

An Indian-Australian research partnership

Project Title:	Safety and Coordination of Connected Autonomous Vehicles	
Project Number	IMURA0967	
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Research Clusters:
Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? (Please nominate JUST <u>one</u> . For more information, see www.iitbmonash.org)		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	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	
3	Math, CFD, Modelling, Manufacturing	3	Infrastructure Engineering
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Clean Energy
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Water
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Nanotechnology
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Biotechnology and Stem Cell Research
8	HSS, Design, Management	8	Humanities and social sciences
			Design

The research problem

Motion coordination of a multi-agent dynamical system has been studied for the past few decades and many breakthroughs have been made in the last two decades. There are several variants in the multi-agent motion coordination problem such as consensus, formation, coverage, and pursuit-evasion, mostly based on the goal behaviour of the system. The common constraint of all these problems is that the information exchange only happens locally, which means that an agent only communicates with its neighbours. It is easy to see that Connected Autonomous Vehicles (CAVs) can be regarded as a multi-agent system. However, it has unique features that differentiate itself from other multi-agent systems. First, the safety of each agent is very important, sometimes even more important than the system's collective goal. The second feature of CAVs is the high sensing, communication and computing capability of an individual agent. The key

research question is how to achieve collective behaviours of CAVs through distributed interactions with certain guaranteed safety.

Project aims

The project aims to develop an algorithm for connected autonomous vehicles. We first review distributed algorithms for multi-agent systems and then design the way of exchanging information to achieve certain on-road safety such as collision avoidance and lane keeping. The algorithm will be first validated on a complex simulation platform, and it will be tested in the controlled environment involving real autonomous vehicles.

Expected outcomes

- A distributed and implementable strategy for connected autonomous vehicles which can satisfy roadside safety constraints.
- A couple of peer-reviewed journal publications.

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

The development of a new class of distributed algorithms is the key objective of the project. Also, simulation will play a crucial role for the validation of the developed algorithms.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. 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.

Necessary:

- Knowledge of modern control theory.
- Experience with algorithm development.

Desirable:

- Knowledge of ROS and vehicle simulation tools such as CARLA and LGSVL

Necessary Courses

- Introduction to Wheeled Mobile Robotics
- Advanced topics in Mobile Robotics
- Machine Learning

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.

Prof. Hai Vu, Dept. of Civil Engineering, Monash University.

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.

Robotics