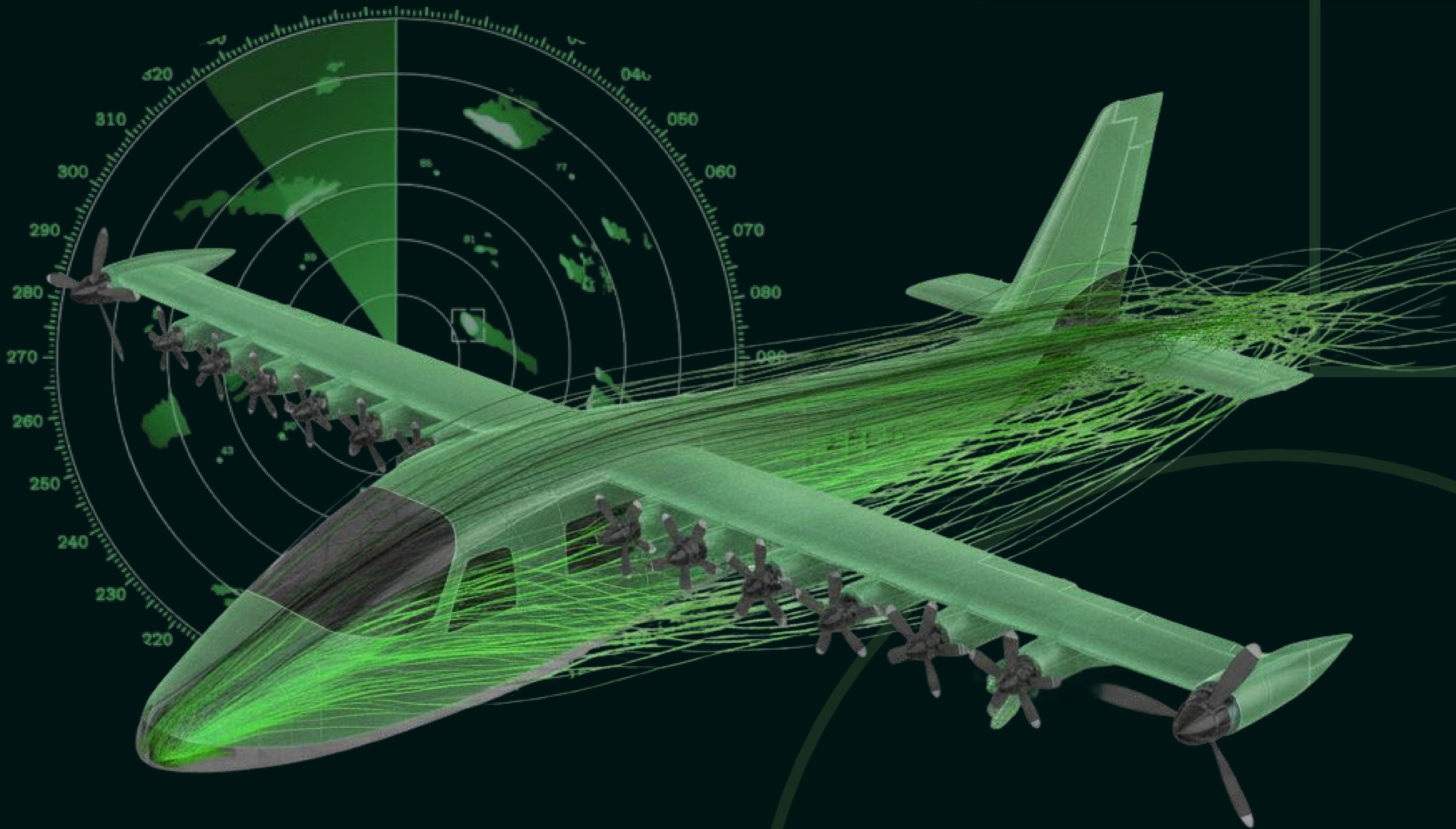




INTER IIT
TECH MEET 14.0

HIGH PREP



AEROSPACE

Powered Lift Wing Design

About the Company

LAT Aerospace is building a new generation of Short Take-Off and Landing (STOL) aircraft, engineered to operate from compact air-stops rather than conventional airports.

Take a simple example: Gurugram to Navi Mumbai. Today, it's a one-hour cab to Delhi airport, two hours waiting before your flight, a flight to Mumbai, and then another long cab to Navi Mumbai. Half your day is gone.

With us, that same trip looks completely different. Our 8-seater hybrid-electric STOL aircraft will operate from 2-acre air-stops, one in Gurugram and one in Navi Mumbai. Drive in, board, and fly straight. Door to door in a fraction of the time, without the chaos of big airports.

We're rethinking everything from first principles, aerodynamics for extreme lift, hybrid propulsion for lower fuel burn, and autonomy built-in from day one. And that's where you come in, our problem statement is rooted in the same challenge, how do we squeeze out every ounce of lift to push the limits of what's possible?

Because at the end of the day, our mission is simple, to make regional flying as easy as taking a cab

Introduction and Motivation

The History of STOL

Short Takeoff and Landing (STOL) aircraft have fascinated engineers for decades. NASA's pioneering research in the 1970s produced the YC-14 and YC-15 aircraft that pushed the boundaries of lift and takeoff efficiency. The YC-15, in particular, became the blueprint for the legendary C-17 Globemaster, boasting a takeoff distance of just 950 meters and a lift coefficient of 7, performance that was revolutionary for its time. Since then, STOL technology has seen only incremental gains. At LAT Aerospace, we aim to break that stagnation and redefine regional air travel for India, bringing bold engineering solutions to the forefront.

