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MOON NANOSATELLITE CONSTELLATION CONNECTED BY TETHERS

Abstract

The aerospace technology has evolved considerably in recent decades, for example with the use of huge cables to connect satellites and nanosatellites. The use of large satellites leads to high operating costs, thus, innovation is sought with the reduction of its size, investing in better technologies and minimizing the costs of space missions. In view of this scenario, a nanosatellite constellation is proposed whose mission is to measure the magnetic field, solar radiation pressure and perform communication in space. All these experiments will be carried out using sensors embedded in the nanosatellites. For this work, the moon was chosen as the primary body of the system because there is no atmospheric drag in low orbits, discarding the need for active control of the system's attitude over time because it remains in its orbit for a longer time, extending the life of the mission. It is analyzed a nanosatellite constellation formed by six point masses connected by cables along the cartesian axes. The reference is fixed in an inertial reference (primary body). The cables are considered massless and with variable length. The constellations movement is described from the center of mass position which moves in a Keplerian orbit around a primary body along the XYZ axes. Since it is not necessary to know all the forces acting in the system, it was decided to use the Lagrangian formulation, movement equations that relate the Potential and Kinetic energies and the generalized coordinates of the system. For the mathematical model, it was defined that the system is conservative with no perturbative forces acting on it. The generalized coordinates used were the rotation angle of t he constellation and the lengths of the tethers. For this system, the behavior of the length of the tethers is analyzed as a function of the true anomaly, considering specific values of eccentricity and angular frequencies of rotation. Graphs of the potential and kinetic energies and control laws for the rotation movement were also obtained. In future papers it is intended to improve the mathematical model considering the influence of the mass of the tether and consider an elastic behavior of the cables by adding springs on the model with small oscillations.