IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**A Computational Fluid Dynamics and Heat Transfer Solver for Complex Geometries and Multiphase Flows**	
Project Number	**IMURA0338**	
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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

The fluid dynamics and heat transfer with fluid–fluid interfaces are relevant to multiphase problems such as interaction of a droplet with a solid surface, flow segmentation in a microchannel, bubble dynamics in a channel and bubbly flows. The modeling of the flows in above systems generally involves complex three-dimensional geometries with moving fluid-fluid interfaces, and convection heat transfer. The flow and heat transfer in many of the above applications is highly unsteady and state-of-the-art numerical techniques are needed to simulate the problems. While modeling of the fluid-fluid interface is challenging in its own right, the conjugate heat transfer raises the challenge to an even higher level. The objective of the project is to develop and benchmark a fully-parallelized, three-dimensional and state-of-the-art Immersed-Boundary (IB) method based solver to compute incompressible flows in complex geometries with moving fluid–fluid interfaces and conjugate heat transfer. The IB solver will be employed to simulate challenging multiphase flows. High-fidelity, parallelized simulations will employ more than 16 processors and are being planned to carry out at national supercomputers.

Project aims

The aims of this project are the following:

- To develop a computational fluid dynamics and heat transfer solver to compute incompressible flows in complex geometries with moving fluid–fluid interfaces and conjugate heat transfer.
- Extend the developed solver to applications in multiphase flows.

Expected outcomes

We expect the following outcomes from this project

- A state-of-the-art, three-dimensional, parallelized, computational fluid dynamics and heat transfer solver.
- Quality Ph.D. graduate with ability and skills to understand and model incompressible flows in complex geometries.

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

The target of the project is to model incompressible flows and understand multiphase flows via advanced computational techniques. Thus, the project will address the goals of above theme (Advanced computational engineering, simulation and manufacture).

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These

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.