National Aeronautics and Space Administration

NASAfacts

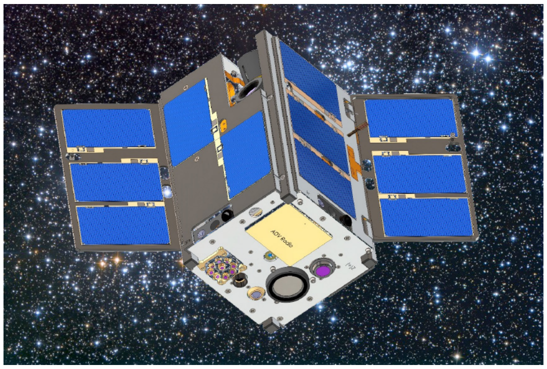
Optical Communications and Sensor Demonstration

Technologies for Proximity Operations and Data Transmission

The Optical Communications and Sensor Demonstration (OCSD) project addresses two cross-cutting capabilities of value to many future small spacecraft missions: high-speed optical transmission of data and small spacecraft proximity operations. Optical data rates demonstrated by OCSD are expected to be 200 megabits per second (Mb/s) or higher, a factor of 100 increase over current high-end CubeSat communications systems. The proximity sensors developed for this mission enable relative position measurement between two small satellites - a capability not previously demonstrated.

The OCSD project will produce three 1.5-unit (1.5U) CubeSats that will be launched as secondary payloads on two separate missions. Each CubeSat is about 4 inches x 4 inches x 6.7 inches (10 centimeters x 10 centimeters x 17 centimeters) and weighs approximately 5 pounds (2.5 kilograms). The first OCSD mission, with one satellite, is scheduled to launch no earlier than Sept. 23, 2015 aboard an Atlas rocket from Vandenberg Air Force Base in California. The satellite will evaluate the ability to point the satellite accurately as it demonstrates data transfer by laser at rates of up to 200 Mb/s. Downlink communications experiments will take place between the satellite and The Aerospace Corporation's optical communications test facility at Mount Wilson in Southern California.

The second OCSD mission, with two satellites, is scheduled to launch no earlier than Dec. 1, 2015, aboard a Falcon 9 rocket, also from Vandenberg. The satellites may be modified as necessary to incorporate any lessons learned during the first mission and the laser communications system will attempt data transmission rates greater than 500 Mb/s. In addition, the two satellites will perform the proximity



OCSD Spacecraft Configuration

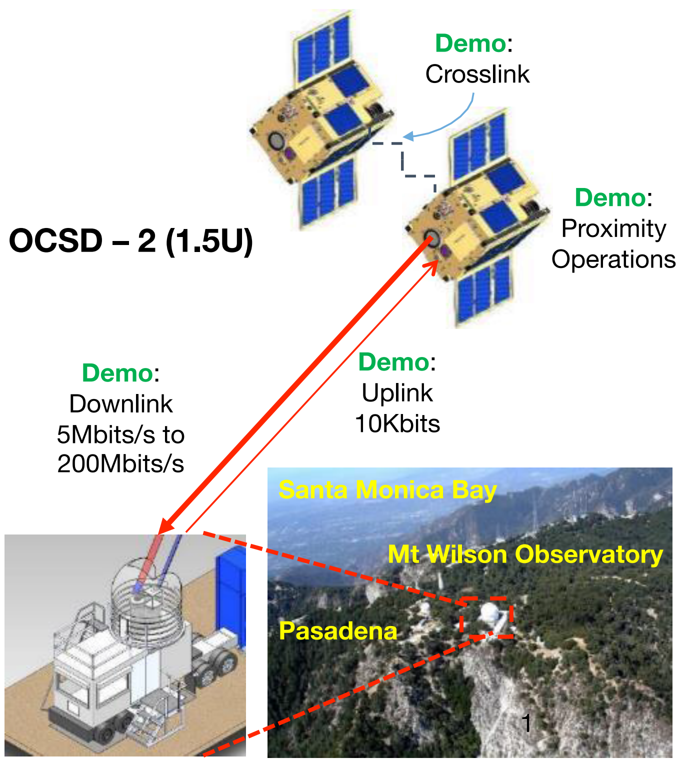
operations demonstration, which will involve relative position measurements using cameras, beacons, laser rangefinders, and relative maneuvering using variable drag and propulsion. The novel propulsion system on OCSD uses water as a propellant, exhausted as steam.

The optical communications system on OCSD differs from other space-based laser communication systems because the laser is hard-mounted to the spacecraft body. The beam is pointed by controlling the orientation of the entire spacecraft. This makes the laser system much more compact than anything previously flown in space. The attitude control system developed for these satellites includes a pair of miniature star trackers that are devices that measure the position of stars for navigational purposes. These star trackers are expected to enable pointing to an accuracy of 0.05 degrees, which is 20 times the precision previously demonstrated in a satellite of this size.

The OCSD mission addresses the need for low-cost sensors that small spacecraft can use to assist in maneuvering and operating safely in close proximity to other spacecraft or objects in space. Capabilities in proximity operations will enable multiple small spacecraft to operate cooperatively during science or exploration missions, to approach another spacecraft or object for in-space observation or servicing, or to connect small spacecraft together to form larger systems or networks in space.

The potential for optical communications technology will not reach its limit with OCSD; it is anticipated that relatively simple upgrades, primarily to the attitude control system, will enable download rates of 2.5 gigabits per second (Gb/s) or higher. This would open the possibility of using small satellites in applications, such as synthetic aperture radar or hyperspectral Earth imaging, that produce volumes of data far beyond the capacity of radio-frequency downlink systems. It is also possible to use these satellites as data relay nodes in low-Earth orbit; a modest constellation of small satellites has the potential to provide low-latency, high-rate communications as a service for other satellites in orbit around Earth.

The OCSD project is managed by The Aerospace Corporation of El Segundo, California.



The OCSD 1.5U CubeSat Transmits Data Via Laser from Space to Ground.

The OCSD project is funded through NASA's Small Spacecraft Technology Program (SSTP), which is chartered to develop and mature technologies to enhance and expand the capabilities of small spacecraft with a particular focus on communications, propulsion, pointing, power, and autonomous operations. SSTP is one of nine programs within NASA's Space Technology Mission Directorate.

For more information about the SSTP, visit:

http://www.nasa.gov/smallsats

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