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CUBESAT-BASED HYPERSPECTRAL MISSION FOR MINING RESOURCE EXPLORATION : A PRELIMINARY STUDY

Abstract

Technological advancements in spectral sensors and nanosatellites have enabled the development of new applications in remote sensing, particularly in geological mapping, mining exploration, and environmental monitoring. Hyperspectral imaging has attracted significant interest over the past decade due to its ability to combine digital imaging and spectroscopy. Hyperspectral imaging is a powerful tool for capturing detailed information about a scene of interest. This technology operates by capturing radiation across numerous contiguous and narrow spectral bands, allowing for local spectral information to be obtained for each pixel in the resulting image. Hyperspectral imaging is capable of covering a broad spectral range that spans from 0.4 m to 2.5 m, as well as the infrared range between 3-5 m and 8-12 m. Compared to other satellite imaging technologies, hyperspectral imagers provide significantly more comprehensive information. With the development of nanosatellites, there is an opportunity to implement a various type of missions, including earth exploration missions for mining and energy resources, using increasingly compact imagers. This work proposes to explore the use of hyperspectral payloads embedded on CubeSat-class satellites to meet mining exploration needs. The objective is to synthesize the characteristics of various hyperspectral sensors, define the technical specifications required for the mining sector, and select a compact payload that can be embarked on board nanosatellites to explore mineral resources. The localization and detection of minerals on surfaces are often complex and require payloads with narrow spectral bands corresponding to the spectral responses of each element, as well as databases grouping their spectral signatures. The study investigates the technical feasibility of using a hyperspectral camera for imaging applications designed for CubeSat platforms, the challenges associated with its use, and the preliminary results of the mission analysis using Systems Tool Kit (STK) software package. STK provides a comprehensive set of design and mission analysis tools for space missions, enabling the evaluation of satellite orbit and payload performance. The results show that a hyperspectral mission, based on nanosatellites, can provide valuable information for mineral resource exploration while reducing the costs and risks associated with traditional missions.