

An Indian-Australian research partnership

<b>Project Title:</b>	Distributed coordination of mobile visual sensor network for boundary tracking and coverage applications	
<b>Project Number</b>	IMURA0445	
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## 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

## The research problem

In many applications, it is desirable to autonomously detect and monitor an environmental region. Examples of such applications can be monitoring poisonous oil spills, harmful algae blooms, wild fire spreading, temperature and salinity distribution in the ocean and hazardous weather conditions such as hurricanes and tropical storms [1], which indicates the requirement of autonomous operation. However, to monitor the entire region with possibly time varying boundary, the use of mobile sensor network would be a wiser option. Thus, the objective of this project is to guide the set of mobile sensors to detect the boundary and to cover the entire region of interest. To ensure scalable and robust operation, only local information is used. The goal is to achieve optimal distribution of the sensors among the targets. We will both focus on theoretical development, mathematical analysis as well as empirical studies by implementing the

algorithms on Monash University's Wireless Sensor and Robot Network Laboratory's experimental testbed.

1. Zhipu Jin and Andrea L. Bertozzi: "Environmental Boundary Tracking and Estimation Using Multiple Autonomous Vehicles", Proceedings of IEEE Conference on Decision and Control, New Orleans, LA, USA, Dec., 2007, pp .4918-4923

## Project aims

The aim of the project is to study the behaviour of a mobile sensor network with respect to the changes in the environmental conditions. We divide the problem into two parts – finding the boundary of the region of interest and uniformly placing the sensors inside the boundary. Both parts need to be solved simultaneously since the boundary may be varying with time. Therefore, broadly the aim of the project is to

1. Develop a control strategy for the mobile sensors using only local information.
2. Study the global behaviour of the sensor network.
3. Propose a matrix to judge the performance of the system.
4. Demonstrate on mobile robot platform.

## Expected outcomes

At the end of the project, we expect that

1. Distributed algorithm for efficient monitoring of an environmental region will be created.
2. Mathematical foundations on the optimality, scalability and stability of the algorithms will be established
3. Experimental performance of the algorithms over a test network will be obtained
4. 3 journal papers will be published

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

- A thorough review of the existing research literature will be conducted and most promising approaches, including their weaknesses will be identified.
- A theoretical analysis of the selected approaches, over simplified models will be conducted.
- Based on the findings in the above steps, new algorithms will be created and their theoretical bounds will be studied
- Algorithms will be implemented on Wireless Sensor and Robot Networks Laboratory's testbed and a rigorous empirical study will be completed.

## Capabilities and Degrees Required

BE or MTech with knowledge in basic control systems, and C/C++ programming. Real-time systems programming is desirable.

## 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.