

An Indian-Australian research partnership

Project Title: **Multiple link disruptions in road networks considering network dynamics**

Project Number **IMURA0848**

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Research Clusters:

Research Themes:

| Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <u>one</u>. For more information, see www.iitbmonash.org)</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 www.iitbmonash.org)</i> | |
|--|---|--|--|
| 1 | Material Science/Engineering (including Nano, Metallurgy) | 1 | <u>Advanced computational engineering, simulation and manufacture</u> |
| 2 | Energy, Green Chem, Chemistry, Catalysis, Reaction Eng | 2 | <u>Infrastructure Engineering</u> |
| 3 | Math, CFD, Modelling, Manufacturing | 3 | Clean Energy |
| 4 | <u>CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control</u> | 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 | Design |

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The research problem

Define the problem

Roadways are susceptible to a variety of disruptions. Most frequent disruptions are non-severe ones, but occur at multiple locations simultaneously. Capacity disruptions, if left unaccounted, will result in significant congestion in the road network as the residual capacity may not be enough to serve the demand. Under such situations various strategies such as staggered departure, directional/turning restrictions, entry restrictions to specific modes, etc. can be adopted. However, in order to implement an efficient strategy it is important to assess network over time and space. An informed decision can be taken by local transport authorities based on this assessment to minimize the impacts of disruptions. The network assessment should result in indices to quantify network resilience which will help in knowing the additional demand a network can handle without failure. Similarly the upper bound demand for different strategies can also be evaluated. This evaluation can also give critical links in the network which is an important input to local transport authorities.

One important application of this methodology is for the disruptions of Mumbai road network in Monsoon. During Monsoon, in Mumbai, capacity on many urban arterials get affected due to heavy rains. This causes a great inconvenience and delay to the commuters. During such a situation the proposed framework can assess the network resilience and suggest optimal strategy in real time. Another common cause of disruptions, especially in Australian cities, is due to fire accidents. If there are multiple fire accidents significantly larger road network will get affected. Proposing a suitable alternative routing can improve the network performance.

The proposal involves developing a dynamic system which will assess the performance of a road network under given traffic and network conditions over time and space. The assessed performance can be used to arrive at the indices to define resilience and identify critical links. Since real time assessment is needed, we will use dynamic traffic assignment. This framework will be developed using a simulation tool such as AIMSUN and PARAMICS. The developed methodology will be evaluated on test network as well as real-world road networks. Road networks in Mumbai and Melbourne will be used to apply the methodology.

Project aims

Define the aims of the project

To develop a simulation based framework for Real time Resilience assessment of urban road network subjected to link disruptions

Expected outcomes

Highlight the expected outcomes of the project

- Practice ready framework to assess resilience of road network in real time
- Suggest a suitable strategy to minimize the impact of link disruptions
- Identify critical road links in a network over time and space

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.

We are developing a simulation based framework. In order to incorporate network dynamics and disruption it is required to deal with advanced data handling techniques and computational skills.

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.

- Master's degree in Transportation Engineering/Electrical Engineering/Computer Science or any other relevant specialization (Bachelor degree in Engineering with valid GATE score may be considered)
- Good analytical skills (background in optimization is added advantage)
- Proficiency in computer programming such as C/C++ or Java
- Good technical writing skill

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

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.

Computational science, Data mining, Database systems, Dynamical control