IMT Lille Douai
École Mines-Télécom
IMT-Université de Lille

iemn

PhD scholarship - academic years 2018/2019 – 2020/2021

Topic : Cooling of Electronic Components by using Non-Colloidal Suspensions

Institutions host :

IMT Lille Douai represents the largest engineering school in the north of Paris. In a partnership with the University of Lille, each year the IMT Lille Douai, of the IMT (Institut Mines-Télécom), graduates PhD students and many talented engineers trained to overcome the engineering, economic and social challenges.

This PhD research scholarship proposal will be hosted by the Energy Engineering Department of the IMT Lille Douai situated in the research center in Douai city (around 40 km from Lille metropole). The PhD will be in collaboration with researchers from the IEMN of Lille (Institut d'électronique de microélectronique et de nanotechnologie) who will be co-supervising the successful candidate with researchers from DEI of Douai. The PhD candidate will work for 3 years starting from september/october 2018, on the research topic entitled « Cooling of Electronic Components by using Non-Colloidal Suspensions». The PhD candidate should expect to conduct several visits from DEI-Douai center to the IEMN-Lille center.

PhD Objectives :

Many techniques are developed in the literature for enhancing the overall heat transfer in heat exchangers. These techniques tend to reduce the size of fluid flow tubes and/or to modify the fins size-to-number ratio (to increase the overall surface of the fluid/structure interface) in order to make the heat exchanger to be more compact. However, adopting this approach is not always a very good choice, because many times it decreases the heat-exchange-by-convection thus limiting the overall heat transfer enhancement in many applications (i.e. in electronic components cooling, micro and macro heat exchangers etc...).

A good alternative way to enhance the overall heat transfer is to perturb the fluid flow to be more chaotic (for example to generate more vortices) or to include multiphase fluid flows. An example on the latter approach was introduced in the literature who used colloidal suspension flows to enhance the overall fluid thermal properties as a function of the particles concentration and thermal conductivity. We mean by colloidal suspension (or nano-fluid) any concentrated rigid nano-particles that are immersed in a Newtonian fluid. However the colloidal suspensions approach (or use of nano-fluids) is very dangerous in terms of pollution for the living organisms as shown and it is limited when it comes to an industrial usage (can be easily inhaled by the living organisms respiratory systems).

In this PhD, it is required to enhance the overall heat transfer in heat exchangers by using **non-colloidal suspension flows** of rigid particles immersed in a liquid. Recently the DEI team has developed a new CFD solver in [1-2] in OpenFOAM® [3] for this purpose.
The main objectives in this PhD are the following :

- First, the PhD student should conduct a detailed bibliography/literature study about heat transfer enhancement techniques applied to the cooling of electronic components in the last 10 to 20 years.

- Second, she/he will conduct CFD numerical simulations in OpenFOAM using the CFD solver developped in [3] in order to quantify and characterize the suspension flow material properties to be adopted next in the experimental measurements (particles size, particles density, flow rate, pipe configuration type and dimensions, fluid phase properties, etc).

- Finally, conjugated heat transfer experimental measurements will be conducted in an objective of quantifying the thermal perfomance (overall efficiency) of a new system for the cooling of electronic components by using non-colloidal suspension flows.

The successful candidate will get a net salary of about 1400 euros (±50) per month as a PhD scholarship over a total period of three years.

Profile:

The successful candidate should have good physical and numerical backgrounds in numerical Fluid Dynamics, Heat Transfer, CFD simulations and Rheology. Candidates with experience in electronics cooling applications are welcomed. She/He should own a good knowledge in CFD simulations applied to conjugate heat transfer problems using OpenFOAM®. The successful candidate should be highly motivated for research, and keen to work as part of a team and in a multidisciplinary environment.

Contact:

All candidates should send their (CV) Curriculum Vitae and a Motivation Letter **before the 30th of June 2018** to all of the following three email addresses:

talib.dbouk@imt-lille-douai.fr
daniel.bougeard@imt-lille-douai.fr
vincent.thomy@iemn.univ-lille1.fr

References

[1] T. DBOUK, L. LOBRY, E. LEMAIRE and F. MOUKALLED, "Shear-induced Particles Migration; Predictions from Experimental Determination of The Particle Stress Tensor", Journal of Non-Newtonian fluid Mechanics, 198, pp. 78-95, (2013).

[2] T. DBOUK, "Heat transfer and shear-induced migration in dense non-Brownian suspension flows: Modelling and Simulation" Journal of Fluid Mechanics, Volume 840, pp. 432-454, (2018).
DOI: https://doi.org/10.1017/jfm.2018.72

[3] http://www.openfoam.com/