Submission : 14312

Thesis proposal CSC 2015

Title:
Modeling stationary and transient heat transfer for convective micro-cooling

Thesis supervisor:
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PhD School name:
Mechanics, Energetics, Civil & Process Engineering (MEGEP)

Research Laboratory:
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Scientific domain:
%scientific_domain

Subject short description:
Micro-cooling is an important issue in diverse area such as biomedical engineering associated with tissue micro-vascular exchanges and mechanical engineering in relation with computer cooling. The aim of this PhD is to contribute to the understanding and modeling of micro-cooling in single phase parallel convective micro-coolers.

There are important applicative issues concerning the cooling of computing units either at the level of individual PC and up to large computer centers. Currently, chips are cooled by forced air convection, but for next electronics cooling
generation solutions need to be improved. In addition high heat flux removal is also required in other contexts such as photo-voltaic chips for solar concentrators. Liquid heat convection is more promising in this context since its heat exchange capacity is more efficient than air, especially for coolants used in refrigeration units. Following bio-inspired solutions, counter-current parallel micro-channels oriented perpendicularly to the heat sink base can reach heat-power extraction as large as 100 W/cm² K with reasonable imposed pressure drops of few bars. But there is a need for more systematic and broader understanding of heat transfer problems for improving performances.

We wish to explore deeper this area using new theoretical and computational tools that we have developed in the context of exchangers. We have developed the theory of generalized Graetz modes [1-3] to be applied to any given configuration of parallel micro-channels and various applied boundary conditions [3]. We have shown that this is an efficient strategy for computing complex 3D configurations [4] whilst only computing a succession of 2D eigenvalue problems. We are confident that this strategy can be extended to more complex boundary conditions with imposed heat-fluxes. We wish to provide systematic parameter explorations so as to predict the best coolant configuration.

The candidate is expected to work on the python code developed by the team, to be able to perform numerical tests, to interpret them and to modify the given code. The candidate should possess a strong background in mathematical modeling, numerics and knowledge in fluids and thermic physics. Above all, it is imperative to possess strong self-motivation, excellent written and spoken English communication skills and team spirit.

To apply: Please send a CV to Franck Plouraboué: francck.plouraboue@imft.fr & Frédéric de Gournay: Frederic.De.Gournay@math.univ-toulouse.fr

References


Two major publications in the domain of PhD:

Keywords: micro-cooling, scientific computing, convective heat transfert, optimal heat cooling, Generalyzed Graetz modes

Expected collaboration in China:

First name and family name of the laboratory director:
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Signature and stamp of the laboratory director: