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Author: Mr. Harry Byers
The Ohio State University College of Engineering, United States

Mr. Thomas Margevich
The Ohio State University College of Engineering, United States
Mr. Conner Partin
The Ohio State University College of Engineering, United States
Dr. John M. Horack
The Ohio State University College of Engineering, United States
Dr. Elizabeth Newton
The Ohio State University, United States

INTEGRATION OF A REACTION WHEEL SYSTEM INTO A SOUNDING ROCKET TO INCREASE STABILITY AND PERFORMANCE

Abstract

A stable, vertical attitude is integral to a sounding rocket's performance, however these vehicles are prone to a phenomenon called weathercocking, or reorientation into the wind, when coming off their launch rails. Ideally, weathercocking would be minimized by the stability of the vehicle, but that is not always the case. Currently, common practice to prevent weathercocking is to ensure that the vehicle has adequate momentum near the end of the launch rail, or to impart spin stabilization to the vehicle through a rolling motion. Another problem that arises with this method of spin stabilization is the possibility of spin destabilization, where the excess rolling motion causes the vehicle to destabilize. To combat both of these problems, a reaction wheel system will be added to a test vehicle to increase its angular momentum and provide the capability to alter the vehicle's roll rate. To investigate the efficacy of such a system, flight profile data will be collected from two geometrically similar sounding rockets launched with and without the added system. Using the data from the flight without the system installed, a dynamic model for the vehicle will be created and be used to compare the data from the flight with the system installed. With the model, flight profile characteristics such as flight path and roll rate can be directly compared between the two real flights, allowing the performance of the reaction wheel system to be determined. The expected result of the comparison is a flight profile attitude closer to vertical and roll rates closer to a desired rate. The value of the reaction wheel system performing as expected is the ability to increase the reliability and performance of a sounding rocket without altering the aerodynamic profile of the vehicle itself.