

An Indian-Australian research partnership

**Project Title:**

**Project Number**

**Monash Main Supervisor**

(Name, Email Id, Phone)

*Full name, Email*

**Monash Co-supervisor(s)**

(Name, Email Id, Phone)

**Monash Department:**

**IITB Main Supervisor**

(Name, Email Id, Phone)

*Full name, Email*

**IITB Co-supervisor(s)**

(Name, Email Id, Phone)

**IITB Department:**

## 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](http://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
7. Humanities and Social Sciences

## The research problem

*Define the problem*

High speed turbulent jets impinging on solid plates constitute a benchmark problem in fluid dynamics. Not only are they rich in physics, but they are also important for applications like rocket take-off, hovercraft, etc. Jets that impinge orthogonally on a flat plate are characterized by a feedback loop between the coherent structures arising due to the natural instability of the jet shear layer and the reflected disturbances, both acoustic and hydrodynamic, coming from the jet-plate interaction. This problem will be analyzed using global linear hydrodynamic stability theory – the resonant condition in the impinging jet makes this theory especially appropriate. Both subsonic and supersonic jets will be analyzed, the comparative study being of interest for deepening physical understanding. The theory will be compared against large-eddy simulation (LES) data of this flow.

## Project aims

*Define the aims of the project*

To develop global hydrodynamic stability models for predicting the behaviour of high-speed high-Reynolds number impinging jets. To simultaneously create an empirical database of the same flow consisting of numerical simulation (LES).

### **Expected outcomes**

*Highlight the expected outcomes of the project*

a) The stability theoretic model will be elucidate the essential flow physics in the impinging jet problem. b) The LES database will be useful not only for validating the model, but also as an aid to understanding the finer details that are not modelled.

### **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.*

Stability models pose an inexpensive alternative to fully-resolved computation of turbulent jets. This project will thus feed into advances in computational fluid dynamics. Reducing the pressure loads on jet impingement surfaces will also afford economical designs of relevant infrastructure, like rocket launch pads.

### **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 prospective student should have strong background in fluid dynamics and engineering mathematics. Exposure to code development will be a bonus.

### **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.*

Prof. Julio Soria

Please provide a few key words relating to this project to make it easier for the students to apply.

**Global hydrodynamic stability analysis, impinging jets**