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SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Design and Technology for Small Satellites - Part 2 (6B)

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ANALYSIS AND PROCESSING ON HOMOGENEOUS IMAGE SETS FOR NANO-SATELLITE CAMERA SYSTEMS

Abstract

Students for Exploration Development of Space (SEDS), Students' Chapter, VIT University started a project to build a small satellite (CubeSat) VITSAT-1 of the nano-satellite class. A CubeSat is essentially a small satellite of dimensions 10X10X10 cm3 having a total weight of 1kg.

As a payload, the team has decided to integrate an off-the-shelf digital camera which will be able to give reasonable image quality and resolution meeting constraints of weight, size and other parameters. As the miniaturization induces constraints on the shape, weight and physical parameters (heat generation etc.) of all components on-board the computer, the Command and Data Handling unit which runs the On-board computer also faces the similar restrictions and thus has limited memory capacity, Random Access Memory and other computational resources.

The earthlink of such a satellite is very limited and the ground-station to satellite communication is possible for approximately 10 minutes, not more than 2 or 3 times a day, during which necessary payload data and log files are to be downloaded and new software (flight path etc.) uploaded. The large amount of image data collected on-board is stored in flash memory which is susceptible to radiation-induced bit flips, thus damaging image data. Also even using standard image compression techniques, it is not possible to download all images captured by the satellite.

It's required to select the best image(s) out of set(s) of images captured by the camera when operated in multi-frame capture mode. It's aimed to successfully develop such a tool, which would help in image processing on-board a small satellite and thereby be integrated along with the software.

With inclusion of camera module in VITSiAT-I, there was an urgent need to formulate a platform that made the images captured by the camera could be more economical in terms of transmission time and size. To do this, it's needed to perform basic image processing on-board the satellite which selects the best image from the image-sets captured.

The goal is to develop an image analysis tool which identifies the most appropriate image from a set of similar images taken over a short interval of time. The algorithm to select the best picture includes judging all pictures on specified criteria.

Study of previous missions having used camera module reveals that on-board image processing has not been achieved at the nano-satellite level. After a detailed literature survey of various image processing techniques and acquiring programming skills in MATLAB, it has been possible to formulate a framework for doing this analysis.