QUB - Mechanical and Aerospace Engineering
PhD Project Description

Title: CFD of Turbulent Flow and Nosie Control over Airfoils Using Porous Materials

Theme: Aerospace Engineering

Project description:

Project summary:

Flow past a spinning cylinder (Fig. 1) and rotating airfoils (Figs. 2 and 3) has led to continues studies over the past decades for many applications, from aeroplane landing gears, airplane wings (Fig. 4), wind turbine blades (Fig. 5), high-rise buildings and etc. Interest in these flows arises from the point of view of understanding wake dynamics. One of the very important and complex phenomena that occurs around the bluff bodied and airfoils is vortex shedding. Vortex induced symptoms are undesirable as they can result in structural vibration, acoustic noise, increased drag and stresses on the structures. Therefore, it is crucial to control the vortex shedding effectively.

Project Objective:

In this project we will investigate a passive flow and noise control technique based on porous material for rotating circular cylinder and airfoil. The study interests in reducing the vortex shedding and noise propagation experienced in these two geometries. Therefore, we will perform a high fidelity CFD using Large Eddy Simulation (LES) approach to analyse the details of the high Reynolds number turbulent flow and noise generation due the vortex shedding behind the rotating cylinder and airfoil. The analysis will be performed for different rotational speed with and without porous material. The objective is to study the use of porous material in controlling the shedding and reducing the noise generated. The project will be conducted in collaboration with the University of Bristol (which will provide us with experimental data), and two companies, Embraer (one of the largest aerospace companies in the world) and Airbus.

Fig. 1: Shedding in the wake of a cylinder

Fig.2 : Vortex wakes of a flapping foil

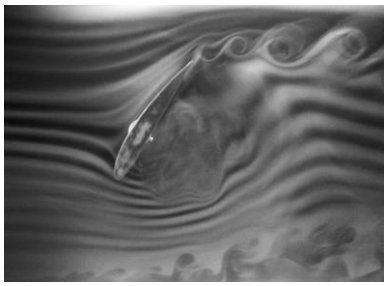

Fig. 3 (a): Vortex shedding around an airfoil

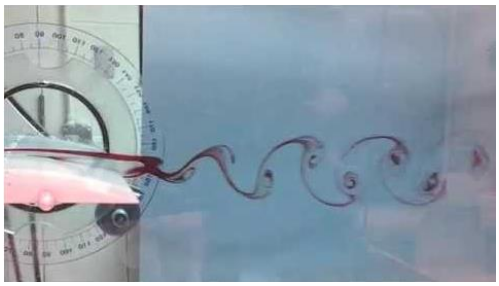

Fig. 3 (b) : Vortex shedding behind an airfoil

Fig. 4: Vortex shedding behind the airplane

Fig. 5: 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, Aerospace Engineering, Physics, Applied Mathematics or a related discipline. Applicants with an interest in fluid flow, computational/CFD and aeroacoustics will be considered. Experience in using CFD software such as Fluent and OpenFoam is an advantage.

Key transferable skills that will be developed during the PhD:

At the end of the project you will have acquired the expertise of CFD modelling, acoustics together with the skills to look into the turbulent flow, transport in porous media, and noise reduction techniques.

Lead supervisor:	Dr Yasser Mahmoudi Larimi, (s.mahmoudilarimi@qub.ac.uk)
Other supervisor(s):	Dr Juliana Early (j.early@qub.ac.uk) The research also will be conducted in collaboration with the University of Cambridge and University of Bristol
Funding mechanism:	EU / UK
Application closing date:	Until suitable candidate appointed.
Guaranteed stipend:	£15,009 per annum (tax free)
Conditional top-up available:	NA

PhD students in the School may have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to in excess of £2,400 per year.

Queens University Belfast is a diverse and international institution which is strongly committed to equality and diversity, and to selection on merit. Currently women are under-represented in research positions in the School and accordingly applications from women are particularly welcome.