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1M GSD IMAGING AND VIDEO DEMONSTRATION ON A 65KG MICROSATELLITE

**Abstract**

Canon Electronics started development on a microsatellite platform in 2012 with the goal of capturing the highest resolution images in its class. Using a newly-designed 40 cm Cassegrain reflector telescope and by leveraging imaging technologies built by Canon, the 65 kg microsatellite CE-SAT-I can capture color images and video of less than 1 m ground sampling distance (GSD) from a 500 km orbit. It was launched in June 2017 as a secondary payload on the Indian PSLV C38 and has been conducting experiments to validate the bus and subsystems as well as the optical payload.

The payload uses a COTS 22.3MP CMOS sensor, and exposure is controllable through shutter speed and ISO. Focus can be adjusted via a stepper motor on the secondary mirror, and the effective focal length of the camera is 3720 mm. This leads to images approximately 6 km x 4 km in ground distance near nadir, with theoretical GSD better than 1 m. Quantification of GSD as well as the modulation transfer function are currently underway. By eye, individual cars can easily be recognized, and their motions can be tracked via continuous exposure or video.

In the past, sub-meter GSD color images were captured by larger satellites. Color video at this resolution had never been recorded before. Future demonstration missions are in the works, with more advanced capabilities to meet various user needs. A propulsion module will allow accurate orbit design for single missions or large constellations. An extremely-high ISO sensor is under consideration, which would remove the daytime limitation for optical observation. Frequencies beyond visible wavelengths could meet similar needs. Optical communications, using miniaturized versions of the main telescope, will increase download rates up to live streaming of 8K ultra high definition video. Combining those technological advances with Canon Electronics' expertise in mass-manufacturing precision instruments, a large constellation with inter-satellite communications via optical means could stream real-time video, from anywhere on Earth.