

An Indian-Australian research partnership

Project Title: **Rail-robots for railway tracks routine inspection – Novel re-configurable mechanism Design**

Project Number **IMURA0706**

Monash Main Supervisor
(Name, Email Id, Phone) Professor Sunita Chauhan
Sunita.chauhan@monash.edu *Full name, Email*

Monash Co-supervisor(s)
(Name, Email Id, Phone) Prof. Ravi Ravitharan
Ravi.ravitharan@monash.edu

Monash Head of Dept/Centre (Name,Email) Professor Chris Davies
Chris.davies@monash.edu *Full name, email*

Monash Department: Mechanical & Aerospace Engineering

Monash ADRT
(Name,Email) Professor Emanuele Viterbo
Emanuele.viterbo@monash.edu *Full name, email*

IITB Main Supervisor
(Name, Email Id, Phone) Professor Anirban Guha
Email: anirbanguha1@gmail.com *Full name, Email*

IITB Co-supervisor(s)
(Name, Email Id, Phone)

IITB Head of Dept
(Name, Email, Phone) Professor Suhas S Joshi
Email: head.me@iitb.ac.in *Full name, email*

IITB Department: Mechanical 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)

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

The rapid growth for freight, passenger and heavy haul railway across the world introduces the challenges of increased costs of upgrading railway infrastructure and increased demand for enhanced efficiency and performance. Integration of robotics and smart communication

technologies presents opportunities to develop rail into a more commercially sustainable industry. One of the important rail infrastructure management activities involves regular inspection of track conditions, which is labour intensive and could be potentially augmented with robotics.

The proposed project aims to address the above problem by introducing autonomous inspection of railway tracks using dedicated robotic systems that could 'walk' the track instead of human inspections. Since the terrain/environment for the robots to manoeuvre and interact is known but highly specialized, unlike the road or factory floor surface, it would require exploration of novel mechanisms and configurations. Since the railway track network is known, it comes under structured environment category.

Also, such novel configuration and specified application calls for an inherent 'intelligence' using both interoceptive and exteroceptive sensors for self-balancing and dynamically updating the environmental information. This in turn, requires predictive assessment based upon efficient communication links between the robot(s) and the environment (railway tracks, control room, signalling, scheduling and logistics etc.) for coordination and localization of the robot. Therefore, the aims of this project are to design, develop and analyze re-configurable base mechanisms based on inspection tasks and types. A challenging problem to address is optimality and robustness of configurations and inspection methodologies/techniques: design energy efficient and fault tolerant techniques for repeated autonomous exploration.

Project aims

The project aims to design, fabricate and validate innovative re-configurable mobile robots that can be adapted to various inspection tasks (and hence variable sensing suites) in routine railway inspections.

Expected outcomes

- Design and develop re-configurable mobile robotic mechanisms (wheeled or legged or hybrid) dedicated to railways structured environment;
- Control strategies for self-balanced manoeuvrability on railway tracks;
- Capability of holding, deploying, dispensing and moving variable payloads and sensing suites for dedicated inspection tasks.
- Hardware-software integration and validation.
- Publications in peer-reviewed journals and conferences.

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

The project is related to designing, modelling and optimizing novel mechanisms and control strategies for efficient and fault tolerant exploration for inspection of rail infrastructure. Capabilities of the system would be investigated by extensive modelling and simulations.

The above mentioned research activities thus fall under the two main themes of the research academy, viz. Advanced computational engineering, simulation and manufacture and Infrastructure Engineering

Capabilities and Degrees Required

B.E. or M.Tech in relevant branch of engineering with strong knowledge and aptitude in mechanism design, mathematical modelling, robotics and control systems.

Potential Collaborators

Potential collaborators have already been identified:

Professor Sunita Chauhan and Mr. Ravi Ravitharan, Monash University and
Prof. Anirban Guha at IITB

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

Mechanism design, robotics, control systems