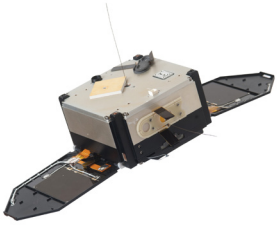
AEROSPACE

AEROCUBES

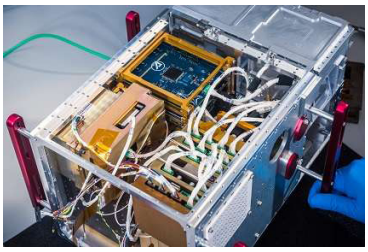
Accelerating the Space Enterprise with Small Satellite Technology

The Aerospace Corporation continues to make cutting-edge advances in the capabilities of CubeSats, both in supporting technologies and in mission results. The technology roadmap for our AeroCube program includes significant developments in several areas, many of which enhance existing Aerospace capabilities, and some of which will extend into entirely new directions. Over the next five years, Aerospace will develop and demonstrate several key enabling technologies with AeroCubes. The future program will focus on advanced autonomy and maneuverability, onboard processing using artificial intelligence, space networking technologies and traveling to higher orbits — including GEO — where the consequences of mission errors are much higher.

Our industry partners are focused on similar objectives, but as an FFRDC, our company can explore the full spectrum of technologies to ensure the best innovations in smallsats are being used by the space enterprise and will continue to share and transition these capabilities to our customers and industry partners.



AeroCube-6, launched in June, 2014, was deployed as a one-unit CubeSat, then split into the world's only two half-unit CubeSats (half-unit shown above). The two satellites flew in the same orbit, a few seconds apart, and collected radiation data continuously.



The Slingshot platform uses a SatCat5 ethernet switch architecture, which is able to simultaneously provide high throughput and low-power consumption.

Future Near-Term Investments and Demonstrations

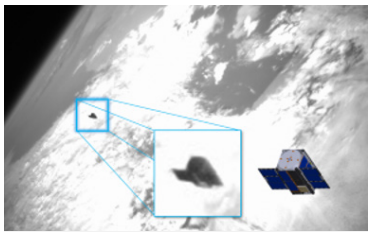
> S-band communications with National Security Agency (NSA)-certified cryptography that could enable future classified missions and payloads
> Compact, low-power, radiation-tolerant onboard computing to enable future missions above low Earth orbit
> Advanced rendezvous and proximity operations capabilities, including autonomous formation control, to enable future distributed aperture collection missions and in-space inspection of other spacecraft
> Large delta-V propulsion capability, greater than 1 km/s to help expand potential rendezvous and proximity operations mission options
> Advanced optical communication links at higher data rates, both from space to ground and crosslinking between CubeSats
> Standardized payload interfaces that allow for complex payload hosting with stressing power, data and timing requirements

A Legacy of Innovation and Progress

The AeroCube program has a long track record of demonstrating the value of continuous development; each flight suggests improvements to be incorporated in subsequent flights. The program has demonstrated many technological and mission firsts. Multiple publications based on the AeroCube program have had a significant impact on the small satellite industry.

AeroCube Highlights and Milestones

> AeroCube-6 (AC-6) is the first CubeSat to show that variable atmospheric drag via orientation control could be used to manage relative orbit spacing, 2014
> The OPAL Picosatellites demonstrate the first tracking and comms from a containerized satellite, 2000
> AeroCube-4 is the first 3-axis, stabilized CubeSat to demonstrate 1 degree pointing accuracy, 2012
> AeroCubes-4 and -6 are the first CubeSats to demonstrate orbit control using variable drag profiles, 2012 & 2014
> AeroCube-7 demonstrates the first space-to-ground optical communication link from a CubeSat, 2017
> An AeroCube demonstrates the first optical illumination of resident space objects and ground assets from a CubeSat
> AeroCube-15 is the first to demonstrate commercial infrared cameras from a CubeSat to perform military and civilian missions, 2019
> AeroCube-10 demonstrates closest rendezvous and proximity operations (RPO) for a CubeSat and is the first CubeSat to collect imagery of another CubeSat as part of an RPO demonstration, 2019
> Aerocube-7 hosts the first water-based propulsion demonstration and is the first CubeSat propulsion system to meet International Space Station safety standards, 2017
> First demonstration of a solid rocket motor propulsion system on a CubeSat, 2008
> Developed and published a streamlined assembly methodology for adhering solar cells using double-sided polysiloxane pressure-sensitive adhesive (PSA) polyimide film. This process has achieved wide-scale industry adoption, helping to decrease cost and improve reliability
> Developed and published shape-memory alloy actuators for small satellites, an innovation enabling resettable release mechanisms resulting in 100% deployment success for Aerospace small satellite missions
> The PSSCT-2 CubeSat captured the last image taken of a space shuttle (STS-135) on orbit, 2011



AeroCube-10A (dimensions 10x10x15cm) photographed from 26 meters away by AeroCube-10B.

PSSCT-2 taking a photo of STS-135 in 2011, the final photo captured of a space shuttle on orbit.

The Aerospace Corporation

The Aerospace Corporation is a national nonprofit corporation that operates a federally funded research and development center and has more than 4,500 employees. With major locations in El Segundo, California; Albuquerque, New Mexico; Colorado Springs, Colorado; and the Washington, D.C. region, Aerospace addresses complex problems across the space enterprise and other areas of national and international significance through agility, innovation, and objective technical leadership. For more information, visit www.aerospace.org.

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