∂'Alembert
Institut Jean le Rond ∂'Alembert

SCIENCES SORBONNE UNIVERSITÉ

Postdoctoral position

Mechanism reduction for the JP10 thermo-oxidation simulation

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Context and objectives

The aim of the present project is to adapt a JP10 ($C_{10}H_{16}$) combustion/pyrolysis comprehensive mechanism to CFD simulations devoted to aeronautical applications.
The study will focus on adapting a mechanism reduction tool, recently developed at ∂'Alembert Institute, based on several classical reduction methods (Directed Relation Graph (DRG), Sensitivity Analysis (SA), Level of Importance (LOI)) to the underlaying problems. In particular, the reduction will be operated in order to respect a previously defined accuracy on relevant data such as adiabatic flame temperature, ignition delay, laminar flame speed, etc. Furthermore, an optimization step will be set up to reduce the error introduced by information loss induced by the reduction. Implementation and investigation of new reduction methods will be considered in the frame of this project. At first, we will focus on the Lumping method, which consists in coupling similar isomers whom transport and thermodynamical properties are similar. It is known that this approach is particularly useful for the reduction of large mechanisms, where the presence of isomers is more likely. Next, we wish to implement and study the computational singular perturbation (CSP), which is a powerful tool for reducing the simulation calculation stiffnesses. New methods, eventually inspired from model reduction on other topics and based on more mathematical or numerical approaches may be considered in this project.
This post-doctoral project is part of a collaboration between the ∂'Alembert Institute and the applied and fundamental energy department of the ONERA (French National Office of Spatial Studies). The association of the reduction mechanism tool and the multiphysics (energetic and propulsion) calculation software CEDRE will be realized in the frame of this collaboration.

Tasks

The postdoc will work on:

- Adaptation of the existant in-house code to the present project
- Implementation of new methods (i.e. *Lumping* / *Computational Singular Perturbation*, etc.)
- Performance analysis and evaluation of the reduced model limitations

Applicants profile

Applicants must posses (or be in the process of obtaining) a PhD degree in mechanical engineering (preferably in combustion or related fields). Since numerical implementation is required within the objectives of the proposal, strong background in coding (Python) is a mandatory requirement. Knowledge in chemical kinetics and/or reduction methods (order or models) are particularly appreciated, but not essential.

Practical informations

- Host laboratory : Sorbonne University (new name of University Pierre and Marie Curie), Institut Jean le Rond ∂'Alembert (CNRS UMR 7190, Paris)
- Beginning : 2018, june
- Project duration : 1 year (with possibility of prolongation for a second year)
- Gross salary : $\approx 30,000$€ per year depending on the experience

Application

Applicants are required to send a detailed CV and a covering letter to Dr. A. Matynia at the following email adress:
alexis.matynia@sorbonne-universite.fr