

An Indian-Australian research partnership

**Project Title:** **Modelling and Control strategies for object manipulation with soft robots**

**Project Number** **IMURA0914**

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### The research problem

Robots made with 'soft' or deformable materials are well-suited for handling delicate objects as the robot deforms under the action of contact forces and prevents any damage. Such robots can also conform to irregular geometries and grasp objects with multitude of geometries. The forces generated during this interaction are dependent upon the deformation and material characteristics of the robot. Precise control of these forces, which is necessary for object manipulation, is challenging. Consider, for example, a soft gripper that may be used to hold and insert a cylindrical peg in a hole of matching diameter. In such a scenario, forces generated due to the interaction of the peg with the walls of the hole can lead to deformation in the robot gripper. This project aims to develop design and control methodologies to perform contact force control and eventually object manipulation with soft robots. It is expected that the project will involve analytical modelling, simulations and finally experimental validation of the proposed techniques.

### Project aims

- Development and verification of a mathematical model for soft robots that is suitable for analysis of force/impedance control schemes
- Design of stable control methodologies based on the model developed
- Experimental validation of the control algorithms in simple tasks such as pushing a block or writing on a surface
- Develop and test control strategies for fast robotic assembly tasks in manufacturing.

### Expected outcomes

- Modelling dynamics for compliant soft-robotic mechanisms;
- New control algorithms for compliant gripping/interactions;
- Publications related to modelling and control of soft robots.

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

The project aims to develop mathematical tools for modelling and control of soft robots. Such robots are expected to replace conventional robots in manufacturing industry for fragile object handling, manipulation and packaging etc. in the future.

### Capabilities and Degrees Required

The student should have a Bachelors/Masters in Mechanical/Mechatronics/Aerospace/Electrical/Controls engineering (or equivalent) with a keen interest in working with robotic mechanisms/mechatronic systems. As the project involves mathematical modelling, simulations and experiments, a solid background in applied mathematics, programming and hands-on-experiments is required. Prior exposure to control design, microcontroller programming and finite element analysis is desirable.

### Potential Collaborators

Prof. Sunita Chauhan, Monash University  
Prof. Abhishek Gupta

Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

Robotics, Mechatronics, Modelling and Simulation, Systems Analysis and Control