Johann Kailey-Steiner

Rocket Design Part 3: Exploring How Vortex Generators Affect Boundary Layer Airflow

Based on previous experiments, I wanted to determine the speed range that vortex generators (VGs) reduce drag on a model rocket and why they work at those speeds. I wanted to build a mechanism to extend vortex generators at that speed range. I predicted that at speeds up to approximately 50 mph, the VGs would reduce drag because at slow speeds, they create turbulent airflow to prevent laminar boundary layer airflow separation from the rocket's surface.

I built a rocket to test my hypothesis in a wind tunnel. I tested a control rocket without VGs and tested three VG positions at a range of speeds. The results showed that the VGs added drag at every position and speed, which conflicted with last year's launch data. I decided to test the VGs with the rocket at an angle at low speeds as it might be during launch after engine cutoff. I tested the rocket with and without VGs at 0°, 3°, and 6° angles. The data showed that the drag coefficient decreased at a 6° angle with VGs directly below the nose cone - the position at which the air separates from the rocket's surface.

I built a mechanism to extend the VGs during deceleration after engine cutoff. A transmitter signals a servo to push the VGs through slits in the rocket body. In conclusion, I found that vortex generators reduce drag after engine cutoff when the rocket is yawing and the relative wind is not parallel to the rocket's motion.