3D LUNAR SURFACE RECONSTRUCTION BASED ON REMOTE SENSING IMAGERY FROM CE-2

Ahua Yang[1], Xuejun Li[2], Jianwei Xie[2], and Tao Liu[2]

[1]College of Postgraduate,
Academy of Equipment, Beijing, P.R.China, qs08123@sina.com
[2]Department of Information equipment,
Academy of Equipment, Beijing, P.R.China

Abstract: As the exploration and research on lunar has become a hot spot at present, this paper present a complete solution for effectively, automatically and accurately reconstructing the 3 Dimensional (3D) lunar surface based on the linear array push-broom imagery from Chang E-2 (CE-2). Firstly, with the sparse ephemeris data, an approach for estimating the corresponding areas between Forward (F) and Backward (B) imagery is proposed by exploiting the imaging characteristic of linear pushbroom cameras. Subsequently, Feature Based Matching (FBM) is conducted between F and B imagery, followed by area Based Matching (ABM) for dense correspondence. Subsequently, the extrinsic parameters of every scan line are estimated according to the supplied sparse ephemeris; and the orientation matrix is derived. Eventually, the Digital Ortho Map (DOM) and Digital Elevation Model (DEM) of one orbit are produced automatically by a series of steps including spatial intersection, Tin generation and differential correction.

The novelty of the paper lies in proposing an approach for estimating the corresponding area between Forward and Backward imagery by exploiting the imaging characteristic of the linear pushbroom camera. In addition, every scan line's orientation matrix is determined by interpolating the surveyed sparse ephemeris and constructing the virtual camera model.

We compare the result of spatial intersection with the data created by Japan Aerospace Exploration Agency (JAXA) to evaluate the accuracy. The Root Mean Square (RMS) errors in planimetry and altitude are respectively 100.257 m and 110.459 m. We also compare the discrepancies of spatial points' coordinates solved from two adjacent orbits. The RMS discrepancies in planimetry and altitude are respectively 42.890 m (6 pixels) and 106.489 m.

Experimental results show that CE-2 data has the same spatial positioning accuracy as JAXA data, and the accuracy is comparatively high and acceptable for mosaic and reconstruction. The visualized 3D realistic scene of lunar surface validates the feasibility of the proposed solution.

Key word: CE-2; linear array pushbroom camera; corresponding point matching; camera orientation; 3D reconstruction