

Aerodynamic drag analysis on VLEO Satellite by utilizing CelestLab toolbox and its extension

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Abstract

There is a growing interest in research of the operation of satellites in Very Low Earth Orbit (VLEO), due to their ability to provide high-quality Earth observation and communication. In the VLEO region, atmospheric drag is a critical issue which affects the altitude control, satellite orientation and orbit prediction of satellites. This limits the operational life of the spacecraft. The drag arises due to the interaction between atmosphere (primarily the thermosphere layer) and satellite.

For the simulation and drag analysis, this project makes use of CelestLab and its extension CelestLabX, the Scilab toolboxes specialising Space Flight Dynamics. We first employ STELA tool (present in CelestLab) to create the satellite model and define its orbit. Then, we examine drag impacts on the satellite model, in both the scenarios of fixed and rotating solar arrays. Results show that fixed solar panels do not always face the sun, which can reduce their efficiency. However, rotating panels track the sun producing increased energy capture, which makes them more efficient. Furthermore, we investigate the elliptical shape of the satellite's orbit is affected by drag.

The goal is to simulate such a design of the satellite, which experiences minimum possible drag and captures maximum solar energy. This would help scientists develop drag reduction strategies, thus enhancing the satellite's performance in space missions.