PhD Position: « Simulation of nucleate boiling with control of wetting properties »

Project summary

When a solid body in contact with a liquid is heated at a high enough temperature, the liquid undergoes evaporation, a mechanism that controls the overall heat transfer between the solid and the fluid. Bubbles can detach from a horizontal surface thanks to buoyancy, effectively transporting heat, or a vapor layer can form on the whole surface, severely limiting the heat transfer (the so-called boiling crisis). The latter can bring to the burnout of the solid body, with evident harmful consequences.

We propose the development of a numerical tool able to take into account the fully coupled problem of phase-change, contact line dynamics and heat transfer in the fluid and solid. We plan to build on an existing high performance multiphase simulation code, YALES2, largely used in both academic and industrial projects. It offers a solid ground for the proposed implementation, also maximizing the possibilities of exploitation of the new tool for applications. A collaboration is planned with researchers at CORIA (Rouen), where YALES2 is mainly developed.

Once the phase change and contact line will be implemented, a study on the dynamics of vapor bubbles will be carried out, aiming at linking this microscopic dynamics to the heat transfer at the macroscopic scale. In particular, we will focus on the growth of a vapor bubble on the solid surface. We will first consider surfaces characterized by a uniform contact angle; later, heterogeneous surfaces will be studied, focusing on the role of wetting and non-wetting regions in the two main mechanisms governing heat transfer: bubble growth and bubble detachment. The analysis will be guided by the experimental results obtained at LEGI on the macroscopic heat transfer rate for surfaces with controlled homogeneous and heterogeneous wetting properties. A collaboration is also planned with researchers at Institut Lumière Matière (Lyon) on the modeling of contact lines in the presence of phase change.

Location and practical aspects

This call offers a three-year PhD fellowship, starting fall 2015. The successful applicant will be hosted by the laboratory LEGI in the MOST team, Université Grenoble Alpes (France) http://www.legi.grenoble-inp.fr. He/she will work under the supervision of Dr. Giovanni Ghigliotti, Dr. Guillaume Balarac and Pr. Philippe Marty. The gross salary will be 1787 euros/months, equivalent to a net salary of 1452 euros/month.

Qualifications of the applicant

The candidate will be in charge of extensive numerical developments based on an existing simulation code. Skills in fluid mechanics, thermodynamics and computer programming will be highly appreciated, as well as the determination to succeed in an ambitious project. This project includes extensive collaborations; therefore strong interpersonal skills will be an asset.

Applications

Interested candidates should send their CV and cover letter to Dr. Giovanni Ghigliotti, giovanni.ghigliotti@ujf-grenoble.fr. The deadline for the application is May 31, 2015. We encourage the candidates to submit their applications well ahead of the deadline, since the call may be closed as soon as a suitable candidate is identified.

Tec 21
Laboratoire d'Excellence
+33(0)4 56 52 86 50
LEGI Bâtiment K - 1211 rue de la Piscine
Domaine Universitaire - 38 400 Saint Martin d'Hères
www.tec21.fr