

Technical Description - Old Dominion University (Aeternitas)

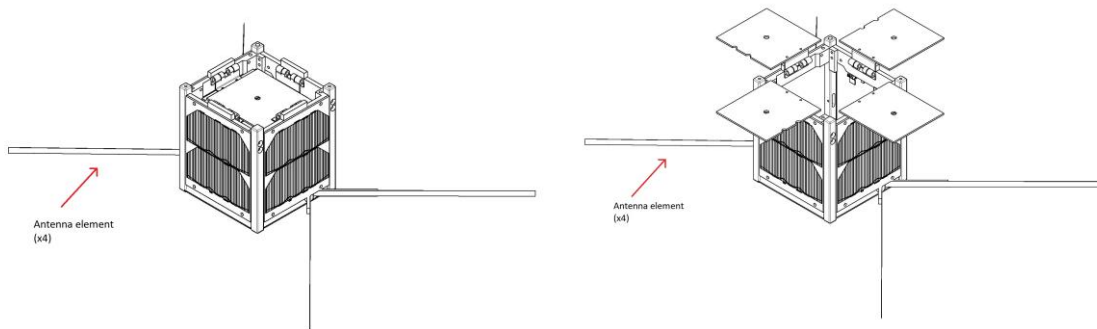
The Aeternitas mission goals are to:

1. Provide a hands-on, student-led flight project experience for undergraduate students by designing, developing, integrating, testing and flying a 1U CubeSat.
2. Obtain measurements of the orbital decay, before and after deployment of drag brake fins, to develop a database of atmospheric drag and the variability of atmospheric properties.

The satellite will launch November 8, 2018, on an Orbital ATK Antares II Cygnus ISS resupply mission. It will be deployed from the International Space Station via the NanoRacks CubeSat Deployer January 8, 2019. It will be inserted into a 400 km circular orbit, at an inclination of 51.6 degrees. The mission plan is that after about 2 months in orbit, the drag brakes will be deployed. It is estimated that 360 days after drag brake deploy, the satellite will deorbit. If the drag brakes are not deployed, deorbiting will occur about 2 years after deployment. See mission ODAR for details.

The spacecraft, shown in Figure 1 below, is a 1U CubeSat with nominal dimensions of 105 mm X 105 mm X 113 mm, massing about 1.3 kg.

Figure 1: ODU Satellite Overview



Aeternitas (ODU) - Showing deployed drag brake on right

Description of Subsystems

Communications Subsystem:

For communication with ground stations the satellite uses an AstroDev Li-2 Lithium radio using a nominal 2 W transmit power operating in the UHF frequency range. The data will be packaged in the AX.25 format and will use the GMSK modulation scheme. Uplink commands will be encrypted, and telemetry downlinks will be unencrypted. Telemetry downlinking is initiated based on receipt of a valid uplink command from the ground station.

Payload Subsystem:

The payload on the satellite, for investigating atmospheric density as it affects orbit decay, consists of a microelectromechanical systems (MEMS) three-axis magnetometer and MEMS three-axis gyroscope in an inertial measurement unit and external sun sensors to determine the spacecraft's attitude and a GPS receiver to determine spacecraft's position. In addition, Aeternitas has a deployable drag brake to increase the surface area of the satellite perpendicular to the direction of travel, and accelerate the rate of orbit decay by increasing drag. A burn-wire system will release the hinged drag brake petals.

Software and Data Handling Subsystem:

The satellite records magnetometer, gyroscope, sun sensor, and GPS position versus time, and will store that data on SD cards for downlinking. Aeternitas will use Atmel SAM4E16CB-AN microcontrollers, one for interfacing with the radio and one for flight operations, and the μ C/OS-III RTOS (real time operating system).

Attitude Determination and Control Subsystem:

The satellite will use passive magnetic attitude control to align with earth's magnetic field, using a combination of permanent magnets and hysteresis material. Aeternitas can also implement active pointing using magnetorquers. The satellite will use a combination of magnetometer, gyroscope, and sun sensor data to determine orientation.

Power Subsystem:

Aeternitas uses a GomSpace electrical power system (EPS) and integrated 20 Wh battery, with GomSpace solar panels.

Structures Subsystem:

Aeternitas' chassis is a custom structure of aluminum 6061 (anodized), with steel screws.