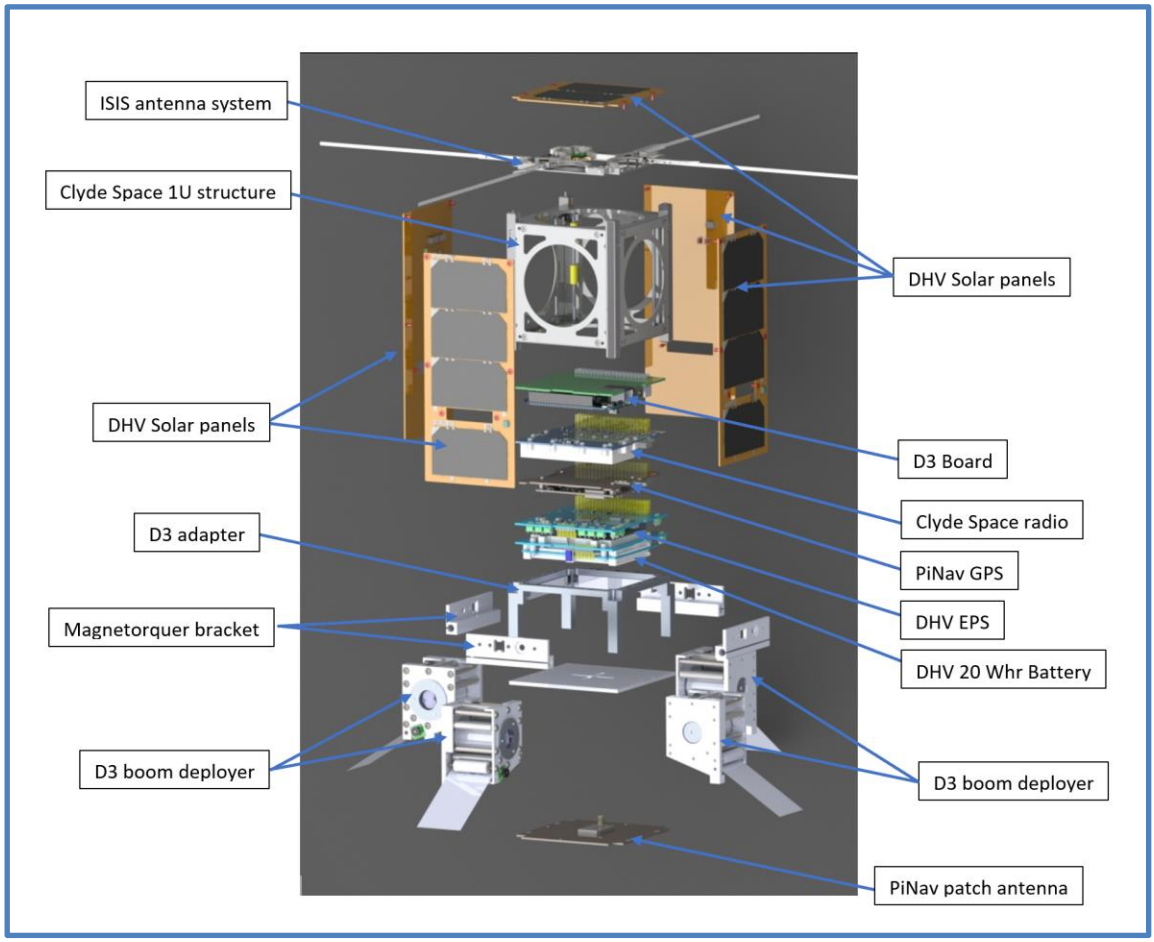
Mission Description

D3
University of Florida, ADAMUS Lab
2U



The D3 CubeSat is designed to test the D3 device, which enables a standard CubeSat for using the drag acceleration for orbital maneuvering. The mission will test a de-orbit point targeting algorithm developed at the University of Florida ADvanced Autonomous Multiple Spacecraft (ADAMUS) laboratory.

