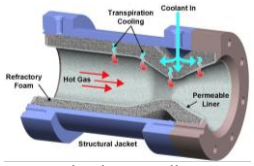
QUB - Mechanical and Aerospace Engineering PhD Project 2019-2020

Title: CFD of Flow and Temperature Control Using Porous Materials

Project description:

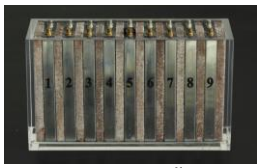
The use of porous materials (i.e. solid medium permeated by a network of pores), in particular, for passive control of flow and thermal purposes has received considerable academic and industrial attention over the past five decades. Examples include transpiration cooling, packed bed energy storage and battery and LED cooling, as well as noise control for aerospace and wind turbine applications. In such applications fundamental understanding of interaction between the fluid flow and the porous medium at the pore-scale is deterministic for an efficient thermal and flow/noise control using porous materials.

In this project we will investigate the flow and thermal control using porous materials for application to aerospace and renewable energy systems. The study performs fundamental analysis of fluid flow and heat transfer in porous materials with the aim of achieving an in-depth understanding of the flow features at the pore-scale. Therefore, we will perform a high fidelity CFD using Large Eddy Simulation approach in OpenFOAM to analyse the details of the high Reynolds number turbulent flow and temperature fields in a porous media system. The project will be conducted in collaboration with the University of Bristol for experimental measurements on the velocity field. The PhD student has the opportunity to visit University of Bristol for data collection. The PhD student will work closely with the industrial partners (BL Refrigeration and Air Conditioning Ltd., B9 Energy Ltd., and Glen Dimplex Heating & Ventilation Ltd), undertake an industrial placement, and also visit the companies twice a year for formal project review meetings. The student will join an active research team including three academics, one postdoctoral researcher and five PhD students working on different aspects of porous materials for thermal management application.

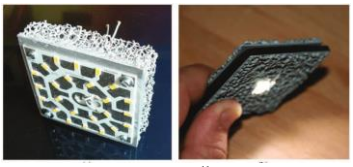


Transpiration cooling


Packed bed energy storage



Battery cooling


LED cooling


Vortex shedding behind the airplane


Wake swirl behind wind turbine

Key skills required for the post:

Applicants must have a first or upper second, MEng, MSc degree or equivalent with a background in Mechanical or Aerospace Engineering, Physics, Applied Mathematics or a related discipline. Applicants with an interest in fluid flow, computational fluid dynamics (CFD) will be considered.

Key transferable skills that will be developed during the PhD:

At the end of the project you will have acquired the expertise of CFD technique in fluid dynamics, heat transfer together with the skills to look into the turbulent flow and transport in porous media. The PhD student is expected to participate in the international technical community by presenting at conferences such as International Conference on Porous Media and UK Heat Transfer Conference. These events will provide a platform to develop a network of professional contacts for further career progression.

Applying:

Applicants should apply online at http:/go.qub.ac.uk/pgapply. Interested applicants can also send a CV and covering letter to the Lead Supervisor Dr Yasser Mahmoudi Larimi (s.mahmoudilarimi@qub.ac.uk).

Lead supervisor:	Dr Yasser Mahmoudi Larimi (s.mahmoudilarimi@qub.ac.uk)
Other supervisor(s):	Dr Juliana Early Prof Mahdi Azarpeyvand (University of Bristol)
Industrial partners	(1) BL Refrigeration and Air Conditioning Ltd. (2) B9 Energy Ltd. (3) Glen Dimplex Heating & Ventilation Ltd.
Guaranteed stipend:	£15,009 per annum (tax free). UK/EU applicants only. There is also the opportunity to undertake teaching and demonstration duties within the School to earn additional income up to £2,400 per year.
Conditional top-up available:	£3000/year additional income dependent on the recommendation of the interview panel.