: Laurent Gicquel
E-mail: gicquel@cerfacs.fr
Duration: 3 years
Level of education required: PhD

HOST LABORATORY

The **Cerfacs** is a fundamental and applied research center specializing in modelling and digital simulation. Through its resources and expertise in high-performance computing, it addresses major scientific and technical problems in public and industrial research. The Cerfacs teams develop innovative methods and software solutions to meet the needs of the aeronautics, space, climate, energy and environment sectors. Cerfacs works in close interaction with its seven associates: **Airbus**, **Cnes**, **EDF**, **Météo France**, **Onera**, **Safran** and **TotalEnergies**.

HOSTING TEAM

The CFD (Computational Fluid Dynamics) team is the largest team at CERFACS. It focuses on the simulation of flows by developing advanced numerical methods and applying them to aircraft, rockets, helicopters, car engines, turbines, etc. This team develops essential tools in many application fields with a well-known leitmotiv in industry today: let's calculate systems (aircraft, engines, etc.) before building them.



JOB DESCRIPTION

Topic(s): Combustion Acoustics High Performance Computing

Context: With the uprise of ever more efficient combustion systems for aviation which target ever more reduced pollutant emissions and reduced fuel consumptions, the risk of thermo-acoustic instabilities to arise becomes critical. Indeed, resulting from a synchronization between the burner actoucis and the flame, these instabilities remain today a clear scientific challenge which are very often only diagnosed while testing the final product. Being able to anticipate and ultimately mitigate such resonant oscillations while designing next genration of lean aeronautical combustors is a key industrial aspect for successful and viable solutions. In collaboration with SAFRAN AE, CERFACS' CFD team has invested masively in numerical tools to leverage such a difficulty and has acquired worldwide recognition on the matter. This PhD work contirbutes to these past efforts and collaboration by addressing multi-phase turbulent reacting flows and their impact on thermo-acoustics.

Mission:
In this context, the main objective of this PhD offer is to develop and validate liquid phase models (injection, film and atomisation models) developped at CERFACS and made available in its Large Eddy Simulation solver AVBP for accurate numerical prediction of the sol called Flame Transfer Functions (FTF). These FTF's will then have to be incorporated in the acoutic suite of tools able to address engine stability for a wide range of operating conditions and to qualify and eventually mitiagte thermo-acoustic instabilities arising while designing next generation of lean aeronautcial combustors. Conducted within the CFD team at CERFACS, this research project will benefit from past and on-going efforts as well as research collaborations with French laboratories like EM2C (CentraleSupelec), CORIA (CNRS, Rouen), IMFT (CNRS, Toulouse).

DESIRED PROFILE

Background required:

Numerical simulation Fluid dynamics Programming in Python

Languages: French or English

Abilities:

Capacity for analysis and synthesis Innovation capacity Ability to work independently

Relational qualities	**Rigorous**
PLEASE SEND CV + COVER LETTER	