

# MUREP HV



## Computational Fluid Dynamics Simulation of APC 11" by 4.7" Drone Propeller

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### Overview

The MUREP HV Research Experience focuses on the development and optimization of lightweight and durable materials for future spacecraft production. My work focused on computational fluid dynamics simulations of an injection-molded APC 11 by 4.7 in. drone propeller. The thrust of the propeller was found at 1000 - 20000 RPM and validated alongside a physical experimental setup. Ansys Fluent is used for meshing and solving; Ansys CFD-Post is used for post-processing.

This research is very useful for potential NASA projects where a spacecraft may use propellers upon reentry. Alternatively, this research could segue into design and simulation of Martian propellers.

### Capacity at Tuskegee

My involvement in the computational side of the research directly exposed students of the University to the rather high-level field of computational mechanics.

I was able to directly help another group of aerospace engineering students with a simulation of a scale aircraft in SimScale.

I was also able to write tutorial materials for setting up fluid simulations in Ansys for future students.

### Personal Impact

Due to the very self-guided nature of this research, my experience in computational simulation setup was greatly improved. My soft skills of technical communication were improved as well.

The advanced nature of this project greatly elevated my graduate school and directly affected my admission.

### Connections to NASA Missions

My research helps to contribute to the simulation of propellers and other related components made with lightweight components. Given the rise of additive manufacturing, precision 3D methods will continue to improve. Thus, propellers can be cheaply and quickly made using these new methods. Along with experimental results, computational models can help to give a full view on the rotational forces acting on the propeller. Furthermore, the thrust and drag coefficients can be determined from these simulations.

Finally, from data gathered from physical and virtual experiments, new propeller designs can be quickly and reliably prototyped virtually to isolate any problems before the final physical implementation.

## Computational Setup and Results

### Overview

The working mathematical model (Fig. 1) is composed of two domains; the air medium (grey outer volume) and the propeller rotating region (yellow inner volume). The rotating region was set to rotate at speeds from 1000 to 20000 RPM in 1000 RPM increments.

Turbulence model used is k-epsilon; number of elements: 254,175

Experimental data was provided by lab member Camille White; published data from Tyto Robotics Database.

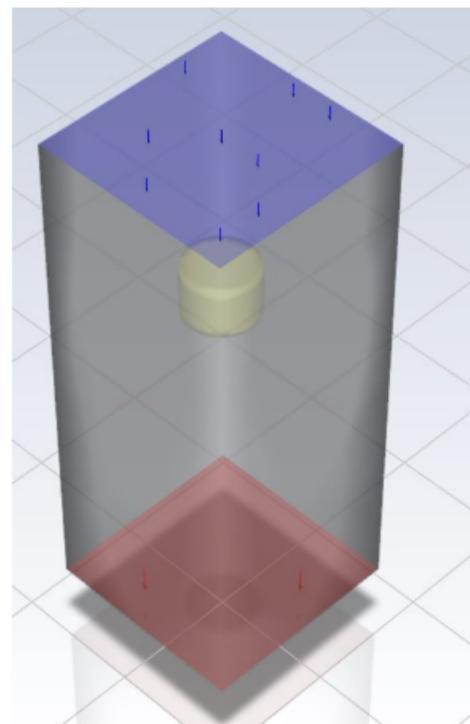


Fig.1 - Extended Domain Setup

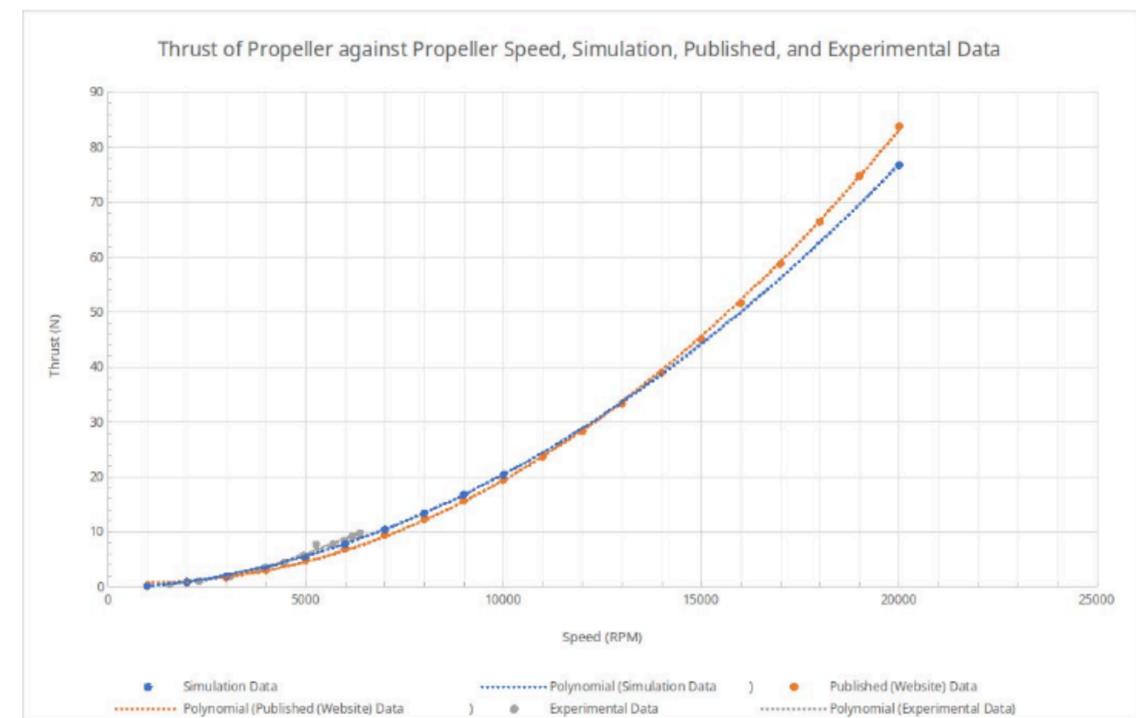


Fig. 2 - Simulation, Experimental, and Published Data

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