Refined Approach to Radiometric Characterization of a Hyperspectral (HySI) camera of Chandrayaan-I

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Chandrayaan-I during its just over one year life in orbit has provided immense data to scientific community globally and generated new hope to mankind's quest to look for life supporting environ in the outer space. Two of the eleven instruments aboard Chandrayaan-I, viz. Hyperspectral Imager (HySI) and Terrain Mapping Camera (TMC) were built at the Space Applications Centre (ISRO) in Ahmedabad (India). HySI enabled mapping of untapped mineralogical wealth over lunar surface in 400-950 nm spectral range with 80 meter spatial resolution, while panchromatic stereo Terrain Mapping Camera (TMC) made it possible to generate Digital Terrain Models(DTM) of lunar craters with 5 metre spatial resolution and cover a swath of 20 Km from orbital height of 100 Km. Developing laboratory measurement techniques, for carrying out the spectroradiometric characterization and calibration of the wedge-filter based dispersion system in HySI, was quite a challenge due to low system output aided by its narrow spectral bandwidth and low transmission of wedge filters. The radiometric calibration of HySI was possible using large area Lambertian source due to its built-in capability of diode array spectrometer in spectral range of 350-1050 nm with step size of 0.25 nm, 850mm diameter circular exit port to cover ±13○ FOV, wide dynamic range of spectral radiance output using seventeen high wattage internal lamps and a focused beam external lamp equipped with computer controlled variable aperture, each controlled by an independent precision regulated dc power supply. The traceability of the radiance output to internationally accepted scale was possible due to the laboratory reference standard source calibrated at NIST Facility for Automated Spectro-radiometric Calibrations (FASCAL) that uses variable blackbody to relate calibration of source to high reported accuracy. The spectral radiance of the source was measured using laboratory radiometer calibrated against laboratory reference standard and it was demonstrated that the expected profile of the Lambertian source is met. Radiometric calibration was used to generate transfer functions for each of the 256 pixels across

the swath, and also determine SNR, and operating conditions like exposure and gain settings useful during its mission life. This paper attempts to present the efforts made and results from this process.

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