Once the CubeSat is deployed from the dispenser it will power up and start collecting solar power. The CubeSat will wait for 30 minutes to start collecting telemetry data. Once the batteries are sufficiently charged, antennas will be deployed and the CubeSat's UHF beacon transmission is enabled. Once communication is established and checkouts are performed, the CubeSat will send telemetry on request and receive commands. A magnetorquer-based de-tumbling law starts until angular rotation rates are below a pre-defined threshold. After the de-tumbling maneuver, the D3 booms are deployed at a pre-defined level for passive attitude stabilization and increase of orbital decay. Once a pre-defined threshold of remaining longitude controllability is reached, the de-orbit algorithm starts generating

guidance profiles which are uploaded to the CubeSat. Upon reception of a guidance profile, the CubeSat starts tracking it by modulating the D3 booms. Guidance updates are periodically uplinked to the CubeSat based on its real location. The CubeSat keeps tracking the guidance until the desired re-entry location is reached.

The CubeSat 1U structure made of Aluminum 6082-T6, and a D3 adapter and D3 Base plate made of Aluminum 6061-T6, all the D3 device screws and the D3 booms are made of austenitic 316 stainless steel and the electronic boards contain Commercial off the shelf Materials.

The CubeSat does not have any pressurized vessels or hazardous materials.

Subsystems: List the subsystems and provide a brief description of each. Typical subsystems include, but are not limited to:

Attitude Determination and Control System (ADCS)

The D3 CubeSat uses a 3-axis magnetorquer for initial de-tumbling, the de-tumbling algorithm is a B-dot law. After de-tumbling, the spacecraft remains aerodynamically ram-aligned due to the "dart" configuration of the booms which locate the center of pressure behind the center of mass.

Command and Data Handling (C&DH)

The D3 CubeSat software handles telecommands using a set of nodes implemented in the Robot Operating System (ROS) framework. A telecommand is defined as an 8-bit sequence which corresponds to a particular CubeSat action. The telecommands are transmitted with the appropriate parameters for the action. The telecommands and parameters interpreted by the interpreter node and executed by the handler node. The CubeSat will always respond to the telecommand with either an acknowledgement package or a return value.

Communications

The D3 is equipped with a Clyde Space half-duplex UTRX transceiver and ISIS antenna system in turnstile configuration. The Up/Down-link operates at the 437.080 MHz frequency. The radio implements AX.25 protocol using unnumbered information (UI) packets. Commands are sent from the main computer to the radio via I2C.

The CubeSat is equipped with a beacon, which will output health data on a timer so that other Amateurs can interact with the satellite. No other telemetry will be downlinked unless the CubeSat is prompted to do so by a telecommand. If the CubeSat does not receive a telecommand after a long period of time, the beacon will automatically stop transmitting data.

Electrical Power System (EPS)

The D3 CubeSat is equipped with a DHV EPS, the five DHV solar panels are connected to 2 BUCK DC-DC and 1 BOOST DC-DC converters. The EPS has 3V3, 5V, 12V and VBat fixed power buses as well as two switchable power buses (3V3 and 5V). The Battery+EPS system has connections for all deployment switches and Remove Before Flight (RBF) switch. All telemetry and telecommand are performed via I2C. Upon a reset/power up event, all the latching current limiters will be held low for 35 minutes. Configuration of deployment and RBF switches are compliant with Nanoracks requirements.

Guidance Navigation and Control (GNC)

The D3 CubeSat is intended to demonstrate a targeted re-entry algorithm using aerodynamic drag. The required ballistic coefficient over time is computed on ground provided an initial and final de-orbit point and is uplinked to the CubeSat as required. The flight software has an LQR-based algorithm to keep the spacecraft as close as possible to the uplinked guidance profile, while compensating for unmodeled dynamics/disturbances. The ballistic coefficient is modulated by extending/retracting the D3 booms.

D3 is not equipped with any imaging or propulsion devices.