Implementing CubeSat Avionics Components to Full-Scale Capsule Return Missions.

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Brief Presenter Biography: Zachary Hughes graduated from San José State University with a bachelor of science in aerospace engineering and is currently pursuing his master's degree. While at San José State University Zachary was an intern at NASA Ames Research Center. While at NASA, Zachary worked alongside the TechEdSat team. During his internship, Zachary was exposed to CubeSat avionics components and realized the wide variety of their applications.

Introduction: Returning samples from Low Earth Orbit (LEO) is no simple task. Whether the samples are scientific experiments or surveillance footage, engineers must overcome many challenges to achieve mission success. In August of 1960 the first payload recovered from LEO, the Corona capsule, carried "more photographic coverage of the Soviet Union than all previous U-2 missions" [2]. The Corona program proved that returning surveillance footage from LEO is possible, the program is still referenced today when designing new sample return missions. Although there are many crucial subsystems that make up a sample return capsule, the avionics subsystem demands the most attention.

This paper will discuss how current CubeSat avionics components can be applied to large sample return missions. One advantage of using CubeSat avionics components is that they can fit into a 1.5 U (10x10x15 cm) compartment, leaving more room for the payload. This paper is broken down as follows. First, the reader is introduced to the history of sample return projects. The major design strengths of previous projects are analyzed and applied to the current capsule design. Next, the typical trajectory of a capsule is presented along with mission requirements and operations. During the re-entry phase, the avionics subsystem is responsible for commanding the deployment of the parachute, back shell, and the heatshield. Next, the power subsystem is discussed in detail including a trade study on batteries and voltage regulators. Next, the interface between the Ground Support Equipment (GSE) and the avionics components is discussed. It is important that the capsule is able to provide avionics system state of health to ensure proper functionality before the capsule is launched. Next, an in-depth analysis of current TechEdSat avionics components, with proven flight history, are presented [2]. The various avionics components including the radios, GPS, IMU, temperature sensors, altitude sensors, and ejectors are discussed. The application of current avionics components to a sample return projects are analyzed. After, the wiring diagram is presented along with a discussion of the design. Next, a summary of how the avionics components are tested and validated is provided. Finally, this article will present current sample return missions TechEdSat avionics components are being applied to.

CubeSat Avionics can be applied to almost all sample return missions due to their compact configuration and proven space flight heritage. The TechEdSat team is currently making great progress in returning samples from the International Space Station (ISS) and is excited to present how their avionics components can be applied to a full-scale sample return mission.

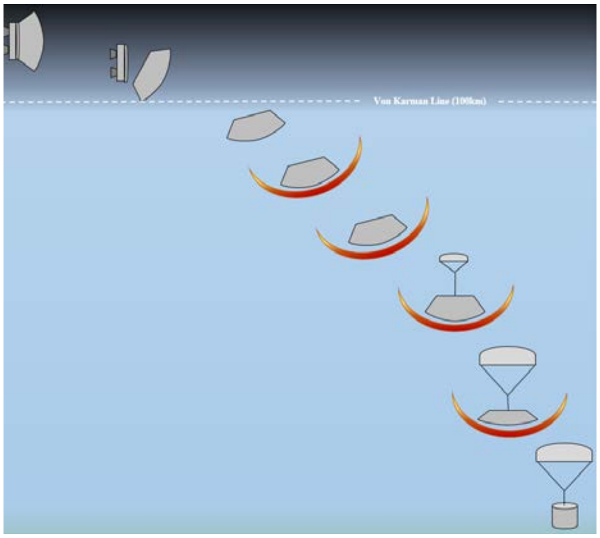

Figure 1: Mission Operation Sequence

References:

[1] NASA Ames Research Center, "TechEdSat-N Procedures".

[2] J. K. McDonald, "Corona: Americas First Satellite Program".

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