

An Indian-Australian research partnership

**Project Title:** Multi-robot coordination and motion planning for automatic cleaning of solar photovoltaic panels

**Project Number** IMURA0639

**Monash Main Supervisor**

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**Monash Department:**

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**IITB Department:**

Systems and Control Engineering.

## 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*

Solar photovoltaic panels accumulate dust, dirt, bird droppings, dry leaves and other particles that reduce the solar radiation reaching them. This in turn reduces the efficiency of the solar panels. Therefore, regular cleaning and maintenance is required. The traditional way of cleaning involves manual cleaning using water jets. Automatic cleaning mechanism can ensure higher reliability with reduced cost. In literature, automatic cleaning has been addressed by electrical, mechanical, chemical and electrostatic methods. Mobile robots have been used for automatic cleaning. They are designed to move on the surface either autonomously or through remote control while scrubbing, vacuuming, or using water jets to clean the panels. The cleaning operation is usually scheduled. In this project, we propose the design and usage of multiple mobile robots that are small and are of low cost to autonomously clean a large installation of solar panels of various

configurations such as PVs and CPVs. The robots will coordinate among them to observe and clean the surface as and when required. For recharging and replenishing cleaning material, the robots will reach the nearest docking station. The problem is to coordinate the motion of the robots for efficient power generation by monitoring functionality and cleanliness.

## Project aims

*Define the aims of the project*

The project aims at developing strategies for efficient cleaning of the solar panels using multiple mobile robots. The problem is spatio-temporal where the robots need to reach the entire surface at desired instants in a proactive manner. The surface may not be flat and horizontal, such as a curved concentrating photovoltaic panels. An efficient task allocation and path planning strategy has to be proposed, analysed and verified. The strategy should involve:

1. Simultaneous detection and cleaning by the robots.
2. Task distribution between multiple robots.
3. Optimal path planning.
4. Scalable and robust performance.

## Expected outcomes

*Highlight the expected outcomes of the project*

- A path-planning algorithm for energy efficient cleaning of solar panels.
- Coordination strategies for autonomous task allocation among the robots and area mapping.
- Hardware validation of the algorithm.
- Publications in peer-reviewed journals and conferences.

## 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 project is related to designing and optimizing algorithmic strategies for efficient solar power generation via functionality checks and cleaning. This will increase the production efficiency and life span of solar installations.

Analysis, simulation and verification of the algorithms add to the advanced computational engineering and simulation theme.

## 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.*

B.E. or MTech with strong knowledge and aptitude in computational methods; object oriented programming, coding and interface with hardware.

## 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.*

Potential collaborators have already been identified:  
Professor Sunita Chauhan, Monash University and  
Profs. Arpita Sinha and Leena Vachhani, IITB

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

**Robot path planning, area mapping, automatic cleaning, task allocation**