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VERY LOW ALTITUDE SATELLITES: A PROMISING OPTION FOR FUTURE EO MISSIONS?

Abstract

This paper reviews the challenges and opportunities of Very Low Altitude Satellites and their potential for operational missions. Low altitude and satellites can be seen as two contradictory words. Nevertheless, low altitude flying is sometimes the main mission requirement for scientific missions. ADM-AEOLUS, GOCE, CHAMP, GRACE or now GRACE Follow-on missions have orbits whose altitude is between 259 and 500 kilometres. In this case, the atmospheric drag becomes a major constraint and drives the design and the lifetime of the mission.

Beyond the scientific missions for studies related to the magnetic field, the gravity field or the atmospheric sounding using advanced LIDAR, low altitude satellites can also have very interesting applications for operational missions, in particular in the Earth Observation domain. Already in the early days of spaceflight, this has been exploited by several military reconnaissance missions.

For optical, RADAR, and LIDAR payloads, the low altitude orbit can simplify the design and reduce the cost of the overall mission. With the same complexity, the resolution of optical instruments is higher, power requirements of SAR instruments are lower, and the signal to noise ratio increases for LIDAR sensors. The main drawbacks are also well-know: the access corridor decreases with altitude and lifetime is limited due to a higher atmosphere density.

As a prime contractor or major contributor of the recent low altitude scientific missions, Astrium has gained a comprehensive experience and know-how in this domain. Since 2011, the Innovation and Advanced Concepts team, with the support of the Earth Observation and Science division, performed a feasibility study aimed at reviewing the realistic operational applications and design challenges of a very low altitude satellite.

This paper summarises the results of this study, both at system, platform, and payloads levels. Starting with a presentation of the specific environment of this type of orbits, it reviews the main challenges: ballistic coefficient, atomic oxygen, drag compensation, communication with ground stations, coverage and revisit, power constraints, etc.

One important finding is that mission durations of up to 5 years can be supported without the use of an electric propulsion system with a properly designed configuration. Either as a single satellite or as a small constellation, one of the objectives of this new type of mission is also to provide cost-effective solutions. Thus, the last part of the paper reviews the most interesting business cases and markets. It highlights in particular the need for low-cost launching solution.