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ABSTRACT SUBMISSION FORM

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Title of the Paper Evaluation of Rational Function Model for Geometric Modeling of Chang'E-1 CCD Images
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ABSTRACT(more than 300 words) [5]

Rational Function Model (RFM) is one of the generic geometric models in photogrammetry and remote sensing to represent the transformation between image space and object space. Due to its generality and excellent capability of fitting complex rigorous sensor models, it has been widely used in geometric processing of high-resolution earth-observation satellite images, especially when the rigorous sensor models are not supplied and internal geometric parameters are not disclosed. So far, to the best of our knowledge, no study on feasibility and application of RFM for extra-terrestrial mapping (such as lunar and Mars mapping) has been reported. This paper presents an evaluation of RFM for the three-line CCD images of China's Chang'E-1 (CE-1) lunar orbiter.

CE-1, China's first lunar probe, was launched on 24 October 2007 and operated until 1 March 2009. The CE-1 CCD camera is a three line pushbroom camera which has a 120m ground resolution and a swath width of 60km. We have developed a rigorous geometric model for CE-1 based on pushbroom imaging principle and exterior orientation parameters derived from spacecraft trajectory (position and orientation) data. Until now, the spacecraft trajectory data of CE-1 is not open to public, though the CCD images and other scientific data have been released for public access.

In this study, we test the feasibility and precision of fitting rigorous sensor model with RFM using CE-1 CCD images acquired from three orbits. Thousands of virtual control points are generated based on the rigorous sensor model. Then RFM model parameters are solved iteratively using a least squares estimation with Tikhonov regularization. After the FRM parameters for forward-, nadir- and backward-looking images are generated, the precision of the RFM is evaluated by comparing with the rigorous sensor model in both image space and object space. Experimental results using images with the size of 10,000 rows *512 columns show that RFM can precisely fit the rigorous sensor model of CE-1 CCD images with RMS residual errors of a magnitude of 1/100 pixel in image space and less than 5 meters in object space. This indicates that it is feasible to use RFM to describe the imaging geometry of CE-1 CCD images and spacecraft position and orientation. More tests will be performed for more lunar and Mars orbital images. RFM will enable planetary data centers to have an option to supply RFM parameters of orbital images while keeping the original orbit trajectory data confidential.