

Executive Summary

GyroTech is developing Gyrotron, a fully 3D-printed remote-controlled autogyro for the UTA 3D Printed Aircraft Competition (3DPAC). Unlike a traditional fixed-wing aircraft, Gyrotron generates lift through an unpowered, free-spinning rotor while a rear propeller provides thrust. The project focuses on creating a lightweight, structurally sound design within additive manufacturing constraints. Through iterative prototyping, analysis, and testing, the team has identified key challenges affecting takeoff and is continuing to refine the design to improve lift, reduce weight, and demonstrate the feasibility of 3D-printed rotary-wing aircraft.



Background

Autogyros are rotorcraft that generate lift through an unpowered, free spinning rotor while a motor driven propeller provides forward thrust. Compared to traditional fixed wing aircraft, they offer a different flight configuration that can improve low speed stability and support shorter takeoff distances. This project was developed within the design and manufacturing constraints of the UTA 3D Printed Aircraft Competition, where aircraft must be 3D printed, operate within a defined flight volume, and continue flying after only a short powered launch period. Within these constraints, the autogyro is intended to demonstrate the following:

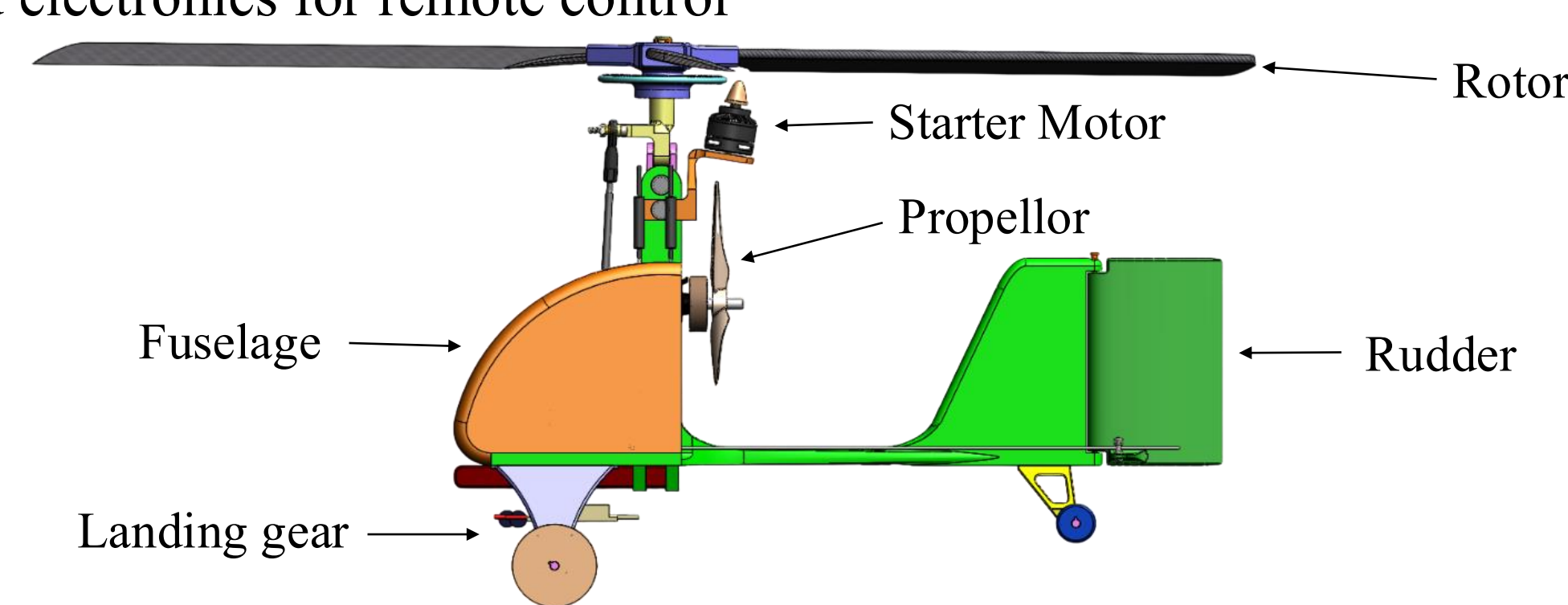
- Lift generation through an unpowered rotor system
- Forward propulsion using a motor driven propeller
- Improved low speed stability during flight
- Capability for short takeoff performance
- Compliance with current 3DPAC manufacturing and flight requirements
- Potential to support autogyros as a future competition category



Experimental Setup

The design followed a structured process that included concept selection, CAD modeling, and 3D printing of the main components. Key parts like the fuselage, rotor, propulsion system, and landing gear were designed and integrated together. Several design and material changes were made to reduce weight and improve performance. The landing gear was updated from skids to wheels to reduce friction and improve takeoff. Electrical components such as the motor, battery, and control system were also integrated to allow remote-controlled testing.

