

An Indian-Australian research partnership

Project Title: **Autonomous mapping in the presence of dynamic obstacles using multiple sensors**

Project Number **IMURA0450**

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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)

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

The map is a representation of an environment. Building map using an autonomous mobile robot involves challenges particularly when the information about the environment is unknown. The map must be consistent and complete. Map-building problem by an autonomous robot is associated with the localization problem. The robot has to localize with respect to the map of the environment while map is being built. Therefore, a simultaneous approach for solving both localization and map-building needs to be considered. The sensors mounted on the robot obtain the information about

the environment and the robot's position. The information extraction from sensors is more challenging in the presence of dynamic obstacles. We next formulate the problem addressed in this proposal:

Generate a map of an unknown environment in the presence of dynamic obstacles. This includes the problem of processing and coordinating information from multiple sensors with different modalities mounted on an autonomous mobile robot whilst simultaneously localizing the robot using this sensor information.

Project aims

The project aims to generate the representation (map) of an unknown environment using an autonomous mobile robot. The problem is challenging when dynamic obstacles are present in the environment. An array of multiple sensors is required to address the problem. The information from one sensor is not enough to distinguish between the static and dynamic obstacles, therefore the project would investigate the use of multiple sensors with different characteristics.

Expected outcomes

Simultaneous localization and mapping of an unknown environment using an autonomous robot is a challenging problem. The challenge is to show that the map generated by the mobile robot is consistent, complete and usable. Prior work deals with the map generation considering static obstacles. This project aims for an approach where the robot attempts to generate the map of an unknown environment in the presence of dynamic obstacles and declares the completion of mapping task. Since one sensor is not enough to distinguish between the static and dynamic obstacles and one sensor can address limited obstacle correspondence issues, the project would investigate the extraction of information from multiple sensors. The outcome of this project would result in good publications. It has applicability in real scenarios, because most real environments contain dynamic obstacles.

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

The project involves the modelling of system described by the mobile robot and sensors mounted on it. Capabilities of the system would be investigated by considering the information extracted from the sensors. The computations required to address the goal of completing the map of an unknown environment would be investigated through this project. The robot path planning whilst building the map will be exploited to enable reliable processing of dynamic obstacles through redundant sensing in both temporal and spatial domains.

Capabilities and Degrees Required

Candidates with a B.E./B.Tech./M.E. /M.Tech. in any branch of Engineering - with consistent good academic performance (First Class with honors). Good mathematical and real time programming skills are essential. An experience in working with robotic platform and solving motion planning related problem is desirable.

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

Mapping, Localization, Sensor processing