IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**CFD analysis of vortex induced vibration of a cylinder**	
Project Number	**IMURA0713**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address?
*(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*

1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research Themes:

Highlight which of the Academy's Theme(s) this project will address?
(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1	*Advanced computational engineering, simulation and manufacture*
2	*Infrastructure Engineering*
3	*Clean Energy*
4	*Water*
5	*Nanotechnology*
6	*Biotechnology and Stem Cell Research*

The research problem

Vortex-induced vibration (VIV) of a cylinder is an attractive method for extracting energy from clean energies such as hydrokinetic or wind energy. This project investigates such a feasibility using computational and experimental techniques. The modelling of the flows in a VIV system involves moving solid-fluid interface with coupled structure dynamics. An in-house immersed-boundary method based Fluid-Structure interaction solver will be developed and employed to computationally investigate VIV of a cylinder. Constitutive models for calculating electrical energy will be developed and tested. VIV with thermal gradients, non-linear springs and tandem cylinders will be considered to explore the energy efficiencies for more complex systems. The effect of several parameters such as density ratio of cylinder to fluid, spring constant, damping coefficient, Reynolds number will be investigated to find the best efficiency of the system. Based on the numerical data, a prototype and its feasibility will be proposed. Experiments are planned during candidate's stay at Monash to test the prototype in a water tunnel.

Project aims

The aims of this project are the following:

- Understand coupled flow physics and structure dynamics of complex VIV systems involving thermal gradients, non-linear springs and tandem cylinders.
- Estimate energy extractions and investigate the effects of problem parameters.
- Verify develop theory and hypotheses using experiments.

Expected outcomes

We expect the following outcomes from this project

- Fundamental understanding of complex VIV systems.
- Feasibility of energy harvesting by such systems.
- Quality Ph.D. graduate with ability and skills to understand and model incompressible flows in complex geometries with moving boundaries.

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

The target of the project is to model complex VIV for energy harvesting applications via advanced computational techniques. Thus, the project will address the goals of above two themes (Advanced computational engineering, simulation and manufacture and clean energy)

Capabilities and Degrees Required

The student for this project will require the following skills

- Sound background in fluid mechanics and numerical methods.
- Some experience with computer programming preferably with FORTRAN and C++. If not, a willingness to learn is essential.
- Good written and communication skills.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at www.iitbmonash.org)** relating to this project to make it easier for the students to apply.

CFD, fluid mechanics, clean energy