IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	An Immersed-Boundary method based solver to compute flows with solid–fluid and fluid–fluid interfaces	
Project Number	**IMURA0325**	
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Research Academy 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

Define the problem

Flows with solid–fluid and fluid–fluid interfaces are relevant to multiphase problems such as interaction of a droplet with a solid surface, flow segmentation in a micro channel, bubble dynamics in a channel and bubbly flows. The flow-induced deformation of soft structures has several applications in engineering and biological systems; examples include micro-aerial vehicles, synthetic jets, transport of fluids in elastic structures, energy-harvesting devices, flow-induced vibration of vocal folds in human larynx during phonation, contraction/relaxation of the heart, deformation of insect wings and fish fins during propulsion and interaction of a blast wave with human body. The modelling of the flows in above systems generally involves complex three-dimensional moving solid-fluid and fluid-fluid interfaces, and flow-induced deformation of a soft structure. The flow in many of the above applications is highly unsteady and the modelling of the structure also involves geometric and material nonlinearities. While modelling of the flow and the structure are challenging in their own right, the coupled fluid-structure interaction and the inclusion of the fluid-fluid interface raises the challenge to an even higher level.

Project aims

Define the aims of the project

The objective of the project is three-fold:

- Develop a fully-parallelized, three-dimensional and state-of-the-art Immersed-Boundary (IB) method based solver to compute incompressible flows with moving solid–fluid and fluid–fluid interfaces.
- Employ the IB solver to simulate flows with deforming fluid–fluid interface in presence of the structure.
- Employ the IB solver to simulate flows with flow-induced deformation of the structure.

Expected outcomes

Highlight the expected outcomes of the project

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

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The target of the project is to develop a generalized flow solver with solid–fluid and fluid–fluid interfaces. The state-of-the-art methods such as immersed boundary, level-set and finite-element will be used to achieve the target, which will help to address the goals of above themes.