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# ACTIVE MAPPING OF CUBESAT'S REFLECTARRAY ANTENNA PATTERN WITH ITS ATTITUDE CONTROL SYSTEM

**Abstract**

NASA has chosen the Integrated Solar Array and Reflectarray Antenna (ISARA) mission as a communications cutting-edge space technology to advance the state of the art for small spacecraft. About three units of the standard CubeSat bus, ISARA will be launched between 2014 and 2015. Its primary objectives are to demonstrate that a reflectarray patched antenna, adhered to the back side of the commercially available solar panels, can be used as Ka-Band High Gain Antenna for communications and that a low-cost radio communication system can significantly increase the amount of return data from small spacecraft. To verify its communications performance, the antenna pattern and gains must be constructed using measurements at a ground station. As a secondary payload, it may not be assigned with a desirable orbit; even if the primary payload's orbit is favorable, the full antenna pattern may not be able to mapped out completely within its primary phase when the spacecraft is passively flying over a ground station. In this paper, we devise an operational approach to optimally map out the entire antenna pattern, cut by cut, using the spacecraft's attitude control system (ACS). Namely, the spacecraft is equipped with an electrical wheeled-gyroscope commercial-off-the-shelf ACS system built for CubeSats and when the spacecraft is in view with a ground station, a combination of roll, pitch, and yaw maneuvers is performed to actively steer certain part of the antenna pattern towards the ground station. The amount of roll, pitch, and yaw can be optimized so that the desired portion of the antenna points towards the target while their rotating rates are within the capabilities of the ACS. For passes that are long, especially for high-altitude or elliptical orbits, multiple cuts of the antenna pattern can be constructed within a single pass. We will show that our approach will provide sufficient characterization of the antenna pattern for all five recommended secondary-payload orbits.