Researcher on 'High-fidelity and low-order modelling of hydrogen-fired industrial combustors of a reheat furnace'

Postdoctoral position - Propulsion Technologies Group (R2)

Context and Mission

The stringent emission regulations and the EU commitment to achieve net-zero greenhouse gas (GHG) emissions by 2050 (EU Commission, COM (2018) 773) is driving the power generation industry to prioritize the development of low-carbon technologies. To meet the European decarbonization objectives, the energy-intensive industrial sectors must be transformed in terms of digitalization and low-carbon technology deployment. The metallurgical sector, with a high dependency on fossil fuels, could strongly benefit from clean combustion technologies and the use of cleaner and more sustainable fuels. Hydrogen and hydrogen-enriched fuels have significant potential to enable the transition to a clean, low-carbon energy system. Nonetheless, reducing the emissions to the levels of the EU targets brings new challenges to the industrial sector and to the metallurgical sector, which is responsible for a large portion of the pollutant emissions produced in the industrial sector and has a high dependency on fossil fuel supply. A digital transformation can facilitate this transition by providing advanced simulation software that can be used to accelerate the deployment of new concepts to the market. Today, the industrial sector requires more efficient burners, which implies not only a reduction in fuel consumption, but also in pollutant emissions, particularly CO_2 and NOx.

Within this context, the candidate will develop a research activity which will comprise the development of a High-Performance Computing (HPC) platform to conduct high-fidelity Computational Fluid Dynamics (CFD) simulations of the furnace and the generation of reduced-order models based on CFD and furnace sensor instrumentation using Artificial Intelligence (AI). The numerical simulations will be conducted with the multiphysics code Alya from BSC with the aim of obtaining further understanding on the combustion performance and dynamics after hydrogen is blended with natural gas and generate datasets for data analysis. The applicant will use these datasets and the real time data acquisition from the sensors to build a Digital Twin. These activities are conducted in the context of an EU project from Horizon Europe and the National Government from Spain in collaboration with a metallurgical company.

The applicant will join the Propulsion Technologies Group (PTG), a research group from the Computer Applications in Science and Engineering (CASE) Department at the Barcelona Supercomputing Center. As part of the PTG, the applicant will form part of a multidisciplinary team of researchers with a strong background on Computational Fluid Dynamics (CFD), combustion and multiphase flows. The PTG is actively involved in several European research-oriented and industrial projects for which results are disseminated in highly ranked scientific journals and conferences.

The applicant is expected to work on the execution of these simulations and development of reduced-order models based on data-analytics and machine learning using Computational Fluid Dynamics with High-Performance Computing (HPC) techniques.

Key duties

Conducting high-fidelity combustion simulations of hydrogen flames using LES with tabulated chemistry.
Developing reduced-order models for the furnace using data-driven methods.
Interact with the different partners of the projects to carry our collaborative research.

Contribute to scientific publications and reporting to different National and EU projects the researcher will be involved in.

Requirements

Education

The candidate should hold a PhD Degree in Chemistry, Physics, Mechanical Engineering, or Aerospace with background in fluid mechanics and thermal systems. Solid background on data-driven methods and Artificial Intelligence will be positively evaluated. Basic knowledge of HPC will be appreciated.

Essential knowledge

Knowledge of fluid mechanics and thermodynamics are expected.

Additional knowledge

General knowledge on computer science and programming languages such as Fortran, Python, C, and C++ will be considered an asset.

Competences

Strong analytical skills.

Ability to work independently and within a team.

Good communication and team-work skills to work in a multidisciplinary team.

Fluency in English is essential, Spanish is welcome.

Application

The application should be done through

https://www.bsc.es/join-us/job-opportunities/52822caseptr2

ONLY APPLICATIONS DONE THROUGH THE WEBSITE WILL BE CONSIDERED

The application should include:
- CV (English), motivation letter and 2 support letters
- Starting date: 01/02/2023 - 01/03/2023
- Only online applications will be considered
- Deadline: 31/01/2023

Contact

Daniel Mira, daniel.mira@bsc.es

Eduardo J. Pérez, eduardo.perez@bsc.es