Paper ID: 50310
student

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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# AUTOPILOT DESIGN OF A LIFTING BODY GLIDER LAUNCHED FROM A HIGH ALTITUDE BALLOON

**Abstract**

A controlled descent lifting body glider to be used as a recovery method for high altitude ballooning payloads has been developed at the Department of Space Studies, University of North Dakota. Current recovery techniques require crew members to monitor GPS signals until the payload, sometimes drifting hundreds of miles, can be recovered. A gliding descent vehicle can effectively reduce the distance for payload recovery. The vehicle is designed to ascend to a maximum altitude of 30 km, at which point the glider will release and be controlled towards the ground station. However, the low air density at 30 km poses unique challenges to the controllability of the glider. Adding to the environmental issues of gliding flight at this altitude, there is no line of sight with the vehicle making it more difficult to pilot from the ground. This paper will detail the design of a proposed autopilot system that will attempt to stabilize the glider until it becomes sufficiently aerodynamic.

A computational model has been developed in MATLAB/Simulink to model the aerodynamic properties of the lifting body glider. Initially developed using the Vortex Lattice Method, preliminary low altitude flight tests have been conducted to verify the computational results. The computational model includes a flight simulation module to simulate test flights and understand the dynamic response of the vehicle. Within the computational model, the MATLAB/Simulink interface provides a platform to conduct dynamic stability tests for various configurations of the glider and anticipated flight envelopes.

The autopilot system will be developed to assist in the transition from vertical to horizontal flight after release from the balloon. Some research suggests the glider may continue to travel upwards due to the inertia from the balloon. As the glider begins to descend, it is possible that a nose-up pitching moment may occur due to the reverse airflow. A drogue chute could be used to pull the tail upwards and prevent a flat spin. A series of simulations were created to determine the size of the drogue chute needed, how it will be deployed, and when it will be released. The point of drogue release will be determined via pitot probe and IMU data, at which the autopilot will determine the glider sufficiently oriented and moving with enough velocity to respond to radio control. It is expected the simulation module can effectively estimate the dynamic response of the vehicle to prepare for high altitude flight testing.