

TMC-2 (TERRAIN MAPPING CAMERA-2 ONBOARD CHANDRYAAN-2 ORBITER) ONBOARD PERFORMANCE VALIDATION OPERATIONS. Vijayasree P^{1*}, Ankush Kumar², Minal Sampat², Amitabh², A.S. Arya², R. P. Rajasekhar², Amit K. Singh², Gomathi Sarata¹, Naga Manjushaa¹, M Srikanta¹, Ritu Karidhala¹, ¹URSC-ISRO, Bengaluru, India 560017; ²SAC-ISRO, Ahmedabad 380015 (*vijaya@urisc.gov.in).

Introduction: The TMC-2 (Terrain Mapping Camera-2 Onboard Chandryaan-2 Orbiter) payloads was switched ON during the Earth bound and Lunar bound orbits before reaching the intended 100km circular orbit around Moon. As there were restrictions on the manoeuvring of the composite module, the payloads were switched ON at specific time for Earth observation. During initial lunar bound phase (in elliptical orbit), TMC-2 captured the images of Moon, which are used for SNR performance estimation. From the Deepspace data dark performance is measured. The onboard performance in terms of dark and SNR, shows that radiometric performance is intact as per pre-launch lab radiometric calibration.

Earth observation by TMC-2: Earth observation by TMC-2 carried out in natural / inertial orientation of the spacecraft (Fig. 1A). It was cloudy condition at imaging location (Fig. 1B). In Earth observation data, portion of the Earth and Deepspace was covered across the swath of TMC-2. About 25% of the swath contains Earth and 75% Deepspace (Fig. 1C). TMC-2 image acts as context information for IIRS image of the same location (Fig. 1D). From the Deepspace view data, (dark offset, SD) values observed are (43.7, 3.5), (45.6,3.5) and (45,3.6) for Fore, Aft and Nadir chains against pre-flight lab measured values of (43.8,3.5), (46,3.5) and (43.4,3.5) respectively.

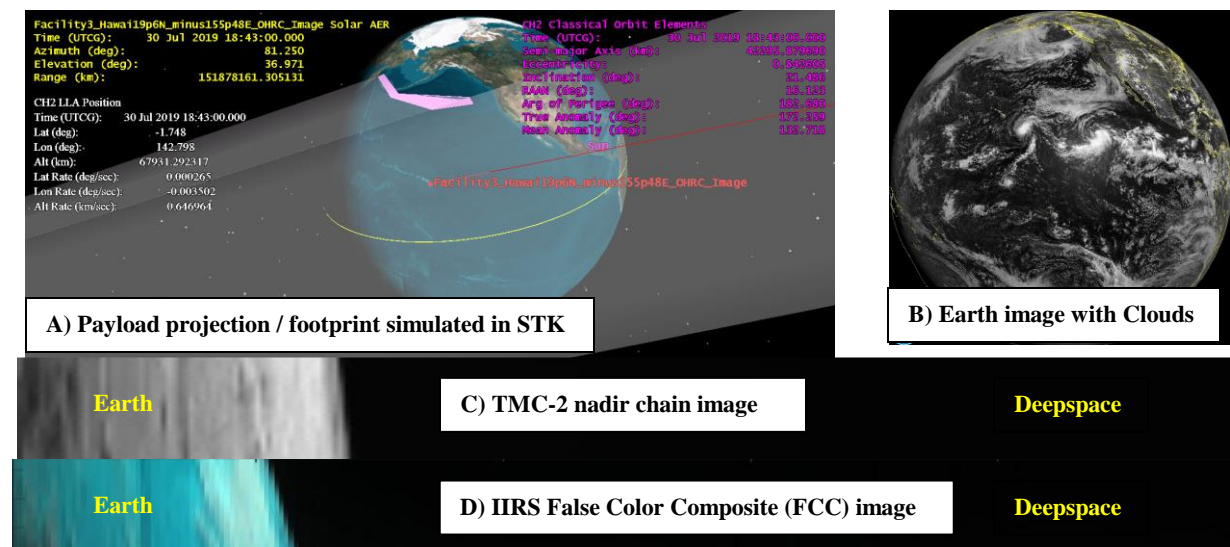


Figure 1: A) STK simulation for TMC-2 swath footprint on Earth (near North Pole) and in Deepspace, B) Earth's optical image of the same time frame showing cloud conditions, C) TMC-2 image of nadir chain showing Earth and Deepspace coverage, D) IIRS False Color Composite (FCC) image for which TMC-2 image acts as context information.

Moon observation from initial elliptical orbit around Moon: TMC-2 nadir chain image of Moon surface from initial elliptical orbit around Moon (Fig. 3A) is used for SNR performance measurement. A uniform region (Fig. 3B) is identified for mean signal and standard deviation (SD) computation. This SNR is computed. This SNR value is then compared with the pre-flight lab measurement for SNR at similar signal or count level. From Moon image measured SNR found to be 108 at mean count of 130, against the estimated SNR of 110 for same count value as per pre-flight lab measurement during radiometric calibration activity.

