

An Indian-Australian research partnership

<b>Project Title:</b>	<b>AgriBot: Agriculture Inspection Robot –design and control.</b>	
<b>Project Number</b>	IMURA0872	
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### Research Clusters:

### Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <b>one</b>. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	<b>Infrastructure Engineering</b>
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	<b>CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control</b>	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	<b>Design</b>

## The research problem

### *Define the problem*

Agriculture industry makes one of the dominant parts of the economy of any country and this is equally applicable to both Australia and India. This industry is facing a whirlwind due to global warming and abnormal weather patterns that has posed a threat to food security in various parts of the world.

Modern farming practices make use of advanced techniques and automated machinery for effectively increasing productivity and reducing waste throughout the food supply chain. Robotics and autonomous systems are set to transform many global industries and agricultural robots have found their way in the market. **The agricultural robots are** characterized by the application (such as harvesting and navigation) and by the types of functions that they perform (such as data collection, inspection and management). There are numerous commercial systems in global market for the former, including heavy automated machinery (non-robotic), however the inspection and livestock management application is estimated to grow at the highest rates in the coming years. This rapid growth rate creates challenges for manual and regular inspection of the crops through the growth process before becoming ready for harvest or collection from the agriculture fields.

One of the most crucial part is comprehensive soil and crop testing for nutrient deficiencies and fertiliser requirements at various phases. This requires routine scientific analysis of soil and additives for several vital parameters at various stages by agricultural scientists. Most of them are done on samples in labs as well as performed in real-time in the farms by multiple hand-held instruments. The latter requires highly skilled personnel to use specified tools and protocols and analyse the results from various instruments for easy feedback to the farmers to adopt specific actions accordingly. In our project, we would like to automate this subjective and time-consuming process by devising multi-agent, customized robots for collecting and analysing soil and crop status *in situ*.

## Project aims

### *Define the aims of the project*

In this project, we propose small, light-weight, agri-bots, equipped with novel sensors for inspection and monitoring of various conditions of the soil and plant with respect to the use of water and fertilizers. These integrated hardware and software systems would be used for replacing stationary sensors with fixed position, maintaining the sensor signal acquisition, preliminary processing and the automated evaluation.

In particular, the aim of this project is to develop a multi-agent robotic system to aid agricultural scientific research (and not big harvesting, weeding, cutting automated machines). This is to complement the strengths of IITB in novel agri-sensors and processing for scientific inference for soil quality and harvest predictive analysis in a given region.

The scope of prospective student in this category (Mechanical/Mechatronics background) would be: 1) to design and develop multi-agent robotic configuration for a given terrain under various conditions (such as mud, water etc.). The design, implementation, locomotion, navigation and control of such agents is a technical challenge worthy of dedicated research. We suggest this to be addressed as a multi-agent problem comprising of a 1) drone: for mapping a wider area of interest and localize stringent positions for deployment of 2) dedicated mobile robots that will comprise both internal sensors for localization and control and external agri as well as environmental sensors.

The developed technology would, therefore, also provide an efficient means to help in collecting the data on weather, temperature, moisture, humidity and other relevant parameters for optimising yield, improving the farming practices, make better decisions on the required resources and their distribution to minimise waste.

## Expected outcomes

### *Highlight the expected outcomes of the project*

Smart Inspection AgriBot prototype (a sensor intensive HW and SW integrated system) for the field parameter sampling, sensor signal recording, monitoring and data base generation

## 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.

- It will involve novel mechanism design, manufacturing and prototyping;
- Multi-agent synchronization, navigation and control;
- Multiple sensor deployment under a given protocol;
- Record and save the information onboard

## 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.

- Ideally a Mechatronics engineering background candidate or,
- Mechanical Engineering background candidate re: mechanism design for customized automated application; navigation and control

## 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.

Dr. Rajul Patkar

We will also interact with one or two agriculture scientists from ICAR or other agriculture institutes.

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.

1. Robotics, Mechatronics, UAVs (30)
2. Systems Analysis and Control (29)