

Orbit Maintenance and End-of-Life Disposal Strategy for Micro-satellites Operating in Very Low Earth Orbit

Abhrajit Ray

ISRO Telemetry, Tracking and Command Network, Indian Space Research Organisation, Bengaluru, Karnataka, India

Amit Kumar Singh

ISRO Telemetry, Tracking and Command Network, Indian Space Research Organisation, Bengaluru, Karnataka, India

Abstract:

The increasing deployment of small satellites in Low Earth Orbit (LEO) has intensified concerns regarding orbital sustainability, collision risk, and space debris accumulation. Satellites operating in Very Low Earth Orbit (VLEO), around 400 km altitude, experience significant atmospheric drag, leading to rapid orbital decay and frequent orbit maintenance requirements. This paper examines orbit maintenance strategies for a representative 200 kg satellite operating within this altitude regime. The analysis includes the primary environmental perturbations affecting orbital lifetime, station-keeping maneuver requirements, expected maneuver frequency, propellant consumption estimates, orbital decay behavior, and planned end-of-life reentry approaches. Results indicate that atmospheric drag dominates station-keeping requirements and can necessitate annual velocity corrections ranging from 20 to 80 m/s depending on solar activity. Furthermore, the naturally short orbital lifetime of satellites below 400 km offers a sustainable pathway for debris mitigation through controlled or semi-controlled atmospheric reentry.

Keywords:

Low Earth Orbit, Orbit Maintenance, Atmospheric Drag, Station Keeping, Satellite Operations, Orbital Decay, Space Debris Mitigation, Reentry.