

An Indian-Australian research partnership



**Project Title:**

Improved techniques for high resolution urban flood modelling

**Project Number**

IMURA0725

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**Research Clusters:**

**Research Themes:**

Highlight which of the Academy's  
**CLUSTERS** this project will address?

(Please nominate **JUST one**. For more information, see  
[www.iitbmonash.org](http://www.iitbmonash.org))

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](http://www.iitbmonash.org))

1	<i>Material Science/Engineering (including Nano, Metallurgy)</i>	1	<b>Advanced computational engineering, simulation and manufacture</b>
2	<i>Energy, Green Chem, Chemistry, Catalysis, Reaction Eng</i>	2	<b>Infrastructure Engineering</b>
3	<i>Math, CFD, Modelling, Manufacturing</i>	3	<i>Clean Energy</i>
4	<i>CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control</i>	4	<b>Water</b>
5	<b>Earth Sciences and Civil Engineering (Geo, Water, Climate)</b>	5	<i>Nanotechnology</i>
6	<i>Bio, Stem Cells, Bio Chem, Pharma, Food</i>	6	<i>Biotechnology and Stem Cell Research</i>
7	<i>Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng</i>		
8	<i>HSS, Design, Management</i>		

## The research problem

*Define the problem*

Accurate prediction of urban flooding has become an increasingly important challenge from the perspective of land use infrastructure planning especially with the uncertainties cause by climate change related issues. Associated with this area of research is also the ability to estimate the effect of inclusion of protective structures such as sea walls, levees and breaches. CSIRO Data61 has been developing an open source tool to predict urban flooding (both catchment and coastal) called Swift (<https://research.csiro.au/swift>). Swift uses a finite volume GPU based shallow water hydrodynamic solver and integrated with this is a one dimensional network modelling capability which then allows the prediction of complex urban flooding scenarios. Ongoing developments in Swift is needed to ensure the tool is able to address key challenges including:

1. The ability to resolve thin structure, essentially structures such as sea walls that have a width or thickness that is smaller than the size of the grid used for the overall simulation.
2. A nested grid technique that allows different regions in the urban flood domain to be resolved at different resolutions to ensure fast computations in large regions and
3. Further development and validation of accurate urban run-off models

In developing the above capabilities we will be working very closely with Local City Authorities as well as Water Management agencies to ensure that data for validation is available and that the outcomes of the research is applicable in the real world.

## Project aims

*Define the aims of the project*

The aim of the project is to improve the capability of the open source tool Swift in predicting urban flood inundation and flood adaptation in an urban setting. The key outcome of this research is the development of improved sub-models and algorithms. This will be achieved through a combination of improvements in speed and accuracy of prediction.

## Expected outcomes

*Highlight the expected outcomes of the project*

1. Key algorithms developed that extend the capabilities of Swift either from the perspective of being able to capture thin structures and/or speed and accuracy of the solver for urban flood applications.
2. Validation of the implementation of the algorithms by comparing the predictions with laboratory scale data as well as potentially a larger scale real world application.
3. Between two and three journal publications in high quality methods based journals such as Environmental Engineering and Software.

## 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.*

### **Advanced computational engineering, simulation and manufacture**

*The project has a key aim of developing algorithms that improve the accuracy and speed of urban flood inundation predictions.*

### **Infrastructure Engineering**

*The application of the outcomes of this project is important to be able to accurately predict placement of engineering structures such as levees and sea walls in an urban inundation protection context.*

### **Water**

*Flooding is a major issue faced by several (especially coastal) cities around the world and this project has the aim of developing capabilities that can better predict flood behaviour as well as analyse adaptation solutions thereof in an urban context.*

## 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 capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.*

The student who applies for this project needs to have demonstrable high level skill sets in mathematical modelling, fluid mechanics especially as it relates to hydrodynamics and hydrology, programming preferably in C and C++. The student will also need to have excellent English language proficiency both written and oral. Finally it would be good if the student has had previous experience in performing in-depth literature review analyses with a view to writing up high quality publications. The student could have a degree in a related field of Engineering (for example Civil, Mechanical, Chemical or Aerospace Engineering), Mathematics or Physics to apply for this project.

## Potential Collaborators

Please visit the IITB website [www.iitb.ac.in](http://www.iitb.ac.in) OR Monash Website [www.monash.edu](http://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 (<http://www.iitbmonash.org/becoming-a-research-supervisor/>) relating to this project to make it easier for the students to apply.