OWLSAT Satellite Technical Description

The overall goal of the OWLSAT mission is to measure the extreme ultraviolet (EUV) radiation and create a more robust orbital decay model using a deep neural network with the inputs as EUV radiation, position, velocity, and orientation data.

The satellite will be launched as a secondary payload aboard a Firefly alpha, from Vandenberg AFB, No Earlier Than April 1st, 2022. It will be inserted into an orbit at 565 km apogee and 565 km perigee, on an inclination from the equator of 97.6 degrees. Transmission will begin within 24 hours after deployment and the science mission will conclude 2 years after the launch. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs 10 years after launch. See the Orbital Debris Assessment Report for details.

The spacecraft is a single unit with the dimensions of one stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an overall dimension of 10 cm X 10 cm X 11 cm not including the antenna). The total mass is about 1.39 Kg.

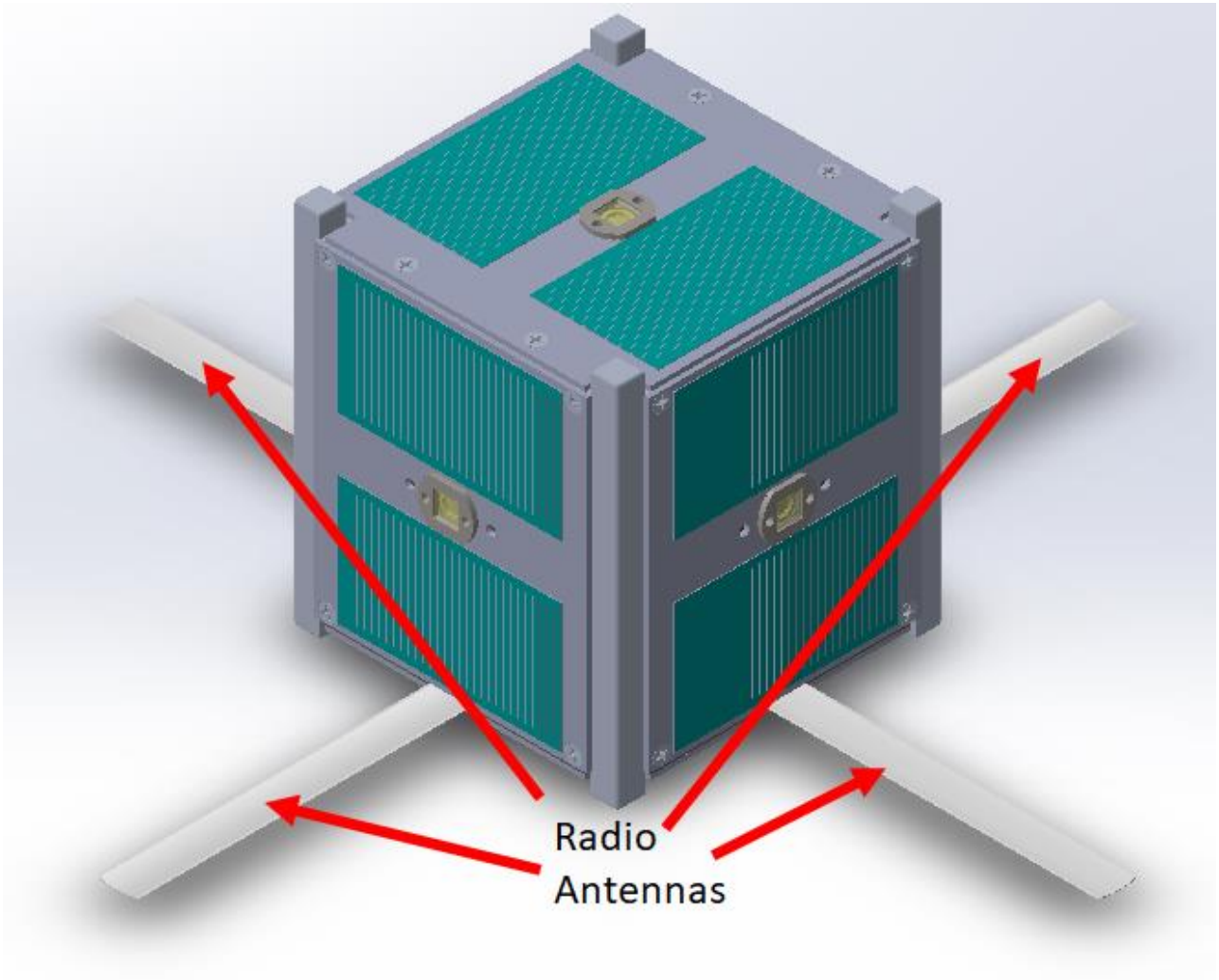

Figure 1 Owlsat Overview

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The satellite contains the following systems:

Guidance, Navigation and Control (GNC) Subsystem: The GNC system is built around the PyCubed Microcontroller board. It includes an IMU with gyroscope, accelerometer and 3-axis magnetometer, and contains the core microprocessor that runs the satellite's ADCS program. External to that board, the satellite also contains a 3-axis magnetorquer module, as well as a GPS module.

Command and Data Handling (CDH) Subsystem: The CDH subsystem primarily consists of Pycubed, an open source cubesat development platform that uses CircuitPython. It interfaces with the components of the various subsystems through the ATSAMD51 microprocessor. Samsung PRO Endurance microSD Memory Card is used as an external storage device and is used to store and access data from the individual components for downlink.

Communications Subsystem (COMMS): The Communications Subsystem consists of a Endurosat UHF Transceiver Type II band, half-duplex transceiver paired with a deployable, RHCP turnstile antenna built using tape-springs. The modulation is GFSK using the AX.25 packet structure protocol. The controlling ground station will be located on the Rice University campus in Houston, Texas. In addition, it is intended to capture downlink data by interfacing with the SatNOGS open-source ground station network. During the science mission, the comm team will attempt to convert the satellite into a digipeater service via an in-orbit firmware update following the 2-year science mission duration.

Electrical Power Subsystem (EPS): The Electrical Power Subsystem consists of a solar array and electrical power system, which regulates the charging of the batteries and the delivery of power to satellite components. The solar array comprises five solar panels, each made from two Spectrolab XTE-SF photovoltaic cells. These panels provide a total of 2.6W of power. The electrical power system is the EnduroSat EPS I, which includes MPPT controlled inputs for solar panels on each face of the cube satellite, a single battery pack (made from two 1/LPP 503759 8HH PCM WC battery cells), a 3.3V bus, a 5.5V bus, and six GPIO ports. The voltage regulated buses will be used to deliver a max of 3A on the 3.3V bus and 2A on the 5V bus.

Thermal Control Subsystem (TCS): The TCS utilizes passive thermal control, radiating heat in order to cool the satellite. Insulation may be used to maintain safe operating temperatures. An onboard heater for the EPS will ensure that the power subsystem stays above its recommended minimum temperature.

Structure Subsystem: The structure is fabricated of 6061 Aluminum that is type 3 hard anodized. Threaded brass rods support internal components, with spacers made of a non conductive polymer.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The payload subsystem consists of five SXUV5 extreme ultra-violet (EUV) sensors, capable of measurements over the entire EUV spectrum (1nm to 190nm). This range supports analysis of thermal expansion of the upper atmosphere.