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MODELING OF ALBEDO NOISE IN COARSE SUN SENSORS USING A STRATOSPHERIC BALLOON.

Abstract

Efforts to improve and implement own space technologies in several countries have been made in recent decades and potentiated with the development of low-cost microsatellite technology, but for the most part, they have remained as ideas, proposals, regional aspirations, and not in concrete initiative due to factors specific to each country. However, the development of nanosatellite technology has grown exponentially in recent years and has given good experimental results in flight. Nanosatellites need several sensors to work, and one type of sensor widely used for low-cost 3-axis stabilization is the Coarse Sun Sensor (CSS). This type of sensor helps in the ADCS (Attitude Determination and Control System) by determining the sun vector with respect to satellite fixed frames. Despite their low-cost and small size with respect to other attitude sensors, one considerable noise that affects CSS is albedo, which is a noise produced by the earth's solar radiation reflected. Usually, mathematical models for CSS are developed in controlled environments neglecting albedo effects and once in satellite flight, several estimation methods based on adaptative Kalman Filters or albedo earth databases can be used to improve CSS attitude estimation, and in this way, the noise generated by albedo is reduced. Furthermore, considering that albedo values are related to region, season, time, and even global warming, it results in a lack of CSS experimental validations to quantify or predict the albedo effects in the designing stage of an attitude determination system that makes use of CSS. This paper presents the results of the development of a model that allows the calculation of the albedo coefficient perceived by the CSS BPW34, being it the payload of a stratospheric balloon mission. Design and development for payload subsystems, such as CSS amplifier circuit, environmental sensors (for gathering altitude data in flight), and manufacturing technics and facilities are explained. The payload had a final mass value of less than 180[g] and the data used for albedo modeling were taken up to an altitude of 17 $[Km]$. The launch was carried out at Space Bolivian Agency in the second Bolivian national contest of experiments in stratospheric balloons. Albedo model was formulated through the linearization of a potential trend function derived after mathematical analysis for payload kinematics in flight was done. In that regard, it is expected that this research will be valuable for researchers working with CSS, seeking low-cost experimental validation. Finally, future research directions are discussed.