The LAT Vision for Next-Gen STOL

Now, imagine an aircraft that can take off from land parcels as small as a parking lot, without relying on tilt rotors, tilt wings, or other mechanically complex solutions. Our approach is simple yet radical, a powered-lift fixed wing architecture where integrated propulsors supercharge lift, maximizing takeoff performance while maintaining efficient cruise. This isn't just an incremental improvement; it's a paradigm shift. We're building the foundation for a new generation of civil aviation in India, faster, closer, and more accessible than ever before.

We invite you to take on this challenge, push the limits of aerodynamics, propulsion, and systems design to make STOL aircraft that aren't just theoretical marvels, but real enablers of a connected India. Your innovation could be the lift-off to the future of air travel.

Problem Statement Description

"Ever tried. Ever failed. No matter. Try again. Fail again. Fail better." – Samuel Beckett

When we decided to start LAT Aerospace, we often used to say to ourselves that if we decide to solve a problem statement, let that be the most difficult one.

In that spirit, this problem is simple - Design a fixed wing, which is combined with a thrust producing device to generate very high coefficients of lift.

You must be wondering what you need to do in order to establish your solutions. We have some points in mind for that:

- You must validate your design through rigorous numerical analysis such as CFD and/or experimental wind tunnel testing. Remember wind tunnels are the gold standard for the aerospace industry.
- You should also characterise the thrust device you intend to use in a CFD so that you are sure of the thrust performances you can achieve.

- In an aircraft the wing has a major impact on the aerodynamic center of the whole system. Identify your aerodynamic center and think how it is different from a conventional wing and what would be the impact of that.
- Remember with such high lift capabilities structural integrity of the wing might be an immense challenge. Don't forget about it. We can't use all the aircraft's weight budget in the wing.

The problem demands a multidisciplinary approach between optimization of numerical methods, design of thrust device alongside development of controls framework to test and validate the models. The problem is also open to explore use of ML/AI to improve speed, precision and overall workflow.

Specifications/ Requirements

Design Targets

- Lift coefficient target = 6.5, Envelope: 6-8, Bonus for achieving 8+
- Lift - to - Drag ratio target > 5 with flaps
- Lift - to - Drag ratio target > 20 without flaps
- Minimum Lift Target = 15kg @20 m/s freestream velocity
- Minimum freestream velocity with flaps deployed [Takeoff mode] = 20 m/s
- Minimum freestream velocity with flaps retracted [Cruise mode] = 80 m/s
- Thrust Envelope: $0.5 < T/W < 0.65$ { $W = 15$ kg}

**T/W: Thrust to Weight Ratio*

Constraints

- Powered lift must be generated from the thrust plant, no other power system is allowed.
- Tilt-Wing/Tilt-Rotor Designs are NOT allowed.
- VTOL Configurations are NOT allowed.
- *BEING INNOVATIVE IS MANDATORY, THINK OUT OF THE BOX AND DON'T START BUILDING THE FIRST THING GPT HAS TO OFFER.*

Studies

- Study on wing parameter tradeoffs for aspect ratio, flap deflection, etc.
- Rigorous CFD along with a mesh convergence study AND/OR wind tunnel testing [Either works]
- Study on thrust device feasibility between propeller, open fan/rotor and EDFs. [Turbojets or rockets will be too much so let's not add them.] [We would love it if you can come up with something totally different and we will be sure to reward such a solution, but again nothing unreasonable in terms of power consumption]

Deliverables

- Interim Evaluation: Midterm Report
- Final Evaluation: Endterm Report + Presentation

We do not wish to enforce a structure within the reports and presentations however would like to see certain topics covered. Those topics are:

Midterm:

- Theoretical math models predicting the wing and thrust device performance.
- Initial numerical analysis of the wing and thrust plant agreeing with the math models

Endterm:

- Refined theoretical math models predicting the wing and thrust device performance.
- Rigorous numerical analysis of the wing and thrust plant agreeing with the math models with good accuracy
- Validation studies with the help of wind tunnels. [Optional but highly encouraged]

Evaluation Parameters & Judging Criteria

The evaluation criteria will be broken down into the following categories:

Category	Weightage
Mid Term	30%
End Term	50%
Presentation	20%

Since we are in the business of aerospace, we will deploy a decision matrix for each design submission across evaluations. Below is an **EXAMPLE** of a part of a decision matrix:

Gain in ref values	30%	20%	10%	0%	-10%	-20%	-30%	Reference Score	Reference Values
Score Gain for CL	1.8	1.5	1.2	1	0.8	0.5	0.2	15	6.5
Score Gain for T/W	0.2	0.6	0.85	1	1.15	1.5	2	10	0.7

The entire decision matrix shall not be shared with the participants for ensuring that the judging criteria does not instill any biases in the solution process of the teams.

All the codes, data and metadata including all the case files, .dat files, and other relevant engineering files must be included in the submission

Submissions should be made in a single .zip file. A list of necessary files with nomenclature shall be provided for both midterm and endterm evaluation. Any additional files submitted should be made with valid justification in order to be considered. Failure to provide valid justifications pertaining to additional files shall attract penalties.

Resource

- Ansys free student license: <https://www.ansys.com/en-in/academic/students>
- OpenFOAM open source CFD: <https://www.openfoam.com/>

**More resources pertaining to STOL research will be provided*