IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Computer-Aided Air Traffic Management**	
Project Number	**IMURA0969**	
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IITB Department:	Aerospace Engineering	

Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** 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	*Infrastructure Engineering*
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*	7	*Humanities and social sciences*
8	*HSS, Design, Management*	8	Design

The research problem

With the arrival of vaccines, many carefully anticipate that major countries in the world would escape the long COVID-19 crisis by the end of 2021. Air traffic is also expected to quickly rebound to pre-crisis level as the economic activities recovers. The air traffic movements in busy international airports in the world will catch up its ever-increasing trend, while the size of air space remains limited. In the presence of disturbing events such as convective weather conditions and sudden peaks in air traffic movements, the air traffic flow through narrow corridors to these airports is disrupted, causing the air traffic management protocol to become more conservative in order to maintain safety under increasingly adversarial circumstances. This results in severe air traffic congestion, arrival/departure delays, and excessive amount of stress on human air traffic controllers, who are already suffering from various health issues caused by heavy workloads. These observations highlight the demand for a new air traffic management methodology that maximizes throughput in adversarial circumstances while maintaining safety in the future global air space.

Project aims

In narrow, congested corridors around busy airports, air traffic is currently under the centralized control of human controllers. The aim of this proposal is to develop a new, shrinking horizon, optimization-based centralized control scheme that can be used to alleviate the burden on human controllers. Our hope is that our work will eventually lead to an automated Air Traffic Management (ATM) system. However, the nature of the underlying theory is such that other applications are also possible, such as managing collision-free taxiing on busy airport tarmacs, and automated computer-controlled navigation for supplementing harbor pilots in bays. In addition to proposing an efficient air traffic management scheme, we intend to develop a number of very fast, specialized numerical computation algorithms which should make our proposed ATM scheme implementable in real time. Finally, to evaluate the efficacy of our ATM scheme, we will implement and evaluate it in a realistic ATM scenario.

Expected outcomes

The ultimate goal of this work is to provide a practical way of implementing a computer-aided ATM system in the real-world airspace. The successful application of the proposed research will result in safer operations of aerial transportation in the global airspace and, because of the reduced need for human intervention, reduced workload and stress on human air traffic controllers. Moreover, the throughput of the air traffic of narrow corridors around busy airports will be maximized even under adversarial conditions by the proposed scheme, and therefore it will be possible to control more air traffic movements at the same time and observe more accurate flight schedule without delays.

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

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

Potential RPCs from IITB and Monash

Dr Chao Chen

Dr Arpita Sinha
Dr Abhijeet Gogullapati

Capabilities and Degrees Required

Necessary:

- Basic knowledge of modern control theory.
- Experience with algorithm development and implementation.

Desirable:

- Experience on numerical optimisation solvers such as IPOPT.

Necessary Courses

Name three tentative courses relevant to the project that the student should complete during his/her coursework at IITB (the student will require to secure 8 point in these courses)

AE 725: Introduction to Air Transportation
AE 755: Engineering Design Optimization

Potential Collaborators

Airports Authority of India

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.

Optimisation, Transportation, Modelling and Simulation