

An Indian-Australian research partnership

**Project Title:**

**The Investigation of Damage Modes under Transient Rail/Wheel Contact Conditions**

**Project Number**

IMURA0697

**Monash Main Supervisor**

(Name, Email Id, Phone)

Prof. Wenyi Yan ([wenyi.yan@monash.edu](mailto:wenyi.yan@monash.edu),

Full name, Email

**Monash Co-supervisor(s)**

(Name, Email Id, Phone)

Dr Cong Qiu ([cong.qiu@monash.edu](mailto:cong.qiu@monash.edu), Mr Peter Mutton ([peter.mutton@monash.edu](mailto:peter.mutton@monash.edu),

**Monash Head of**

**Dept/Centre** (Name,Email)

Prof. Chris Davies ([Chris.Davies@monash.edu](mailto:Chris.Davies@monash.edu))

Full name, email

**Monash Department:**

Mechanical & Aerospace Engineering

**Monash ADRT**

(Name,Email)

Prof. Ana Deletic ([ana.deletic@monash.edu](mailto:ana.deletic@monash.edu))

Full name, email

**IITB Main Supervisor**

(Name, Email Id, Phone)

Aparna Singh

[aparna\\_s@iitb.ac.in](mailto:aparna_s@iitb.ac.in)

Full name, Email

**IITB Co-supervisor(s)**

(Name, Email Id, Phone)

Full name, Email

**IITB Head of Dept**

(Name, Email, Phone)

Prof. N. Venkataramani

[head.met@iitb.ac.in](mailto:head.met@iitb.ac.in)

Full name, email

**IITB Department:**

Metallurgical Engineering and Materials Science

## 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	<b>Material Science/Engineering</b> (including Nano, Metallurgy)	1	<b>Advanced computational engineering, simulation and manufacture</b>
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	<b>Infrastructure Engineering</b>
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	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		
8	HSS, Design, Management		

## The research problem

The rail/wheel contact conditions are determined by the relationship of traction and creep at the rail/wheel interface. In the contact patch, the relative proportions of stick and slip regions are continuously changing as the traction force increases. The pure sliding state will be reached when the adhesion limit is achieved. Under sliding conditions, significant amounts of heat can be generated very quickly due to the associated friction conditions. The combination of this thermal loading and that from normal wheel-rail contact may contribute the development of some types of surface damage, for example "squats" in rails. This is particularly true for the contact between driven wheelsets in locomotives or motorised EMUs, and rails. A detailed understanding of damage modes and material characteristics of rails under these non-steady-state (transient) rail/wheel contact conditions is required to provide better guidance to rail/wheel interface management procedures.

## Project aims

- 1) Study the relationship of adhesion and creep in the contact patch.
- 2) Investigate (modelling) the contact stresses developed in rails under various kinds of wheel-rail interaction scenarios.
- 3) Carry out experiments using twin-disc machine to study transient rail/wheel contact conditions.
- 4) Detailed investigation of damage modes under transient rail/wheel contact conditions.
- 5) Recommendations to the strategies for mitigating the damage.

## Expected outcomes

1. Understanding of reasons for rail surface damage due to non-steady-state rail/wheel contact conditions
2. Development of better guidance to rail/wheel interface management procedures.

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

By understanding the root cause of formation of defects in rails under transient rail/wheel contact conditions, changes can be made in rail manufacturing and maintenance strategies for more robust railway operations.

## 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.*

1. BTech/MTech: Metallurgy/Materials Science/Mechanical Engineering.
2. Hard working
3. Should have excellent analytical and experimental skills.
4. Willingness to do systematic experiments and modelling.
5. Willingness to make field trips to understand railways better.

## Potential Collaborators

Select up to **(4)** keywords from the Academy's approved keyword list (**available at [www.iitbmonash.org](http://www.iitbmonash.org)**) relating to this project to make it easier for the students to apply.

**Rail/wheel contact, metallurgy, modelling, mechanical engineering**