IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project title: A numerical and experimental study of interacting wakes

Project number: IMURA0171

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Research Academy theme/s

Advanced computational engineering, simulation and manufacture

The research problem

The project aims to numerically and experimentally study interaction of wakes from multiple bluff-bodies.

Vortex shedding and formation of wake from bluff bodies have captured the imagination of scientists for long; detailed results on the problem are now available. On the other hand, when multiple bodies are present in the flow, not only do wakes form behind each body, they also interact in a non-linear manner. This leads to a very rich and relatively unexplored area which has several practical implications. The student will get a good exposure to the Lattice Boltzmann Method (LBM) which is a relatively new and powerful computational technique. At the same time, he will get a chance to verify the simulation results through experiments using state-of-the-art Particle Image Velocimetry (PIV) and Laser Induced Fluorscence (LIF) techniques.

Project aims

In this project various configurations (bluff-body positions and Reynolds numbers) would be simulated and results for interesting cases would be experimentally confirmed. Since this is a relatively unexplored problem, results obtained are expected to be new. The aim is to interpret these results in close detail so as to understand the underlying flow physics. Therefore, developing numerical and experimental techniques for the problem and exploiting them to uncover the flow phenomena are both important ingredients of this work.

Expected outcomes

The results obtained thus far have shown that the flow indeed displays some very rich characteristics. We have been able to define different flow regimes based on vorticity and time-series for lift and drag coefficients (Journal of Fluid Mechanics, Vol. 606, pp. 369-392, 2008). The mechanism of wake and jet formed between the bodies has also been explored (Physics of Fluids, Vol. 21, 083602, 2009). However, the spacing at which transition from one regime to another occurs needs to be better predicted. The chaotic flow regime needs to be studied in further detail and possible connections with 2d turbulence need to be explored. The study is expected to lead to answers to these and related questions. We expect that the results would be published in leading journals in the field such as Journal of Fluid Mechanics and Physics of Fluids.

Which of the above Theme does this project address?

Advanced computational engineering complemented by experiments, under the broad area of fluid mechanics.

How will the project address the Goals of the above Themes?

The project involved is computationally intensive requiring advanced computational resources such as parallel computing. The project also involves use of a relatively new computational technique – the Lattice Boltzmann Method. Note that expertise in LBM is limited to only a few groups in the world. Limited comparison of the LBM results against the more standard finite volume method will also be undertaken.