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# DEVELOPMENT OF A COMPUTATIONAL LIFTING BODY GLIDER MODEL FOR FLIGHT SIMULATION STUDIES

**Abstract**

A lifting body scaled model to be used as a recovery method for high altitude ballooning payloads is under development at the University of North Dakota. Current recovery techniques consist of monitoring and chasing the payload signal until it can be recovered. It is expected that a lifting body glider can reduce the distance for payload recovery and in some cases effectively return the payload back to the Ground Station. It is likely that various high altitude ballooning experiments will be conducted which will require different payloads. Thus, the model must be developed such that the operator can simulate different flight paths and optimize the carrying capacity of the glider. This paper will detail the computational model and methodology used to create a flight simulation module for the proposed glider.

A preliminary subsonic aerodynamic model has been developed using MATLAB and the Vortex Lattice Method (VLM). Traditional evaluation techniques typical for calculation of the aerodynamic coefficients are not sufficient to predict the flight performance of the glider due to its fuselage lift contribution. Thus, two-dimensional panel methods along with the traditional three-dimensional VLM are used in conjunction to produce adequate results. The computational method will be used to calculate the longitudinal and directional stability coefficients and derivatives of the glider. The aerodynamic coefficients will be compiled into functions which will be used in the MATLAB Aerospace Module and Simulink Blockset to create a robust model for simulation studies.

The MATLAB Aerospace Module and Simulink Blockset requires the user submit aerodynamic flight data, in this case the computed aerodynamic functions, to be used to calculate look-up tables. The simulation model will include the equations of motion, environmental models, and calculation of the aerodynamic forces, coefficients, and moments. The typical airframe components will be modeled with the following subsystems: six-degree-of-freedom (Euler Angles), environmental models, alpha beta Mach, aerodynamic coefficients, and forces and moments. The resulting simulation will allow the user to analyze and trim the glider for various flight configurations dependent on the location of the center of mass and the anticipated release height. An advantage of the MATLAB Aerospace module is the ability to visualize an aircraft using the Simulink 3D Animation and Aerospace Blockset Flight Instrument library blocks. For high altitude ballooning students unfamiliar with computational aerodynamics, the simulation model will help the student to visualize how difficult or easy the glider would be to control under the current configuration.