- Structured process: concept → CAD → 3D printing
- Main parts: fuselage, rotor, propulsion, landing gear
- Improved design and used ASA aero to reduce weight and increase performance
- Wheels replaced skids for better takeoff
- Integrated electronics for remote control

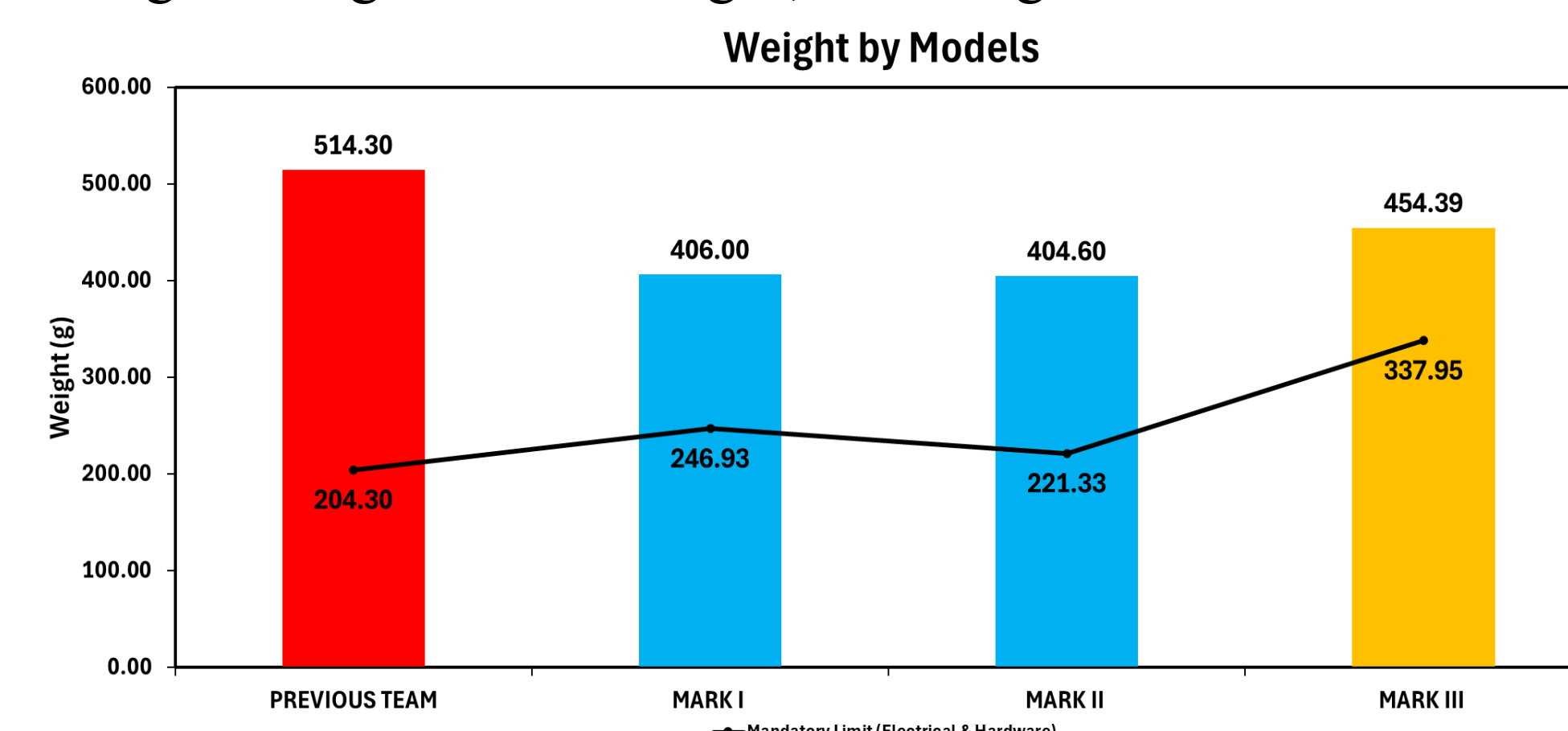


Experimental Test Plan

Flight testing was conducted to evaluate takeoff performance, stability, and control response under real-world conditions. Tests were done on surfaces similar to competition environments to better understand how the system performs during actual operation. Data from each test was used to improve the design, with a focus on reducing weight and increasing lift efficiency.

