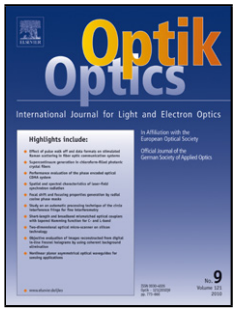

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Logic Based Imaging Payload for a Remote Sensing LEO Orbit Spinning Satellite

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Abstract

This article presents the design and simulation of the visible band imaging system for small sun synchronous LEO spinning satellite. Unlike conventional remote sensing satellites, which are designed based on three-axis attitude control systems, in this paper, the design is based on a spin stabilized satellite. In a spin-stabilized satellite, the satellite body is spun at a rate about an axis perpendicular to the orbital plane. Satellite imaging payload is based on linear CCD sensor that is placed in parallel with the axis of the satellite rotation. Hardware design is provided as a logic resulting in simplicity as well as more reliability of payload due to no need for programming. Moreover, because of the ICs' small surface, this payload is resistant against cosmic radiations and in the other words it is rad hard. It also results in a much lower cost comparing to the processor based structures which benefiting rad hard capability. The required parameters to design an imaging payload are calculated which, include integration time, optic aperture, focal length, field of view, image plane dimension, quantitative inefficiencies of detector, optic filter requirements and sampling parameters. For optic design, target radiation, which depends on sun angle, atmosphere passing and target characteristics, is calculated. After this, the CCD readout system, data handling system and the required circuits of these systems are presented in detail.

Keywords: Spinning satellite, LEO, Camera, Optic, CCD, Data handling, SNR.

1-Introduction

In the recent decades, space science has been significantly developed through the development of LEO orbit satellites. Today microsatellites are commonly utilized for remote sensing and other missions. This is because of the lower cost of microsatellites and the development of solid state imaging sensors which let tiny satellites to be able to perform earth surface imaging via powerfull imaging payloads. Nevertheless, many conditions must be satisfied when microsatellites imaging payloads are designed including low weight, low volume and limitted available power [1].

Spin stabilized satellites have been used for more than 40 years to perform earth observing, space physics and astronomy missions. They are inherently stable, typically naturally in a sunsafe configuration and do not require complex, active attitude control hardware to function properly [2]. In single spin satellites, the whole satellite spins about the angular momentum vector. Spin-stabilized satellites are simpler in design and less expensive than three-axis stabilized satellites. This method of stabilization has a high reliability and a long system life. However, Spin-stabilized satellite are subject to nutation and precession, but have a gyroscopic resistance which provides stability about the transverse axis. Low cost spinning imaging satellites are mostly utilized for low resolution imaging payload, namely hundreds