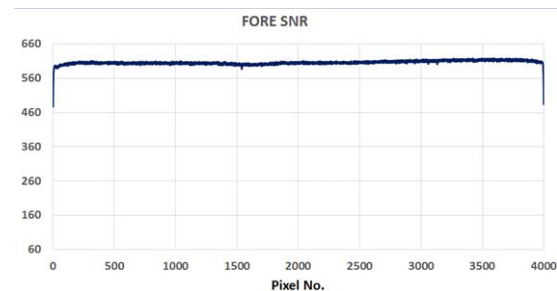


Figure 2: Near saturation SNR plot as per lab data^[1]. At near saturation, SNR of TMC-2 payload is more than 500 (Fig.2), indicating good performance.

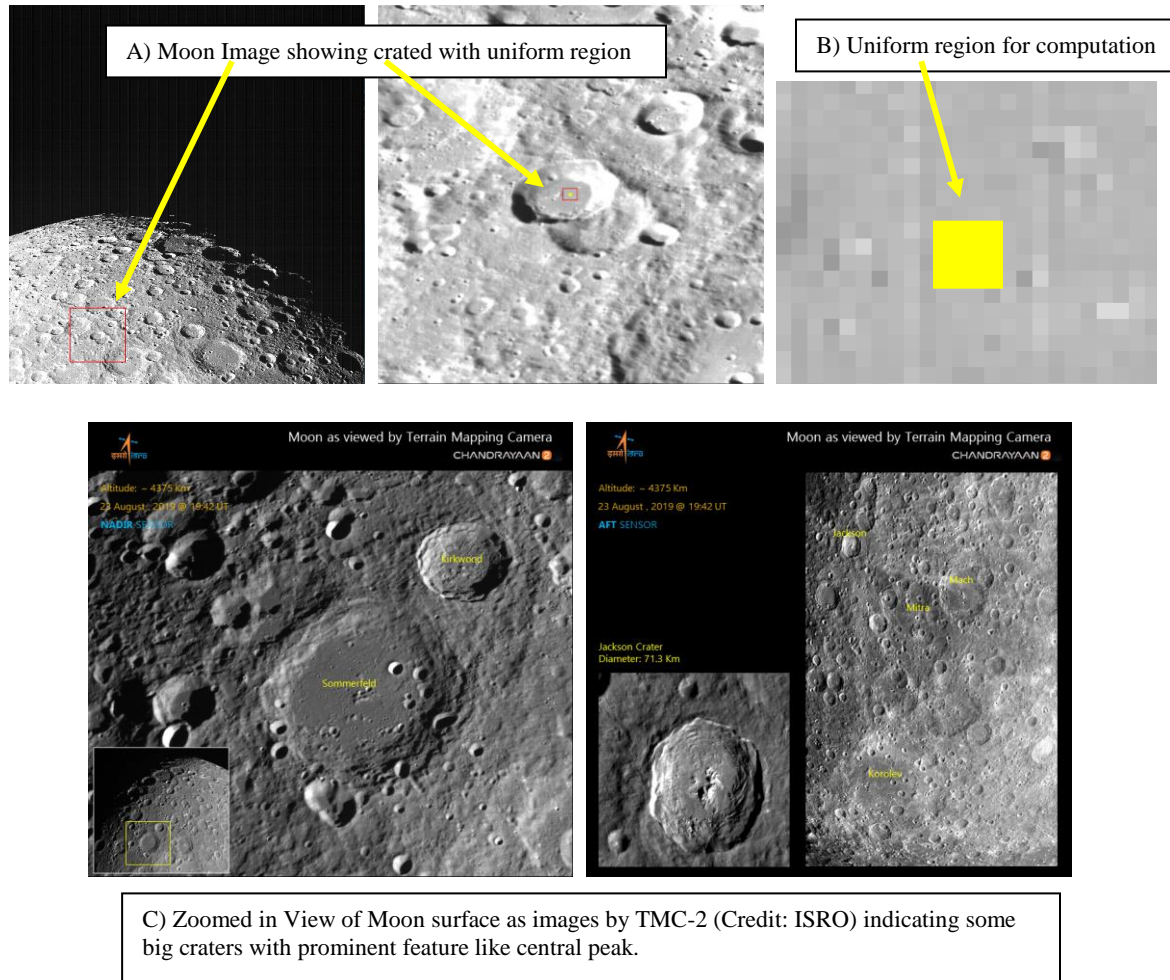


Figure 3: A) From initial elliptical orbit around Moon TMC2 captured Moon image showing crater with uniform region, B) Selected uniform region for SNR computation and C) Zoomed in View of Moon surface as images by TMC-2 (Credit: ISRO) indicating some big craters with prominent feature like central peak.

Summary and Conclusion: Earth observation operation of TMC-2 was useful for context information for IIRS. Deepspace portion is useful for dark performance measurement. Moon image from initial elliptical orbit around Moon is very useful for SNR performance validation. TMC-2 onboard performance w.r.t. dark offset, dark noise and SNR are found to be as expected and matching with pre-flight lab measurements during radiometric calibration activity.

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References:

- [1] RoyChowdhury A., Ankush K., et al. (2020) *Current Science*, 118(4), 566-572, "Terrain Mapping Camera-2 onboard Chandrayaan-2 Orbiter".
- [2] Arya A. S., Ankush K., et al. (2020), *LPSC 51st*, Abstract #1383, #1386.
- [3] Arya A. S., Ankush K., et al. (2021), *LPSC 52nd*, Abstract #2140, #2183.