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DESIGN OF A MODULAR HIGH-ALTITUDE BALLOON GONDOLA WITH A REACTION WHEEL ATTITUDE CONTROL SYSTEM

Abstract

High Altitude Balloon launches by groups around the world design their gondolas by careful optimization of weight and material selection. However, there are groups who want to launch their payloads in high altitudes, but do not necessarily have the resources to allocate for the design manufacturing or testing of the carrying gondola vessel. In addition, some payloads, such as optical instruments or bio-payloads, require directional control of the gondola, the ability to change the gondola's orientation towards a specific inertial or relative reference. The purpose of this paper is to demonstrate how the Space Concordia High-Altitude Balloon team has designed, manufactured and tested a modular high altitude balloon gondola that includes a reaction wheel, allowing directional control of the payload. The gondola is a reusable vessel made out of simple parts using composites and plastics, some of which are 3D printed to drastically reduce the gondola's weight and cost without compromising durability. The design is modular so that its volume can be expanded and allow for more scientific payloads to be included. The attitude control algorithm is based on a Proportional Integral Derivative (PID) scheme, including an open source Kalman filter for the Inertial Sensor Unit (IMU) attitude estimation. The team has performed impact and static tests with plans to perform the first flight in subsequent months. Data and telemetry recorded during

the flight is post analyzed and processed for improved control and stability, as well as for other teams to adapt such a system in the future.