M2 Internship proposal: Parametric study of a horizontal solar receiver for direct steam generation

Context

This internship is part of the TOPCSP project, a program within the Marie Sklodowka-Curie Action (MSCA), funded by the European Union. In the PROMES laboratory, the task is the study of turbulent flows in direct steam generators. Direct steam generation has several advantages, such as eliminating the need for an HTF, reducing the number of heat exchangers and potentially increasing plant efficiency. For this purpose, it is intended to numerically simulate the flow inside a solar receiver, as well as to validate these results with experimental data obtained thanks to an experimental set-up built in the laboratory that reproduces the physics inside a receiver operating with DSG technology.

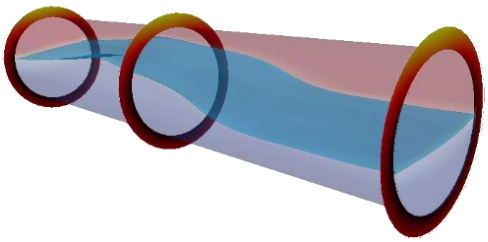

Figure 1. Results for the liquid domain and several slices of the solid domain.

Description

An accurate calculation of the physical phenomena occurring inside a receiver operating with DSG technology is crucial for the design and operation of a solar plant. For this purpose, the Euler-Euler approximation is used for two-phase water-steam flows. To perform such a study, the NEPTUNE_CFD software will be used to solve the fluid mechanics equations, and the Syrthes software will be coupled to solve the driving equation on the solid part. As mentioned above, an experimental setup has been set up to make a small-scale model of a solar receiver. This installation is equipped with a variety of sensors (temperature and pressure), as well as a display section at the output which allows shadowgraphy images to be taken. This richness in the collection of experimental data makes it possible to validate the numerical models. The internship comprises mainly three stages:

- First, the student will become familiar with the software used, the boiling models, and more generally the bibliography related to this work.
- Secondly, the student will run a parametric study and post-process the results of these simulations to assess the effect of the different parameters and the mesh resolution on the results.
- Thirdly and finally the results of the simulations will be compared with the experimental results obtained.

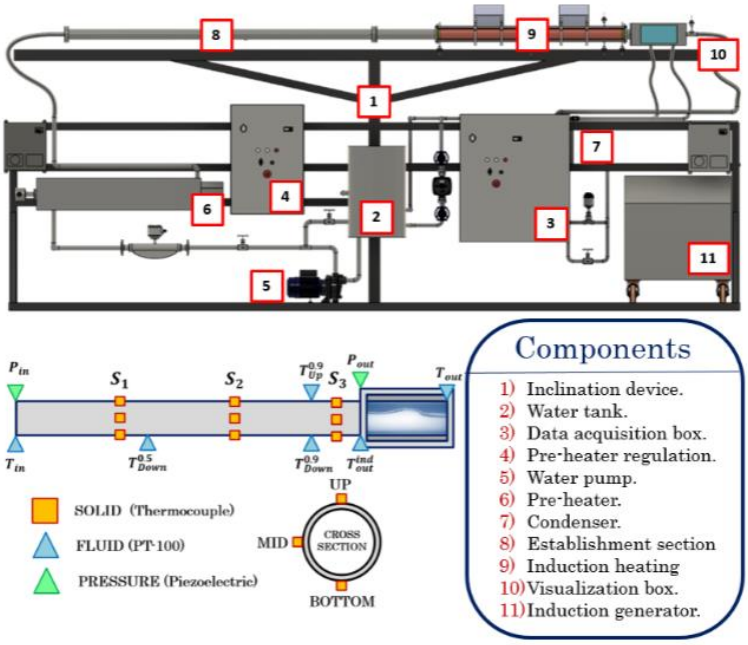

Figure 2. Experimental setup available for the validation.

Skill requirements

Second year of Master's degree or last year of Engineering School student, with a fluid mechanics background. Programming skills will be strongly appreciated, a taste for performing experimental tasks also. A good level of English is advisable.

Location

PROMES-CNRS Perpignan : Rambla de la thermodynamique, Tecnosud, 66100 Perpignan

Duration

5 to 6 months between February and September 2025

Salary

Current CNRS flat rate gratification (≈ 700 e/month)

Supervisors

- Israel AGUILERA-CORTES (PhD candidate, PROMES-CNRS, israel.aguilera-cortes@cnrs.fr)
- Samuel MER (Associate professor, Université de Perpignan Via Domitia, samuel.mer@univ-perp.fr)
- Adrien TOUTANT (Associate professor, Université de Perpignan Via Domitia, adrien.toutant@univ-perp.fr)

Application process

Send an email to all the supervisors with the following documents:

- Your CV.
- A cover letter.
- Your transcript of Bachelor's and Master's degree grades.
- Recommendation letters (optional).