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DEVELOPMENT OF A POWER MANAGEMENT SUBSYSTEM FOR THE "ALSAT#1" CUBESAT MISSION

Abstract

The satellite "ALSAT1" is under development by the "Associazione per la Divulgazione Astronomica e Astronautica" from Italy, envisaged to have an ArduinoSiPM as main payload when placed in orbit, which allows to monitor the cosmic radiation in low earth orbit by using a Silicon PhotoMultipliers (SiPM) coupled to a sparkling crystal. This work aims to develop and analyse the power management subsystem for the ALSat1 mission. The primary task is to find the necessary components to build and make a 1U size CubeSat able to perform the mission and subsequently analyse if it is capable to complete the mission for three different orbit RAANs (RAAN 0°; RAAN 53.5°; RAAN 90°). The orbit with RAAN 0° is the one with most energy available and the orbit RAAN 90° is the least. The 53.5° RAAN orbit was already established, in a previous work, for the CubeSat passing above Malpensa airport during the less traffic hours, for communicating with the ground station. The CubeSat is predefined to be in a circular orbit with inclination 97.68° and the altitude 561km. The components for the CubeSat were selected according to their energy consumption and compatibility. An algorithm to determine when the payload and the transmission subsystems are on or off was made. Then, a MATLAB program following the logic of the algorithm was created, in order to simulate the CubeSat performance. The MATLAB programme simulates the scenario showing the energy consumed and energy deficit during an orbit period and during a day; it also calculates the energy used by the batteries during a year. It was found that the orbit with RAAN 0° and orbit with RAAN 53.5° can complete the mission. The orbit with RAAN 0° is the orbit with more power available and is the best option if we do not consider the air traffic at the Malpensa airport during the communication time. However, considering the air traffic at the Malpensa airport, the orbit with 53.5° RAAN is the best option and has enough power to perform the mission. However, the orbit with RAAN 90° had some deficit cumulated after a day, which leads to lack of energy, which is only possible to overcome by changing the algorithm to turn off the payload when the communication is on, or by using other components with less energy consumption.