Putting Sonoma State University into Space

Kevin Zack, Dr. Lynn Cominsky, Dr. Garrett Jernigan

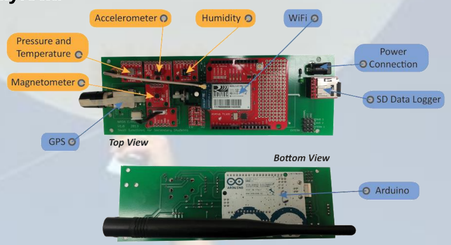
Sonoma State University, Rohnert Park CA

Abstract

Similar to humankind's race to the stars, the development of SSU's space program started with a balloon. From the balloon's 330 meter height, pushing higher to 3km high-powered rockets, and then on to T-LogoQube, our first satellite which orbited at 700 km, SSU's space program has steadily climbed to higher altitudes and greater hardware complexity. SSU's next satellite will build on the success of T-LogoQube, and will fly a Cadmium Zinc Telluride (CZT) array to detect cosmic X-rays from low-Earth orbit. The current stage of development for this new satellite is known as a "flat-sat" as all its constituent components are laid out on the lab bench for testing. Slotted to fly in Spring 2015, we expect our next satellite will be launched into orbit from the International Space Station.

Small Satellites for Secondary Students

S4 Payload

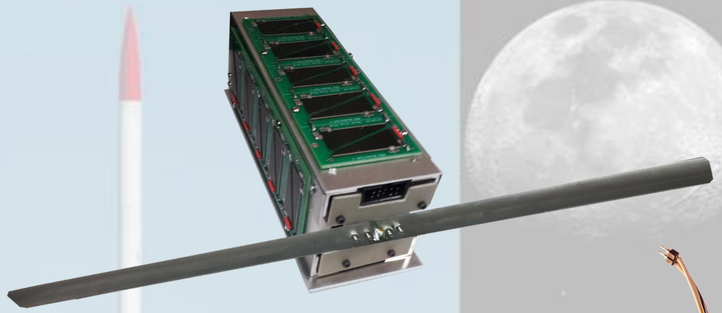


The Small Satellites for Secondary Students program, funded by a three year grant from NASA to bridge the gap in STEM education for secondary-school students, develops programs to provide the educational resources needed to support a small scientific payload curriculum in compliance with National Standards. The prototype payloads are flexible multi-experiment platforms designed for a wide range of abilities and resource requirements. Each payload has a base of GPS and SD storage connected to an Arduino microcontroller, which is built with off-the-shelf components and a pre-etched connector board. The platform also supports real-time telemetry updates though the use of Wi-Fi, which has been tested to 3km. These payloads are launched on either high-powered rockets, reaching over 3km, or weather balloons, tethered at 300m. This program will expand the student's ability to construct payloads and analyze their own data.

The work on the S4 program was a precursor to the T-LogoQube SSU's first satellite in orbit. ***http://s4.sonoma.edu***

T-LogoQube

T-LogoQube Satellite Launched November 21, 2013



Torque Coil on Orbit With SSU Team Names

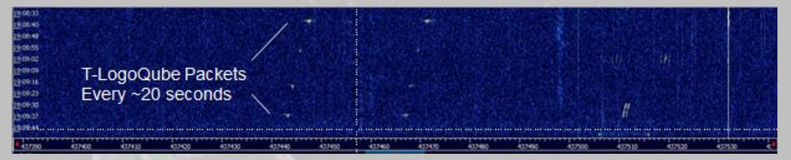
T-LogoQube is a first generation 3P (5 cm x 5 cm x 15 cm) PocketQube with on-board instrumentation. The project is a collaboration between undergraduate universities Sonoma State University (SSU) and Morehead State University (MSU). The purpose of this project is to develop a platform for future space-based scientific experimentation. Launched on November 21, 2013 into a sun-synchronous polar low-earth orbit at an altitude of 700 km, T-LogoQube is one of the smallest, stand-alone satellites to send both a radio beacon and instrumentation telemetry. Flight software is written in the programming language MicroLogo, allowing commands to be created, up-linked and executed in real time and making this satellite the ideal platform for experimental space science. This work is the precursor stage for a next generation PocketQube, which will fly a Cadmium-Zinc-Telluride (CZT) array to detect hard cosmic X-rays and particles while measuring properties of the Earth's magnetosphere.

T-LogoQube was in operation for eight weeks, during which the primary objectives of the flight were achieved First packets were received on November 23 (Image: First T-Logo Packets From Orbit), a command was sent the following day, with a prompt response from the satellite orbiting 700km above the ground station (Image: T-LogoQube Commanded On Orbit).

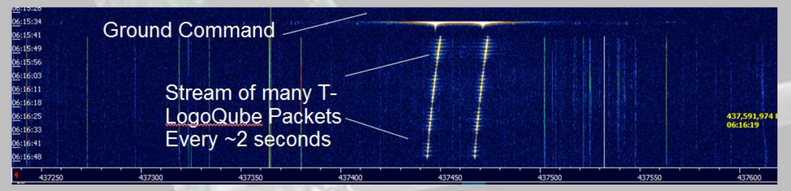
http://universe.sonoma.edu/T-LogoQube

Using a 100mW radio, ~4 times less power than a typical cell phone, packets from the satellite at distances ranging up to 2700 km were received and decoded.

First T-LogoQube Packets From Orbit



T-LogoQube Commanded On Orbit

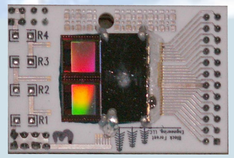


Future Plans

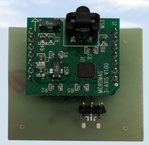
Development and construction of the next satellite is currently underway, with the flat-sat (engineering boards in a test array, not in flight configuration) built, and undergoing design reviews and testing. Still in its design phase, the hardware sub-systems are currently being improved with the information gained from extensive testing. Slated for a Spring 2015 launch from the International Space Station, the satellite will fly a CZT array and magnetometer.

The Society of Physics Students received a grant to build a communication station at SSU for ground support. Construction is scheduled for Summer 2014.

CZT



Flight Magnetometer



Board for Future Satellite