IITB-Monash Research Academy

An Indian-Australian research partnership

Indian Institute of Technology Bombay | MONASH University

Project Title:	**Study of Inflatable Wings for UAVs**	
Project Number	**IMURA1090**	
Monash Main Supervisor (Name, Email Id, Phone)	Prof. Mark Thompson, <mark.thompson@monash.edu>	*Full name, Email*
Monash Co-supervisor(s) (Name, Email Id, Phone)	Mr. David Burton, <david.burton@monash.edu>,	
Monash Head of Dept/Centre (Name, Email)	Prof. Michael Wang, michael.y.wang@monash.edu	*Full name, email*
Monash Department:	Mechanical and Aerospace Engineering Department	
Monash ADGR (Name,Email)	Associate Professor Timothy Scott Eng-ADGR@monash.edu	*Full name, email*
IITB Main Supervisor (Name, Email Id, Phone)	Prof. Rajkumar S. Pant, rpant@iitb.ac.in, +91-9820084502	*Full name, Email*
IITB Co-supervisor(s) (Name, Email Id, Phone)	None	*Full name, Email*
IITB Head of Dept (Name, Email, Phone)	Prof. Sudarshan Kumar, hod@aero.iitb.ac.in	*Full name, email*
IITB Department:	Department of Aerospace Engineering	

Research Clusters:

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

Research 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	*Artificial Intelligence and* ***Advanced Computational Modelling***
2	*Circular Economy*
3	*Clean Energy*
4	*Health Sciences*
5	*Smart Materials*
6	*Sustainable Societies*
7	*Infrastructure*

The research problem

Inflatable wings have been widely regarded as viable candidates for future extra-terrestrial missions as well as hand launched unmanned aerial vehicles (UAVs) due to their inherent foldability and mitigated weight penalties. These have been found to produce significantly lower flow separation in low Reynolds number flow conditions. However, the undulating surface contour related to these unconventional lifting surfaces make them amenable to complex flow characteristics.

It is also noteworthy that erstwhile applications related to these wings have brought-out the relevance of these wings for numerous UAV applications. Most of the studies involving these wings have been limited to two-dimensional analysis as well as rigid structures. However, the two most important aspects related to inflatable wings that is its flexibility as well and three-dimensionality have not been addressed in previous studies.

Project aims

The key aim of this project is to carry out a detailed study on the aerodynamics as well as structural aspects related to a three-dimensional finite wing configuration of inflatable wings for UAVs. Such a study would be helpful to fine-tune the final inflatable geometry to enhance its reliance as a suitable lifting device for future UAV missions.

It is proposed to carry out CFD analyses and Wind Tunnel validation of three-dimensional inflatable wings to obtain their structural and flow characteristics, and study the impact of these deformations on their design and performance. Structural testing of the wings with the estimated loads (predicted by CFD and Wind Tunnel tests) will be carried out.

What is expected of the student when at IITB and when at Monash?

At IIT Bombay:
Problem Formulation, Finalizing geometry of the inflatable wings to be tested, Fabrication of full-scale 3-D inflatable wings and their structural load testing

At Monash University:
CFD Analysis of 3-D wing configurations, Fabrication of model 3-D wings for wind tunnel testing, validation of CFD results by wind-tunnel testing

Expected outcomes

a. Understanding the impact of different geometrical parameters related to inflatable wings for UAVs on their design and overall performance

b. Collation of the data that can be used to implement further modifications to the baseline model and carry out integration of servos and flexible wings to generate the required aerodynamic loading

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

The required objectives will be accomplished through the following sequence of activities:

a. First 4 months: Literature survey and sizing of inflatable wing UAVs
b. 4-12 Months: Finalizing the geometry of the test configurations
c. 12-24 Months: CFD computations and Wind tunnel experimentation and data acquisition at Monash University
d. 24-30 Months: Data analyses and comparison of CFD and Wind Tunnel tests
e. 30-36 Months: Fabrication and structural testing of Inflatable wings
f. 36-42 Months: Thesis Writing
g. Last two months: PhD Defence and Research closure

Potential RPCs from IITB and Monash

RPC Members from IIT Bombay:
Prof. Chandra Sekher Yerramalli, Prof. Dhwanil Shukla

RPC Members from Monash University:
Professor Kerry Hourigan. Professor Murray Rudman

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.

The student should have some exposure to aerodynamic analyses, both CFD and Experimental studies, and should preferably have a background in UAV design.

Prior degree(s) should be in Aerospace/Aeronautical or Mechanical Engineering.

Students who have done internships on similar topics, or have some working experience, especially that involving mechanical fabrication of UAVs will be preferred.

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 706 Computational Fluid Dynamics
AE 724 Experimental Methods in Fluid Mechanics
AE 709 Aerospace Structures

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.

Already identified

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.

Inflatable Wings, CFD, Wind Tunnel Testing, UAV