**Post doctoral fellowhip**

# Numerical and experimental multi-scale flow modeling for thermal and air quality

**Research Center : ENERGY AND ENVIRONNEMENT**

**Affiliation : Ecole Nationale Supérieure Mines-Télécom Lille Douai (IMT Lille Douai)**

**Context :** Created by the merger of Mines Douai and Telecom Lille on January 1st, 2017, **IMT Lille Douai** is the largest graduate school of engineering in the north of Paris. It aims at teaching the general engineers and digital experts of the future. Located at the crossroads of Europe, between Paris, London, Brussels and Amsterdam, IMT Lille Douai intends to become a major player in industrial and digital transformation of the society by combining engineering science and digital technologies.

Based on two sites dedicated to research and education in Douai and Lille, IMT Lille Douai has research facilities of almost 20,000m² devoted to high-level scientific activities in the following areas:

- Digital science,
- Energy and Environment,
- Materials and Process engineering applied to polymers, composites and civil engineering.

**Scientific project :** The **ECOPECCH project** (flow/particle interaction for particle sensors and heat exchangers efficiencies) was proposed recently to study the particle transport and deposition phenomena for two types of applications: the embedded particle sensors and the heat exchangers.

- The embedded particle sensors are used to identify and to realize “real-time” air quality monitoring and is a helpful tool for political decision to decrease the impact of automotive traffic. This device is basically used on-top of vehicle to capture the representativeness of air pollution across a city. Recent studies showed that the pollution representativeness measured from particle sensors is influenced from the vehicle’s velocity: the higher the velocity, the lower the representativeness.

- The heat exchangers are widely used in energy systems (automotive, nuclear, buildings, etc.) for heat transfer between two fluids. Fouling is one of the major problems that one must cope to maintain heat exchanger’s efficiency and durability. This phenomenon occurs when particles inside fluids deposit on the exchange surface which can significantly decrease the heat transfer. To overcome this complex phenomenon, the heat exchangers are usually oversized. Overall analysis of heat exchanger’s fouling can be found in the literature, but the local mechanism such as sweeps and ejections phenomena are not yet understood in such complex and confined systems like fins-and-tubes heat exchangers for instance. A better optimized design could lead to lower fouling and compact systems with higher energy efficiency.

The goal of the ECOPECCH project is to develop both numerical and experimental tools which enable 1) to analyze the impact of flow regimes on the particles sensors detection leading to new sensor design optimization and 2) to predict both globally and locally the particle transport inside and through the heat exchanger.

The **ITAQ project** (Thermal-Aeraulic Interaction and Indoor Air Quality) was developed in the CERI EE to globally and locally analyze both experimentally and numerically the combination of different factors in indoor environment that can have a major influence on air quality such as thermal, flow effects and materials which are the main sources of pollution. One of the goals of this project is to

equip a real-scale low consumption building with thermal, aeraulic sensors and air pollution analyzers.

**Objectives :**

This position has two main objectives:

1- The first objective is **to design a new experimental aeraulic bench** adapted for flow-analysis around sensors and fouling identification for heat exchangers (ECOPECCH project). This bench must include local flow measurements and particle tracking techniques (S-PIV, LDA, PDA), enables the injection of pollutants (particles and gas), and must be adapted to set different size of heat exchangers. This task includes 1) the design and the dimensioning of the bench using both CFD and CAD softwares, 2) the supervising of the bench set-up with the help the CERI EE engineers and technicians, 3) An accurate control on flow properties, such as velocity profile, turbulence level and 4) the first measurement campaign on sensors and/or heat exchangers fouling, depending on the candidate profile. A publication is expected and/or a detailed report on a methodology used for test bench.

2- The second objective is to perform **experimental long-time monitoring in real conditions** inside the low-consumption equipped building including temperature, flow, humidity, and pollution (COV) time-monitoring. This study is expected to be presented at scientific meetings and be published in impact journals.

The researcher will also be expected to participate in teaching activities according to his/her background.

**Candidate profile, personal skills, and requirements :**

The candidate should hold a PhD degree in fluid mechanics (experimental and/or numerical). A true expertise in CFD is required. The candidate must possess a good working knowledge of Solidworks CAD software. Experimental background in one of the following fields will be gratefully appreciated: particle and/or gas dispersion, turbulence, heat transfer, air quality, design optimization. An experience in the setting-up of test bench is a plus.

The candidate will send resume, motivation letter, recommendation letter, PhD diploma, and other documents which might be important to analyze the candidate's profile, to the following email address: remi.gautier@imt-lille-douai.fr

**Further informations:**

- Full-time postdoctoral position

- Duration: 12 months

- Starting date: from September 2020