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SAR DISKSAT DEMONSTRATION FOR CONSTELLATION IN VLEO

Abstract

This paper describes demonstrations of SAR DiskSat at very low Earth orbit (vLEO) scheduled in 2028 and 2030, supported by governments of United States and Japan through an application to the Coalition Warfare Program, USA, DoD 2026. Also, this mission is currently under review of Space Strategy Fund in Japan's government. After this demonstration mission, we will construct a constellation of SAR DiskSat at vLEO. In 2023, we proposed quasi-2D SAR satellites, SAR DiskSats, with novel deployable passive slot array antennas. The satellite body is only 0.13m in height and 1m in diameter. The satellite mass is about 80kg and the plane slot array SAR antenna of 3.6mx0.9m is deployed rearwards of the thin body. There are solar cells on the backside of the antenna since almost no heat is dissipated in the passive antenna. This quasi- 2D configuration makes it possible to keep its altitude with a small electric thruster for several years even at very low Earth orbits (vLEO) of 350km. The key advantage of vLEO SAR observation is that the SAR image intensity increases as inverse-cube of the altitude. When we reduce the altitude from 600km to 350km, the image intensity improves by a factor five. This advantage makes possible unique SAR missions as follows: (i) small X band SAR DiskSat with a very high-resolution of 0.250.5 m with existing standard narrow swath, and (ii) small X band SAR DiskSat combined with Elevation Frequency Scan (EFS) technique, to achieve a very wide swath SAR at high imaging resolution at vLEO, wider than a 100 km swath at about 1.8 m resolution. The mission (i), the high-resolution SAR observation will be demonstrated in early 2028 with dual launch configuration. We will install two SAR DiskSats with double-stacked configuration in a small Japanese launcher "Kairos". The mission (ii), high-resolution wide swath (HRWS) SAR observation will be demonstrated in 2030. The goal performance is a 100km swath with about 1.8m resolution with a strip-map mode. Since the SAR DiskSat has a small SAR antenna (3.6mx0.9m), the azimuth ground resolution can be 1.8m. The original idea of EFS by Air Bus in 2018 cannot maintain sufficient SAR image quality under the constraints of our small SAR antenna size. We will present techniques of EFS which are suitable for small SAR satellites.