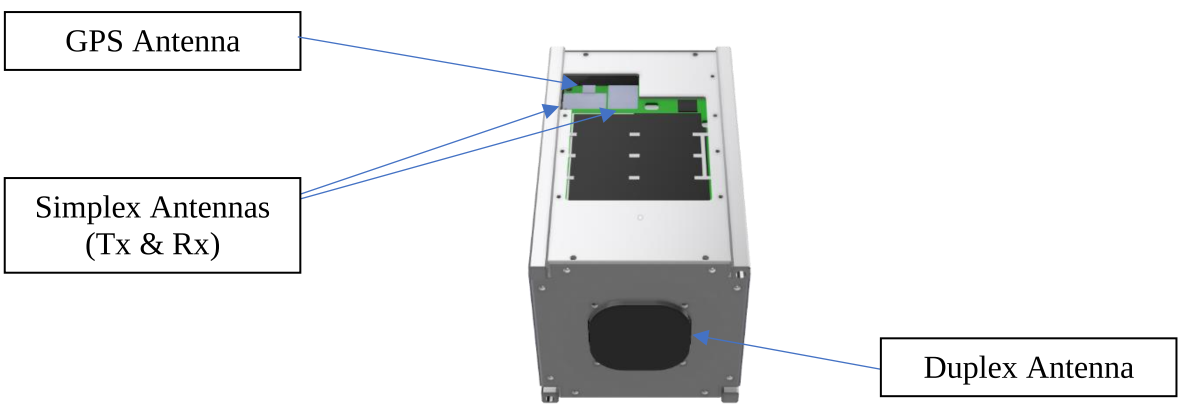
BroncoSat-1 Satellite Technical Description

The overall goal of the Cal Poly Pomona BroncoSat-1 mission is to test the performance of the NVIDIA Jetson single board computer ("Jetson") in Low-Earth Orbit. It will demonstrate the use of a dedicated, Commercial Off The Shelf (COTS) platform for Artificial Intelligence (AI) and Machine Learning (ML). By enabling AI and ML on CubeSats, this mission will be supporting a new wave of advanced data analytics and geographical study.

It will more specifically be quantifying the performance of the Jetson on orbit, for comparison with terrestrial performance. The Jetson will run a custom Computer Vision Algorithm for the geolocation and analyzation of Earth imagery. This algorithm may support future scientific surveys of our planet from space, when employed by fleets of small satellites, to deliver unprecedented coverage and understanding of our rapidly changing world.

The satellite will be deployed from a Momentus Space Vigoride vehicle, which will be carried to orbit on a SpaceX Falcon launch vehicle, No Earlier Than February 1, 2021.   It will be inserted into a circular Sun Synchronous Orbit at 450 km, on an inclination from the equator of 98 degrees. Transmission will begin 45 minutes after deploying from the Vigoride and cease on de-orbit of the satellite. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs about 8 months after launch. See the Orbital Debris Assessment Report for details The spacecraft is a 1.5U CubeSat (an overall dimension of 10 cm X 10 cm X 17 cm.) The total mass is about 1.76 Kg.

Figure 1 BroncoSat-1 Overview



The satellite contains the following systems: GNC, EPS, COMMS, CDH, Structure Subsystem, TCS, and Payload Subsystem.

Guidance, Navigation and Control (GNC) Subsystem: The GNC is an active system consisting of torque coils mounted to cancel environmental torques and provide coarse sun pointing capabilities. The equipment complement of torque coils, tri-axis magnetometer, and dual Inertial Measurement Units (IMU). are the critical components in this subsystem. A GPS receiver and horizon sensor are also provided. The GPS is used for Two Line Element (TLE) generation and location of the satellite on orbit. The Horizon sensor is embedded in the communications subsystem and inhibits the Simplex antenna while it is Earth Pointing.

Command and Data Handling (CDH) Subsystem: The CDH subsystem is contained within the Stanford RExLab PyCubed Flight Computer (FC) board. The FC performs the both most critical spacecraft controls that includes all communications interfaces to the transceiver and basic spacecraft state of health maintenance.

Communications Subsystem (COMMS): The Communications subsystem consists of a Near Space Launch (NSL) EyeStar Duplex, and a NSL Black Box Patch, which contains an EyeStar Simplex for downlink operations. Both are based on Globalstar radios. The communications subsystem connects to the GlobalStar network of communications satellites within the L-Band. The Black Box Patch also contains a horizon sensor for inhibiting transmissions while the Simplex antenna is Earth pointing.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system using a solar array producing approximately 3.5W of orbit average power to charge the 10.2 A-hr battery system. The solar arrays utilize Spectrolab triple-junction photovoltaic cells; the batteries are 6 Commercial Off the Shelf (COTS) Panasonic NCR18650B cells in a 2S3P configuration. The FC board sends signals to the Power Switch Boards to control charging and load switching. Integrated in the EPS are in-circuit protections from over-voltage and over-current.

Thermal Control Subsystem (TCS): The active TCS consists of thermocouples to measure temperatures and Kapton heaters operated by the FC board to warm critical components (such as the batteries) to satisfactory levels for operations. The passive TCS consists of a copper wick to be used as a thermal strap between the NVIDIA Jetson and the structure to transfer heat under heavy loads.

Structure Subsystem: The structure is fabricated of 6061-T6511 Aluminum. This structure consists of two solid walls constrained by a top and bottom panel that creates a hollow rectangular prism. Three walls of the satellite are covered with solar cells mounted on PCB’s with the remaining wall being aluminum sheet metal holding the NSL “Black Box” communications unit. The top and bottom panels are PCB’s that mount the Duplex antenna and pass throughs for electrical interfacing.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The payload of this mission is a COTS NVIDIA Jetson Nano Development Kit, and associated software. The BroncoSat-1 Mission will quantify the performance of the Jetson platform in a Low Earth Orbit environment. It will demonstrate a novel computer vision algorithm, using preloaded data (there is no camera on board). BroncoSat-1 does not contain any imaging capabilities and will not downlink any image data.