

Perfil (FD) Codi projecte: PID2023-153281OB-I00

El projecte amb codi **PID2023-153281OB-I00** (finançat per l'Agència Estatal d'Investigació) del Centre / Departament **Centre Tecnològic de Transferència de Calor (CTTC)** de la Universitat Politècnica de Catalunya (UPC) convoca la sol·licitud d'un doctorand en el projecte anomenat: **DNS y modelado MULTIescala de fenomenos de transporte Interfacial turbulentos en flujos de burbujas y pel·lícules Descendentes. Aplicacion a sistemas y equipos TERMicos (MULTITHERM II).**

**Descripció del lloc de Treball**

The Ph.D. candidate will develop a work based on one or more of the following areas: i) development of numerical models for liquid-vapour two-phase flow with coupled heat & mass transfer phenomena; ii) verification of the numerical results by comparing with alternative numerical platforms; iii) validation of the results using experimental data. In the latter case, available experimental results from the scientific literature or an in-house dedicated experimental test rig (e.g., for falling film flows) could be used. The models will be implemented in open-source numerical platforms or in-house highly portable MPI-C++ numerical platforms. The typology of numerical models will be different according to the final application: i) multidimensional CFD+HT models for a detailed description of the phenomena involved or ii) reduced models for digital twin development or control purposes.

**Perfil candidat/a**

The PhD. candidate should have a bachelor's degree in mechanical engineering, physics, or applied mathematics, with knowledge in Thermodynamics, Fluid mechanics, and Heat Transfer. Moreover, the committee will value their knowledge of numerical methods for mathematical and/or engineering problem-solving and their expertise in experimental procedures.

**Breu descripció del projecte**

Multiphase flows are present in several industrial applications including absorption machines, condensers, boilers, evaporators, cooling towers, steam generators, thermal desalinization, and chemical reactors. Some of the most common forms in which multiphase flows appear in such thermal equipment are bubbly flows and falling films, the main topics of this proposal. Over the years, the CTTC-UPC has established itself as a reference center for the numerical study of those multiphase flows and has participated to several projects. MULTITHERM II is the natural continuation of this research line, which has already contributed significantly to the State-of-the-Art in the field, thanks to a very prolific scientific production and industrial application of the derived know-how. The present project is divided into three WPs. WP1 is a further step in the physical understanding of gravity-driven turbulent bubbly flows (Re up to 1000) by employing unstructured level-set numerical algorithms. The following physics will be studied: variable surface tension-induced phenomena in droplets at a high Ma number, interfacial mass and heat transfer in bubbles/droplets at high Schmidt number, insoluble and soluble surfactants in turbulent bubbly flows, liquid vapor phase change phenomena and simultaneous heat and mass transfer in bubbles and droplets. In WP2, starting from past results, and taking into account the newly developed numerical algebraic solver for HPC computing in the TermoFluids platform, more insights can be obtained: (a) Implementation of an interface tracking algorithm based on the volume of fluid techniques without recompression step to enhance conservation of mechanical energy. (b) Comparison of the results and performance of the new solver vs. existing models implemented in open-source and commercial software platforms. (c) Numerical simulations and experimental validation at higher Re numbers involve hydrodynamics and heat transfer. Regarding WP3, after assessing the significant impact of the Ka number in heat transfer phenomena, reflecting the ratio of surface tension forces to inertial forces, a deep experimental understanding of the vapor heat and mass transfer phenomena (especially when using surfactants) will be assimilated using the Schlieren technique. This will lead to a higher understanding of wave flow physics by studying the influence of wave frequency, Re and Ka numbers, concerning hydrodynamics, heat, and mass transfer, and including phenomena of falling film absorption and evaporation. The scientific implications of the project consist of participation in international congresses, publications in the most relevant international journals, doctoral theses, development of experimental infrastructures, and creation of numerical tools at the highest level. The project will contribute to the efficient development of various thermotechnical devices used in power plants and in the efficient use of energy, relying of multiphase flow physics. It affects climate change reduction since developing advanced phenomenological and computational knowledge of multiphase and multiscale gas-liquid flows has important implications for developing safe, efficient, and clean energy.