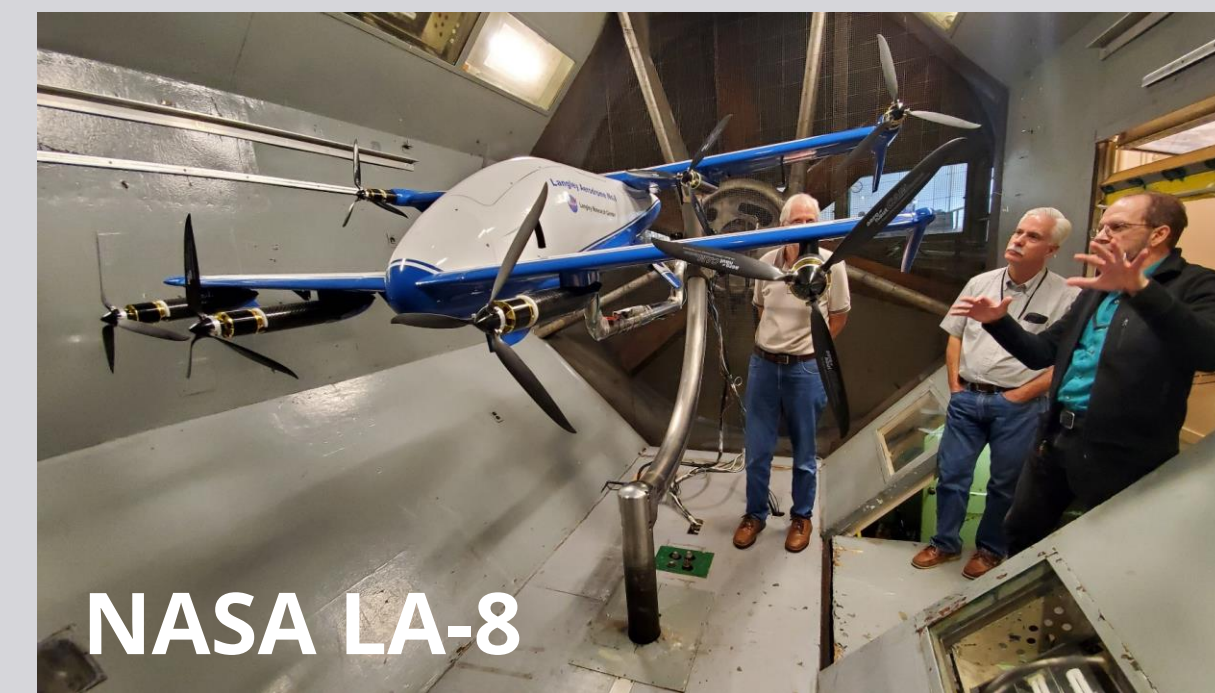# IMPROVED PERFORMANCE FOR DRONE AND UAM PROPELLERS AT LOW RPM FOR NOISE REDUCTION

WHAT WE LEARNED

1 Rotors for new Urban Air Mobility vehicles and small delivery drones are noisy.

NASA LA-8

2 Increasing blade count on propellers while lowering RPM has historically been used to decrease noise on aircraft.

3 Lowering RPM requires small propellers to operate at low Reynolds Number. Performance is reduced – forced transition by using trips helps mitigate losses and lower noise.

BACKGROUND

ODU has a performance test capability for small propellers in the Low-Speed Wind Tunnel. Recent work has been in support of NASA's LA-8 Urban Air Mobility concept vehicle. Three, four, Five and Six blade folding propellers were characterized – high blade count is used for low-noise applications. A performance loss due to low RPM was identified in studies.