Weight was also tracked across different designs to ensure changes did not negatively affect performance, with a reference line showing the weight of required electrical and hardware components.

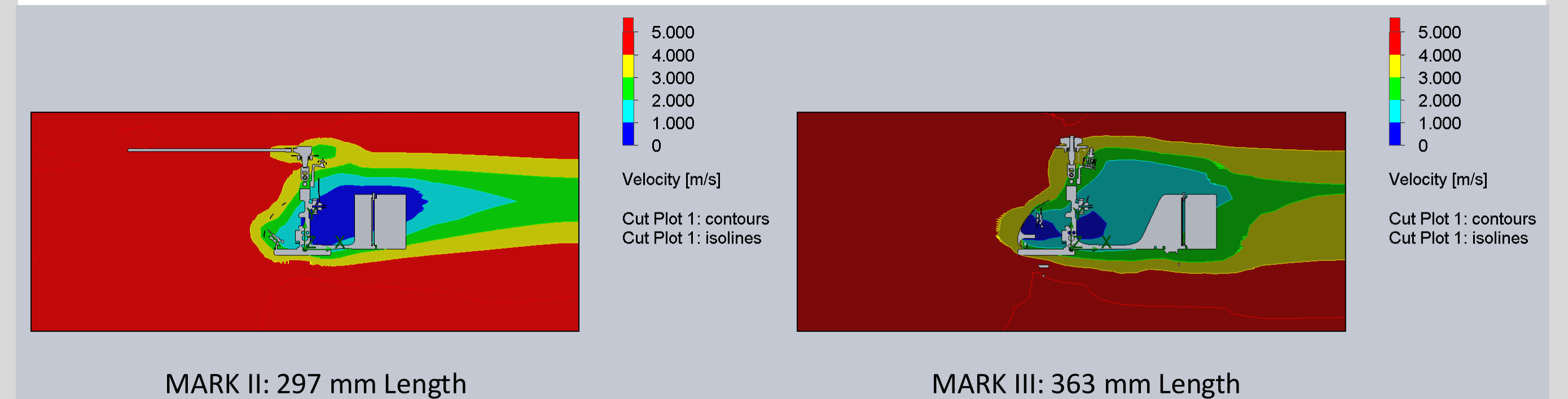
- Tested takeoff, stability, and control response
- Used real-world surfaces similar to competition conditions
- Collected data on:
 - Takeoff distance and acceleration
 - Rotor engagement and lift
 - Stability during ground roll and early flight
 - Structural performance under load
- Used results to improve design (reduce weight, increase lift)
- Tracked weight changes across designs, including electrical/hardware baseline



