CERFACS

CENTRE EUROPÉEN DE RECHERCHE ET DE FORMATION AVANCÉE EN CALCUL SCIENTIFIQUE

Internship Offer: end-of-study internship

Internship Title: Mesh Optimization for LES Prediction of Lean Blowout in Gas Turbine Combustion Chambers

Mission & work plan:

The primary objective of this internship is to contribute to the advancement of simulation techniques aimed at improving the understanding and prediction of Lean Blowout (LBO) in combustion chambers. The intern will be tasked with designing an innovative automatic mesh refinement strategy, taking into account Large Eddy Simulation (LES) subgrid models to converge towards more accurate predictions of relevant quantities.

Work plan:

- Review of the state-of-the-art and selection of mesh refinement approach.
- Implementation and validation of the chosen method on simple non-reacting flows within the AVBP solver, developed at CERFACS.
- Extension to reactive flows.
- Simulation of a combustion chamber under conditions close to lean blowout. Comparison of the cost/accuracy of the method with reference meshes.

Context:

Increasingly strict emissions requirements have led modern gas turbine combustion chambers to operate in lean conditions to reduce the temperature of burnt gases, thus decreasing NOx emissions. However, this increases the risk of flame extinction at the Lean Blowout (LBO) limit, which poses a safety hazard in aeronautical engines and requires costly procedures for land-based power generation turbines.

The mechanisms leading to LBO in swirling flames are poorly understood due to the complex interactions between chemistry, flow, dynamics, and liquid fuel evaporation.

The design of new engines has become faster and more cost-effective through simulation. Large Eddy Simulation (LES) is currently the only method capable of reliably predicting combustion chamber dynamics. However, predicting LBO in gas turbine combustion chambers remains a major challenge due to the complexity of the involved phenomena.

Recent research has highlighted the significant impact of modeling practices, including model and mesh choices, on the prediction of lean blowout. Among these factors, mesh plays a crucial role. Therefore, it is imperative to develop automatic mesh refinement strategies for LES.

A doctoral position (CIFRE thesis with SAFRAN) is planned for October 2024, providing an opportunity for highly motivated candidates to continue this work. This position will focus on LBO prediction using LES.

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