OBJECTIVES

1) Referencing the work of Leslie*, investigate the efficacy for adding trips (thin tape strips) to the propeller blade to improve blade lift by eliminating a laminar separation bubble

2) Demonstrate the potential of this approach by showing efficiency may be improved with the trips – start with a 2-blade propeller

METHODS

1) Perform a trip sensitivity experiment where the location and size of trip was varied on the blade – compare performance to untripped blade over small range of velocity and RPM
2) With best solution, fully characterize the treated propeller versus the untreated in a statistically rigorous comparison test

BACKGROUND

The propeller test stand at the ODU Low-Speed Wind tunnel measures three forces and three torques produced by the propeller and may be inclined to the flow direction
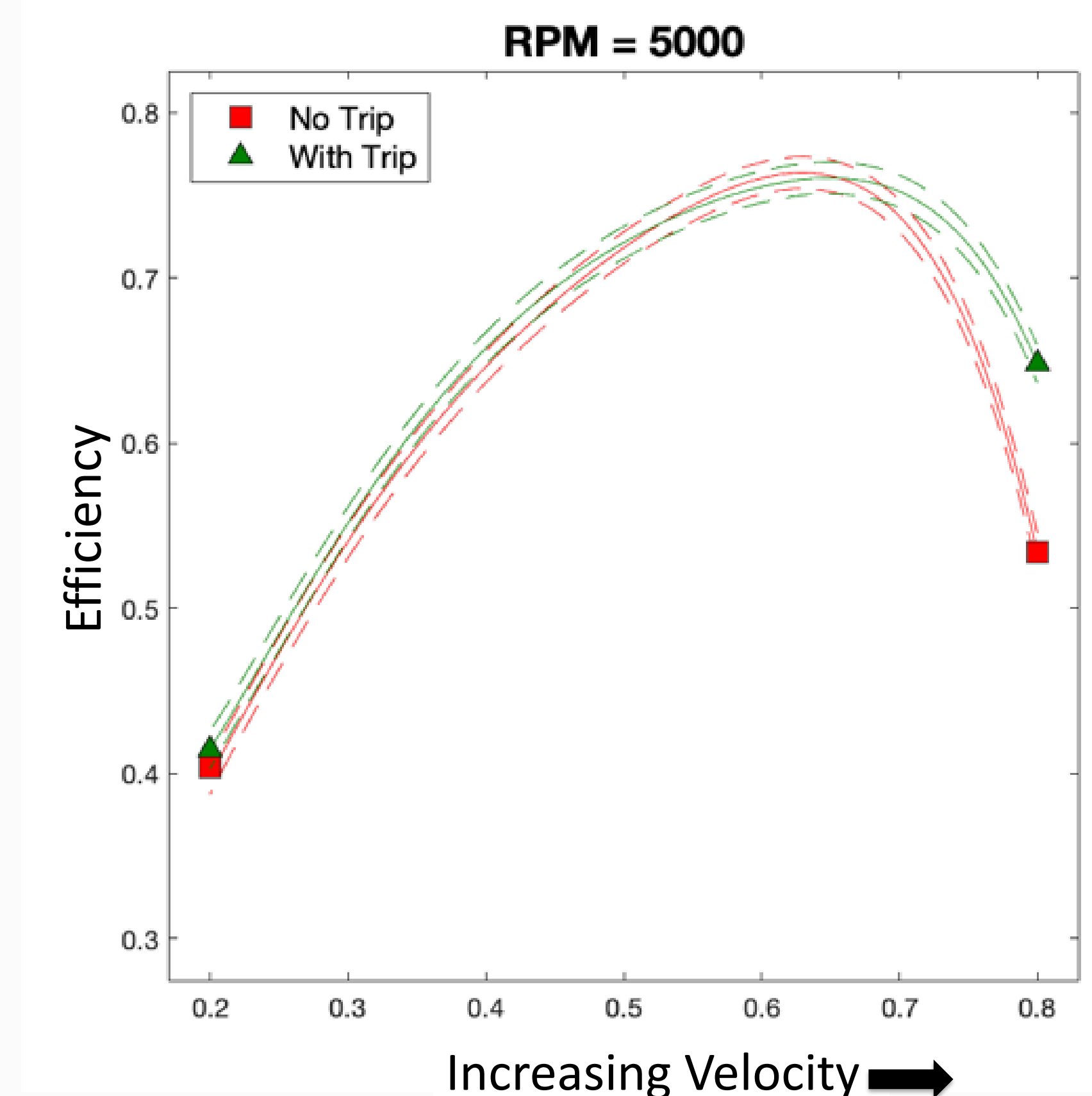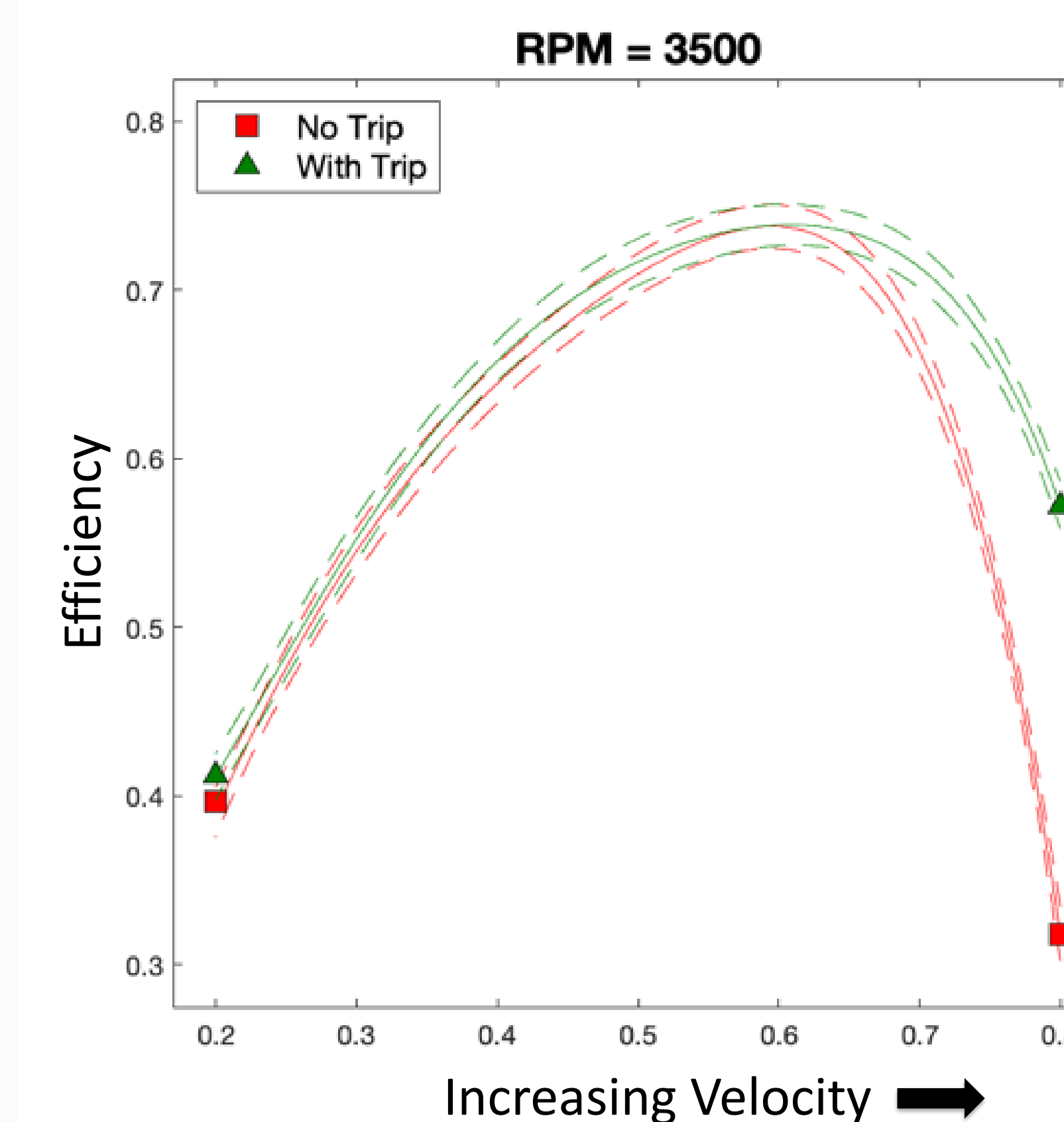
- 6-Axis load cell measurements
- RPM monitoring by retroreflective laser diode
