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Author: Mr. Rodney Gracian
Manipal Institute of Technology, Manipal University, India, rodneygracian774@gmail.com

Mr. Kshitij Naik
Simon Fraser University, Canada, siriuscanis742@gmail.com
Mr. Sukumar Karumuri
Manipal Institute of Technology, Manipal University, India, kai.sukumar@gmail.com
Mr. Adheesh Boratkar
Manipal Institute of Technology, Manipal University, India, adheesh.boratkar@learner.manipal.edu
Mr. Gourav Mahapatra
Manipal Institute of Technology, India, mahapatra.gourav@gmail.com

HYPERSPECTRAL THERMAL IMAGING FOR TERRESTRIAL APPLICATIONS THROUGH A NANOSATELLITE

Abstract

Thermal imaging of terrestrial regions is always fascinating as the images reveal the thermal signature of the major emitting bodies in the atmosphere and on the surface. Thermal imaging acquires significance in analyzing the radiation budget of the earth. The thermal imaging band is the long wavelength infrared (LWIR) band which comprises mainly of emitted and transmitted radiation. Hence, the incident radiance will be a characteristic of the temperature of the body emitting it. The terrestrial applications which have been selected for monitoring are Atmospheric Cloud Monitoring, Ocean Surface Monitoring and Urban Heat Island Monitoring. The device used is a thermal infrared camera with a series of three spectral filters mechanism arranged in front of the camera lens. The thermal sensor used is a Vanadium Oxide**(VO)**bolometer. After frames are captured with one filter on, using a small stepper motor mechanism, the next filter is placed and frames are captured. The frames are then subjected to loss-less compression. This cycle will continue allowing the camera to have a three band view within the thermal band. The atmospheric window used is 7.5um to 13.5um. The filters divide this window into 7.5um-9.5um, 9.5um-12um and 12um-13.5um. The first window will be suitable for water vapour and ocean surface analysis, the second for the analysis of atmospheric clouds and the third for terrestrial mapping. The final composed image will be in band interleaved by line(BIL) format. The nanosatellite will also be equipped with a small CMOS sensor operating in the visible range. As infrared radiation cannot penetrate through the clouds, the visible image obtained from the CMOS sensor will come handy in distinguishing a cloud from a small ground surface area when both are emitting infrared radiation at the same temperature as they can't be distinguished in the thermal images. Thus, the thermal images obtained from the thermal sensor will be processed and then will be used to study thermal characteristics of different atmospheric clouds, cyclones(Tropical Cyclogenesis), ocean currents(El-Nino cycle) and urban regions which inturn will demonstrate the feasibility of hyper-spectral thermal imaging on a nano-satellite.