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SPACE POWER SYMPOSIUM (C3)
Small and Very Small Advanced Space Power Systems (4)

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ELECTRICAL POWER SYSTEM OPTIMIZATION FOR NANOSATELLITE

Abstract

In the last year, the rapid development of cubesat technology created opportunities for universities to launch their own, low cost nanosatellite and thus be able actively enter in the space domain. Although the low cost, cubesat projects are generally not trivial, especially due to the constraints of harsh environment (temperature, radiations, vacuum, etc) and limited hardware choice. In many cases, the success of the mission depends on the reliability of the Electrical Power System (EPS), which is one of the most critical module.

This paper proposes a methodology for optimizing the EPS module, taking into account all the space requirements, such as orbit trajectory, inclination, aging, solar array's deterioration, battery life's improvement, energy consumption monitoring. A fundamental part of the study is focused on finding the best solution for solar arrays, which are the only source to actively and periodically supply power to nanosatellite. Therefore, it is fundamental to extend their lifetime as long as possible, opposing to their degradation. A specific algorithm has been developed to optimize and maximize the solar cells lifetime taking into account the effective area of exposure and the surface temperature.

In order to preserve the cells and maintain a high levels of performance, the study addresses the effective area of the solar cells for harvesting the maximum power and for controlling the thermal exchange in the satellite, combining the EPS with the Attitude Determination and Control System (ADCS). The interaction between the EPS and the ADCS allows to wisely change the attitude in order to selected the faces to be exposed to the sun. The aim is to design a fully autonomous system taking eventually into account all parameter such as temperature, voltage etc.

The approach is based on simulations executed with AGI's STK software, and modeling. The result obtained in the simulations have been compared with the ones carried out with the test bench developed at INSSET laboratory. Further works will consist in defining the best reliable architecture to avoid the power losses and at the same time, to ensure the necessary protection, from radiation and, to secure the system in case of failures with the necessary redundancy, in order to define a fully optimized EPS.