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ATMOSPHERIC COUPLING AND DYNAMIC EXPLORER (ARCADE): TECHNOLOGY
DEMONSTRATION FOR VLEO FLIGHT

Abstract

Atmospheric Coupling and Dynamic Explorer (ARCADE) is Singapore's first satellite aimed to fly in very low earth orbit (VLEO). ARCADE is a small satellite of approximately 30 kg flying on a near equatorial orbit. The key objectives of the spacecraft mission is to measure middle and upper atmospheric data for improving the understanding of space science phenomena and behaviour and earth imaging. ARCADE carries four major instruments to perform scientific measurements: 1) a heterodyne interferometry-based limb imager for middle atmospheric temperature measurements to characterise the effect of gravity waves on the mean flow and global circulation, 2) an ionospheric probe to measure in-situ plasma density and drift velocities, 3) RGB imager for earth observation, and 4) an instrument flying perovskite solar cells to qualify the performance of the cells in space along with atomic oxygen detectors. All the four payloads are expected to provide valuable earth observation data. However, the main mission of ARCADE is to measure the atmospheric data at varied altitudes. Using an electric propulsion system, the orbit will be gradually lowered from 550 km to 350 km near-circular orbit over a span of 6-8 months. The propulsion system can produce a thrust of 0.75 mN which is used for orbital manoeuvres. The F-region in ionosphere peaks roughly at 350 km. It is expected to discover new and interesting findings as the spacecraft lowers its altitude gradually. While the instruments collect data as the orbit is lowered, the imager will be used to demonstrate the improvement in image resolution as the altitude is lowered. Flying at 350 km, a small 0.5U camera assembly weighing less than 500 g is expected to achieve an image GSD of 25 m, while flying at 550 km, the GSD will be 40 m. The complexity of performing missions for all the payloads while successfully executing the orbit manoeuvre with consideration for the possibility of collision is high. The technology to support such as mission also requires to be complex and reliable. ARCADE mission is scheduled to be launched in July 2023 on board ISRO's PSLV launch vehicle. This paper describes

the analytic results for altitude profile, drag analysis, power generation and communication for the estimated flight period. The objective is to highlight the mission design process considering the limitations and considerations of sub-systems. A detailed description of the sub-systems required to support orbit manoeuvres and payload missions is given.