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VERY LOW EARTH ORBIT NANOSATELLITE PLATFORM WITH INNOVATIVE, RESOURCE-SAVING ORBIT KEEPING STRATEGY

Abstract

Based on the successfully operated nanosatellite SOMP2b (01/2021-11/2024) a scalable nanosatellite platform employing an innovative orbit keeping strategy for the use in very low earth orbit (VLEO) has been developed. The platform is designed for cost-effective, scalable operations in altitudes below 300 km. It leverages aerodynamic forces via movable control surfaces for 3-axis stabilised attitude control and uses electric thrusters to counteract atmospheric drag, enabling extended mission lifetimes in this challenging environment. Foregoing the need for heavy and energy intensive air-breathing thrusters, this enables the use of smaller and cheaper nanosatellites. Key for the design is the integration of main bus components into the modular side panels. This enhances redundancy, simplifies assembly, and facilitates rapid scalability for constellation deployments.

Choosing VLEO instead of low earth orbit (LEO) environment enables higher-resolution imaging and lower communication latency due to proximity to Earth. The lower orbit also allows faster technology refresh cycles and debris mitigation through natural atmospheric re-entry. Intense atmospheric drag in VLEO necessitates frequent propulsion adjustments, increasing operational complexity and fuel demands. Satellites face shorter lifespans without robust propulsion systems.

The employment of movable control surfaces in conjunction with a conventional magnetorquer facilitates the utilisation of electrical propulsion exclusively for the purpose of orbit maintenance, thereby conserving valuable fuel reserves. The platform is thus enabled to adjust its attitude with greater autonomy, whether for payload operation or to optimise the orbital average power produced by solar cells.

The underlying design of the highly integrated side panels of SOMP2b already included structural components, attitude detection and control, energy generation via solar cells and evaluation and monitoring of the aforementioned functions. SOMP2b focused on the utilisation of cost effective commercial off-the-shelf components. Drawing upon the lessons learned from this mission, the new platform employs flight-proven, highly integrated side panels and incorporates additional functions to enhance scalability and redundancy of the platform as a whole. Critical subsystems are embedded into standardised side panels, reducing internal wiring complexity. This approach mirrors CubeSat backplane concepts but extends integration to structural panels, thereby improving thermal management and fault isolation. This enables fast and

flexible design of payload specific satellite bus systems. An important design goal for the platform is compatibility with conventional commercial nanosatellite deployers, although a flat design is preferred for aerodynamic reasons.