M-Cubed Public Summary

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The Michigan Multipurpose Minisatellite (M-Cubed) is a 1U CubeSat conforming to the guidelines established by the California Polytechnic State Institute. M-Cubed started entirely as a student project at the University of Michigan in the summer of 2007 and made slow progress for some time. In the spring of 2009, M-Cubed partnered with NASA's Jet Propulsion Lab (JPL) to fly a novel new Field Programmable Gate Array (FPGA) testing out an imaging algorithm for the Aerosol Clouds Ecosystem Mission from NASA. The Multiangle SpectroPolarimetric Imaging (MSPI) algorithm is being tested on the M-Cubed spacecraft bus as the CubeSat Onboard Processing Validation Experiment (COVE). The partnership with JPL led to M-Cubed and the COVE task being sponsored by NASA's Earth Science Technology Office (ESTO) starting in May of 2010 and ending in September of 2011. Furthermore, M-Cubed was prioritized #1 in NASA's Educational Launch of Nanosatellites (ELaNa) Program. M-Cubed also gives students at the University of Michigan hands-on experience with real flight spacecraft.

M-Cubed uses primarily commercial off-the-shelf components in its design. The exceptions to this include the in-house developed structure, Electrical Power System, and the JPL-developed COVE payload. M-Cubed uses a taskit STAMP9G20 Microprocessor for all command and data handling operations with a 2 GB SD card for image and telemetry storage. Two Lithium-1 radios from Astronautical Development will be transmitting and receiving over UHF and VHF respectively. The camera implemented on M-Cubed is an Omnivision OV2655 2 MP CMOS sensor with an active array size of 1600 x 1200 pixels. The FPGA being demonstrated onboard M-Cubed is the Xilinx Virtex-5QV Rad-Hard By Design (RHBD). M-Cubed uses a passive magnetic stabilization system to align with the local Earth magnetic field when in orbit.

M-Cubed will be launched into Low Earth Orbit on a Delta II rocket out of Vandenberg Air Force Base, CA on October 25, 2011. Once in orbit, M-Cubed will de-tumble to align with the Earth's magnetic field in preparation for mission operations. After stabilizing, M-Cubed will receive commands from the ground station in Ann Arbor for when to take pictures. At these picture taking opportunities, M-Cubed will turn on its camera and capture imagery of Earth. The ground sampling area for these images is approximately 265 meters. At this point, the raw image will go to the Stamp microprocessor and then copied and handed off to the COVE payload. The COVE payload will run the MSPI algorithm on the image and return it to the Stamp processor. Concurrently, the microcontroller will also be processing the image to compress it for downlink. After both the image and COVE payload data are stored onboard, M-Cubed will be commanded to downlink its telemetry, collected images, and payload data at the first available pass. This will continue until the downlink is completed and the process will repeat.