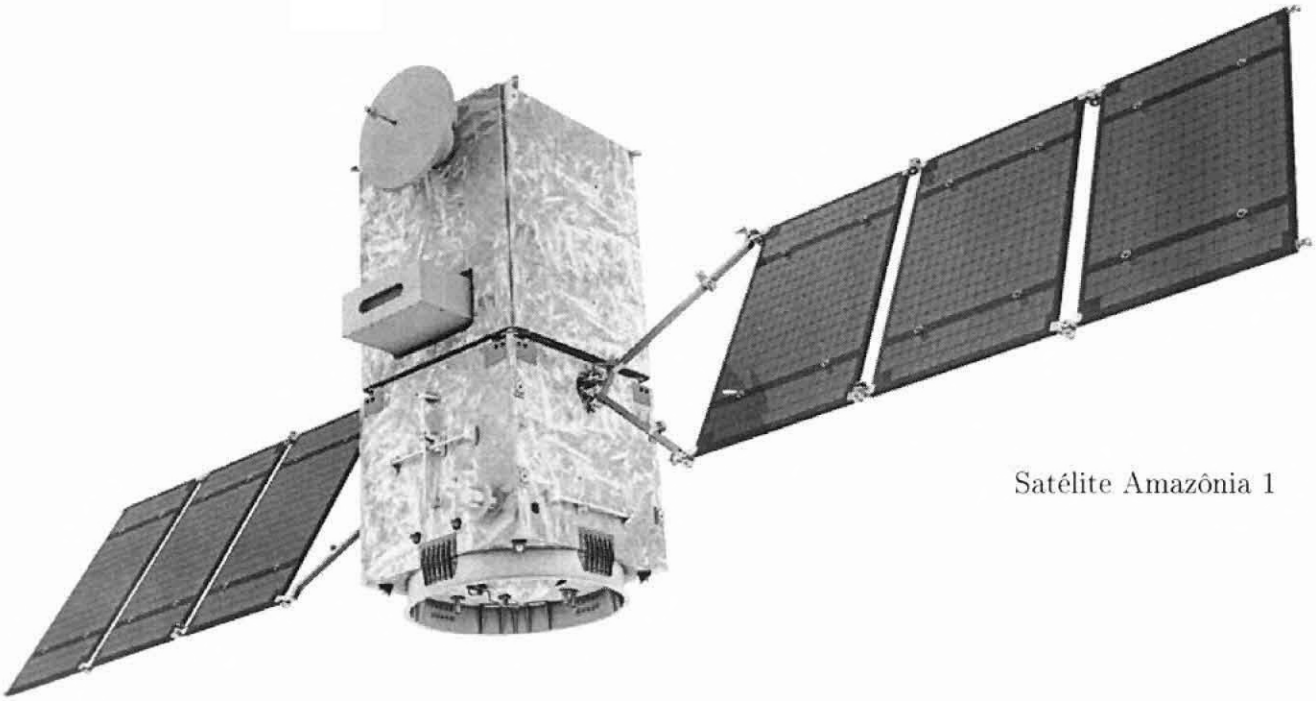
# XXI Colóquio Brasileiro de Dinâmica Orbital - CBDO 2022

# LIVRO DE RESUMOS



Satélite Amazônia 1

12 a 16 de dezembro de 2022

Instituto Nacional de Pesquisas Espaciais, INPE
São José dos Campos, SP, Brasil

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# Influence of periodic aerodynamic forces on the orbital elements of cubic satellites

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Satellites in Low Earth Orbits are highly perturbed by the interaction with the atmosphere, which is the main non-gravitational perturbation (Miyata et al, 2014; Murcia et al, 2021). The two components of the aerodynamic force are the lift and drag, which initially are a function of the satellite geometry, materials, atmospheric and flow conditions. Due to the uncertainly in these values, traditional model search to fix the coefficients along the orbit lifetime (also known as canon ball model), without considering the changes due the flow direction (Prieto et al, 2014), product of the satellite attitude and rotational dynamics.

The purpose of the present study is to analyze the influence of periodic variations of lift and drag on the orbital elements of a cubic satellite in Low Earth Orbit (LEO). For a practical approach, it is assumed the satellites in rotation at constant angular velocity. Three parallelepiped solids were selected to model the satellite geometry, which are similar in volume to the CubeSat standard The CubeSat population in LEO is increasing (Anz-Meador, 2015), and one advantage of those nanosats is that the uncertainty due to mass and dimensions are small. The aerodynamic coefficients are modeled using the panel method in free molecular flow, as a function of the angle of attack and the roll angle. For each solid, were selected two configurations in attitude at eight angular velocities. The effects of periodic variations in drag results in small secular perturbations in the orbital semi-major axis and eccentricity, with large differences at the lowest angular velocity. In the case of lift, the inclination is perturbed, and, at lower angular velocities, the effect is increased, because it keeps the magnitude and direction of this perturbation for a long time, however do not present significant perturbation from the mean orbit. The novelty of the study is the detection and quantification of the effects of periodic lift and drag in parallelepiped small satellites at Low Earth Orbits.

References

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