Ad Astra! Testing Rocket Fin Configurations and Their Effect on Flight Stability

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Experimental rocketry is the field of engineering that studies scale rocket designs to optimize flight performance. Simulation engineering is an important part of this process because it saves time, effort, cost, and materials. It allows the researcher to create prototypes and perfect designs before creating actual models. The purpose of this study was to test the effect of rocket fin shapes on flight stability. Five fin shapes were tested: Right Triangle (Control), Isosceles, Scalene, Rectangle, and Double Triangle. Model rockets were designed, built, and tested in 15 launches under adult supervision. Using the same design configurations and weather conditions, virtual rockets were created and tested in 125 simulated launches. The Dependent Variables were rocket Velocity, Acceleration, and Apogee. The researcher hypothesized that different fin shapes would result in different measurements. T-tests compared the means for each group and found the following significant differences ($p<.05$). Results from model rocket launches showed that compared to Control Apogee (362.33m), Double Triangle (331.33m) was lower. Results from the simulated launches showed that compared to Control Velocity (122.25m/s), Scalene (122.79m/s) was faster. Compared to Control Acceleration (269.27m/s2), Scalene (271.29m/s2) was greater. Compared to Control Apogee (389.25m), Scalene (386.18m) was lower and Double Triangle (397.73m) was higher. Differences between fin shapes could be explained by their effect on drag, weight, lift, and thrust (Bernoulli principle). The researcher hopes to continue testing fin parameters to help advance space technology.