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Author: Ms. Danlei Chen
Western University, Canada

DYNAMIC ORBIT DETERMINATION OF LOW EARTH ORBIT CUBESAT

Abstract

From the Canadian Space Agency CubeSat Project Design Specification Document, CubeSats are designed to have an expected in-orbit lifetime of at least three months. However, historical data has shown that some nanosatellites can survive up to two years dependent on perturbation factors such as solar activity. As such, an accurate estimate based on the simulated orbital elements and perturbation effects should be conducted to determine the mission duration of its orbit lifecycle.

Satellite orbital lifecycle assessment serves to inform the satellite mission preparation, operational cycle, and post-operational analysis. Determining launch and orbit parameters in Low Earth Orbit (LEO) and examining orbital perturbation factors for the decay of the satellite orbit ensures a greater accuracy of the predicted orbit and lifespan of the CubeSat.

The object of the current work aims to demonstrate the first year of the Western University – Nunavut Arctic College CubeSat Project CubeSat orbit determination, which will be launched from the ISS in 2021. This will also serve as accurate CubeSat tracking, confirmed by observational data upon deployment. Based on the theoretical analysis of the orbital dynamics principles and orbital perturbation effects, the orbital parameters of the satellite were then numerically calculated based on the position from the ISS launch. These elements were then simulated using the STK perturbation effects propagator. These orbital elements will contribute to the determination of the lifecycle and timeline of the CubeSat within LEO prior to its de-orbit. This undergraduate thesis emphasizes the importance of initial orbit determination in the first year design of the CubeSat, and contributes to analyzing communications transmission periods and eclipse timings for the CubeSat communications and power teams, respectively.