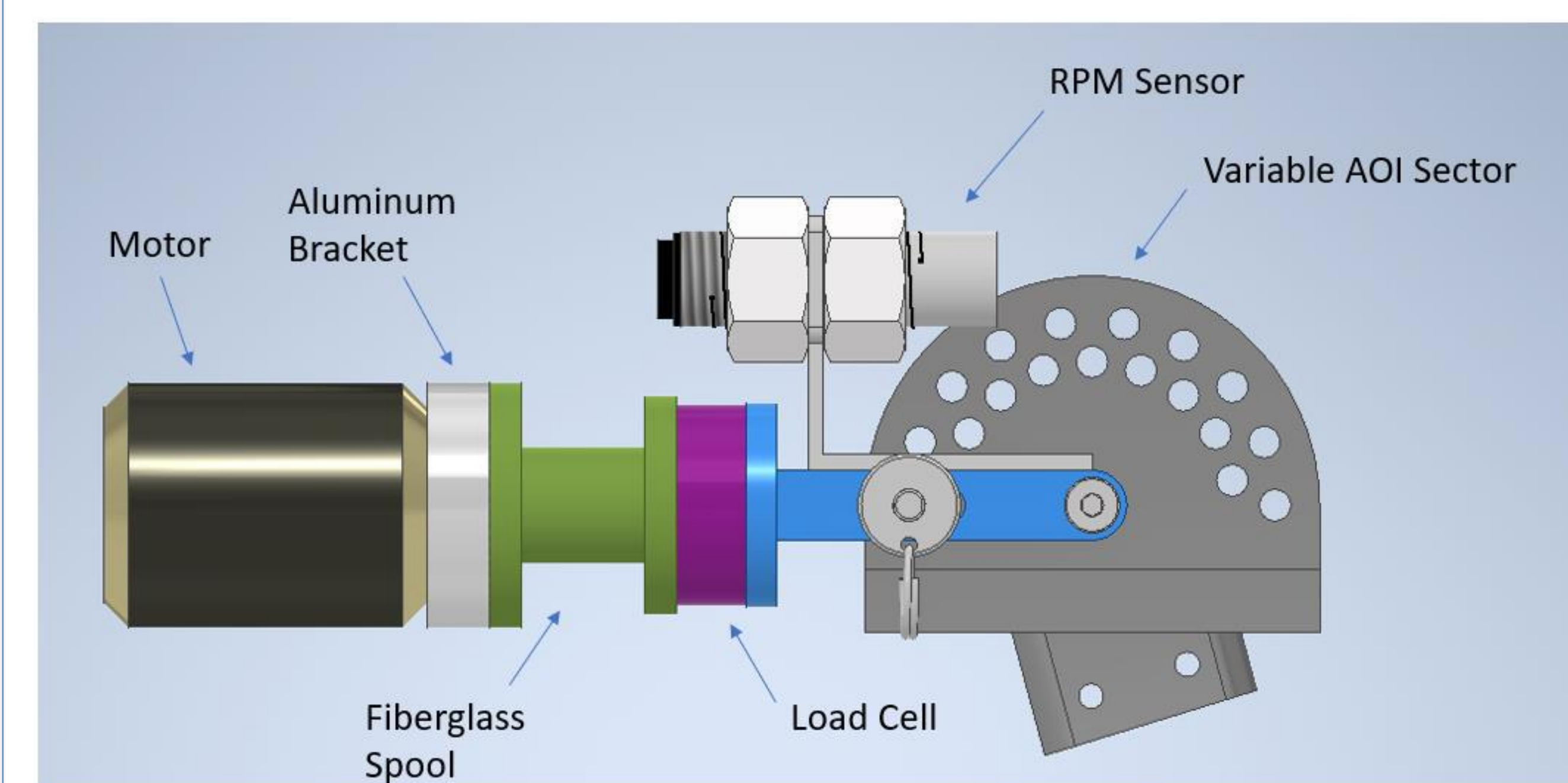- Statistical Design of Experiments used to generate test matrices and perform analysis

RESULTS

Propeller Test Stand ODU Low-Speed Wind Tunnel

Efficiency Increase Due to Treated Propeller Blade

RPM = 3500

- No Trip
- With Trip

Efficiency

Increasing Velocity →

RPM = 5000

- No Trip
- With Trip

Efficiency

Increasing Velocity →

Instrument Details

Motor — Aluminum Bracket — RPM Sensor — Variable AOI Sector — Fiberglass Spool — Load Cell

Propeller Treated with Trip