Experimental Results

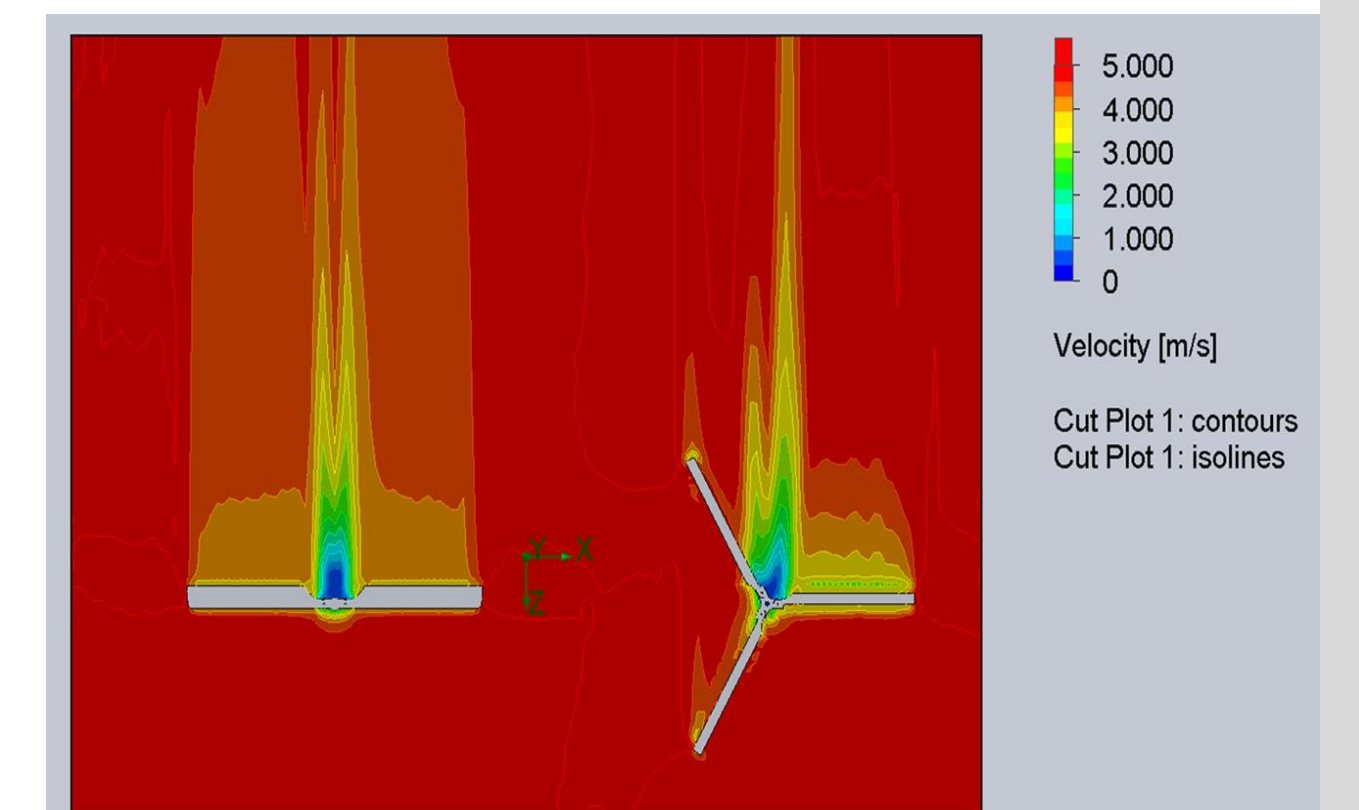
The previous iteration of the autogyro was evaluated using flow analysis to examine its aerodynamic behavior and identify areas of poor airflow. Based on the results of that initial simulation, design changes were made to improve airflow around the aircraft and increase overall aerodynamic efficiency. The second image represents the updated configuration, which shows smoother and more controlled airflow compared to the earlier design, indicating improved aerodynamic performance. The new design has the following improvements:

- Smoother and more consistent airflow, showing better overall aerodynamic behavior
- Reduced low velocity regions around the body and tail, which helps decrease drag
- Improved rudder placement, allowing the rudder to sit in moving airflow instead of a dead zone
- Higher dynamic pressure at the rudder, which helps generate greater side force
- Better yaw authority, which can improve directional control and turning response



A simulation was conducted to compare 2 blade and 3-blade rotor configurations. The 3-blade design showed better overall aerodynamic performance, including:

- More continuous airflow interaction
- More balanced loading across the rotor
- Improved lift consistency
- Better overall stability



Conclusions

The Gyrotron project successfully developed and tested a 3D-printed autogyro within the constraints of the 3DPAC framework. The team will attend the competition to present and demonstrate the autogyro platform, providing performance data and design insights. This work establishes a foundation for evaluating autogyros within the competition and supports the potential development of a new category for rotary-wing aircraft in future events.



References

1. Liu, S., and Bobrow, J. E., "An Analysis of a Pneumatic Servo System and Its Application to a Computer-Controlled Robot," *ASME Journal of Dynamic Systems, Measurement, and Control*, 1988, Vol 110 pp 228-235.