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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 1 (2A)

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ON ORBIT EXPERIENCE AND CHALLENGES OF OPERATING CHANDRAYAN-3 ROVER NAVIGATION CAMERA

Abstract

ISRO has performed precise soft landing in Chandrayan-3 mission to Moon and demonstrated capability of controlling a Lunar Rover PRAGYAN which has explored the lunar terrain in the search of scientifically interesting area. A pair of state-of-the-art, miniature, monochrome, digital Navigation Camera (NavCam) are mounted on the front side of the Rover to compute the 3D position of the terrain ahead. For interplanetary mission or lunar mission, rovers are used for in situ measurements of scientifically interesting areas. Stereo Cameras are usually low cost methods to derive 3D information and perform path planning from the 2D image pair. Camera based measurement requires precise calibration and mounting to ensure required coverage and accuracy of the measurement of terrain ahead. Stereo matching needs similar performances over full FOV between left and right image pair. Considering the harsh operating condition in the moon with low mass and power constrain, reliable NavCam operation was challenging. Test and calibration is an utmost important aspect of making a mission critical Navigation camera. Electro-optical performances of NAVCAM was verified in front of an uniform light source and non-uniformity correction was done. Image sharpness was verified with Modulation transfer function measurement using different method. Left and Right NavCam alignment was ensured during mounting on the rover and it was calibrated with 3D target. This calibration data was used post landing to generate 3D point cloud from stereo image. NavCam was switched on just after the ramp deployment and post landing calibration ensured. These images were used for DEM generation, path planning and context imaging for various scientific measurement and geological study. Path planning of lunar terrain under different lighting condition was a challenging due to presence of slope, boulder, occlusion due to big boulder and crater. With multiple images taken at different angle has helped to complete 100m traversal of rover using NavCam images. During this traversal, it has images different size of rocks (1-11.5cm), boulder which has significant information for geological study. During The mission it has captured images of VIKRAM lander for outreach purpose as well as to study landing condition which will be useful for future mission planning and analysis. Overall Navigation camera has provided very important information for path planning and study of the lunar soil near Chandrayan-3 landing region.