MIGRATE

MIniaturized Gas flow foR Applications with enhanced Thermal Effects

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 643095

MIGRATE (Research and training network on **MI**niaturized **G**as flow fo**R** **A**pplications with enhanced **T**hermal **E**ffects) is planned as a multi-partner Innovative Training Network (ETN – European Training Network), assessing research and applications for thermal aspects of gas microflows. The network consists of 10 beneficiaries and 7 associate partners, spread all over Europe. This unique combination of university research, SME and world leading industrial stakeholders will contribute in a synergetic way to the increase of knowledge about micro scale gas flow heat transfer problems as well as to industrial applications of highly efficient miniaturized devices. Within MIGRATE, a number of Early Stage Researcher (ESR) projects will cover different aspects of enhanced heat transfer and thermal effects in gases, spanning from modelling of heat transfer processes and devices, development and characterization of sensors and measurement systems for heat transfer in gas flows as well as thermally driven micro gas separators to micro-scale devices for enhanced and efficient heat recovery in automotive, aeronautics and energy generation.

The ESRs recruited for the network will undergo training in at least three different locations. Additionally, short stays can be arranged at beneficiaries and associate sites. Moreover, annual network wide workshops and summer schools will ensure that each researcher receives exposure to, and benefits from, the full expertise of the Network.

More information can be obtained from www.migrate2015.eu.

Within the MIGRATE network a joint

E S R Position

is offered at IUSTI Laboratory of the Aix Marseille University, Marseille, France with the topic

Temperature Gradient Driven Gas µFlow

Ref. N°: MIGRATE-ESR 7

The position includes secondment at

Institute of Mechanics, Bulgarian Academy of Sciences (IMECHBAS), Sofia, Bulgaria (4 months)

and

ATG Europe BV, The Netherland (6 months)

Short stays at INFICON, Lichtenstein and at Karlsruhe Institute of Technology (KIT), Germany are also foreseen.

Main goal: Experimental investigation of the temperature gradient driven flow through the microsystems and/or porous media, including the study of interaction between gases and different solid surfaces. Development of the mathematical models, allowing the simulation of the temperature gradient driven flows.

Duration: 3 years

Expected starting date: 1-Mar-2016

Application deadline: **1-February-2016**

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Detailed description of the project:

The temperature driven flow (thermal creep flow) is one of the most interesting phenomena in the relatively high Knudsen number flows. This flow is induced by a temperature gradient along a surface, and it is directed from the cold to hot side. The Knudsen number, defined by the ratio of the molecular mean free path to a characteristic length of a system becomes large at a low-pressure environment and/or in a small-scale flow field. Recently, it draws much attention due to the rapid development of the micro- and nano-technologies. The manifestation of this phenomenon can be positive, i.e. the possibility to vehicle a flow by using only a temperature gradient, or negative, i.e. the additional flow inside a pressure sensor can perturb the pressure measurements.

The goal of the present PhD project is to investigate experimentally the properties of the temperature gradient driven flow. The dependence of this flow from the gas nature, surface properties, the intensity of the temperature gradient and geometrical shape of a channel will be studied. A mathematical model will be developed for the simulation of temperature gradient driven flow.

This project is a collaboration between 3 partners: the Aix Marseille University (AMU), Marseille, France (http://www.univ-amu.fr/) involved in experimental study of temperature gradient driven flows; the Institute of Mechanics, Bulgarian Academy of Sciences (IMECHBAS), Sofia, Bulgaria, (http://www.imbm.bas.bg/), which is specialized in the numerical analysis of gas microflows; and ATG Europe BV (http://www.atg-europe.com/), which is an international leader company, recognized as a leading provider of specialized engineering, scientific and technical services to the aerospace and high-tech industry. The researcher will spend the majority of his/her time at the Aix Marseille University, with a 4-months secondment at IMECHBAS and a 6 months secondment at ATG Europe.

Expected time schedule

ESR n°7	Year 1		Year 2	Year 3	
	1^{st} Stay	2^{rd} Stay	3^{rd} Stay	4^{th} Stay	5^{th} Stay
Location	**AMU**	**IMECH**	**AMU**	**ATG**	**AMU**

1^{st} stay: AMU (5 months): Bibliography on temperature gradient driven flows. Development of an experimental setup for the measurements of the temperature gradient driven flow mass flow rate in the cases of flow through the microchannels and the porous media. The choice of the surface material and the structure of porous media, which will be used in the experimental setup. Short visit to Karlsruhe Institute of Technology (KIT) (www.kit.edu/english), Germany, for discussion on the details of the microchannels and the porous media fabrication. Design of a new experimental setup or adaptation of an existing setup. Order of the required components and materials.

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2nd stay: IMECH (4 months): Training on the basic knowledge in kinetic theory, modelling of the flow in transitional regime using the DSMC approach. Development of the mathematical model, based on the DSMC technique, for the simulation of the temperature gradient driven gas flows through the microchannels and the porous media.

3rd stay: AMU (16 months): Starting of the series of measurements of the temperature gradient driven flows. Short visit in INFICON for an industrial experience in the temperature gradient driven flows inside the pressure sensors and gas chromatographs.

4th stay: ATG (6 months): Training for the numerical simulation of the temperature gradient driven flows through porous media. Validation of open source codes based on the Lattice Boltzmann method, modification and adaptation of the applicable code for the current experimental set-up and using the code for the numerical simulation of the flow under experimental conditions.

5th stay: AMU (5 months): The last stage of the experiments. Comparison of the experimentally obtained results with the results of the numerical simulations.

Requirements

This is a challenging and highly rewarding course of study and therefore the successful candidate will need to have the following qualifications:

- Master-level (5 years) degree in Engineering or Physics or Applied Mathematics with high standard results;
- very good background in fluid mechanics and heat transfer as well as in Fortran and C++ programming;
- excellent communication skills and written/verbal knowledge of the English language;
- high autonomy and adaptability skills;
- if the candidate has some experience in microfluidics and/or in experimental and computational techniques adapted to fluid flows, as well as in kinetic theory of gases, this would be a benefit.

Financial information / Salary

Annual gross salary: 41,425 €

Annual mobility allowance: 7,200 € (researcher without family obligations) – 13,200 € (researcher with family obligations).

Contacts:

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or Pierre Perrier: pierre.perrier@univ-amu.fr

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Application procedure:

Applications for this position have to include a detailed Curriculum Vitae with the contact details of three referees, a covering letter, attestation of the diploma / master degree and last transcript of records and they should be sent, using the reference number in the subject line via e-mail, either to:

Irina Graur: irina.martin@univ-amu.fr
or
Pierre Perrier: pierre.perrier@univ-amu.fr

Deadline: 01-02-2016

Eligibility of your application can be checked here: www.migrate2015.eu/