**Multiple techniques for Lunar Surface minerals mapping Using Simulated Data**

Haixia He[1] ,Bing Zhang[2],Zhengchao Chen[2],Ru Li[3]

（1. The State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing Applications, Chinese Academy of Sciences,Beijing,100101 2. Center for Earth Observation and Digital Earth, Chinese Academy of Sciences, Beijing, 100080 3. Institute of space and earth information science, the Chinese university of Hong Kong）

Lunar surface minerals mapping is one of basic aims of China's Lunar Exploration Program. Spectroscopic studies of moon analog minerals combine multiple techniques which were successfully used in the mineral mapping of the earth. It should be studied deeply whether these methods are effective to the surface features identification or not in that spectral characteristics of the moon are evidently different with that of the earth. These spectroscopic differences come into being from the different physical and chemical components, the different geological formation process and different surface characteristics between the moon and the earth. The goal of this paper was to use multiple mineral mapping techniques including classification and spectral matching for lunar surface minerals mapping and choose the effective methods based on the image data. While the spectral region and the spectral resolution of the lunar image data present is not ideal to mineral mapping, the simulated image data were required.

The image data was simulated using spectra of 76 lunar samples (19 surface features with 4 sizes) supplied by LSCC (Lunar Soil Characterization Consortium). Firstly, the spectra characteristics and the affected factors of the lunar surface features were analyzed. Then, choose the supervised classification, unsupervised classification and spectral matching methods to perform lunar mineral mapping. In the supervised classification, mean values of the spectral data of four sizes(<10 $\mu m$, 20-45 $\mu m$, 10-20 $\mu m$, <45 $\mu m$) for every 19 samples were calculated and select this mean samples as training classes. Classification methods included Parallelepiped, Minimum Distance, Mahalanobis Distance, Maximum Likelihood, Binary Encoding, and Support Vector Machine. SAM (Spectral Angle Mapping) and SID (Spectral Information Divergence) were used as spectral matching methods. At last, the lunar mineral mapping results were analyzed and evaluated and the effective method was brought forward to.

The results indicated that unsupervised classification was not useful to the lunar mineral mapping. The ability of the supervised classification is different to the simulated image data. Mahalanobis Distance perform best and its classification precision is 100%, support vector machine is 97.37% , minimum distance ,Parallelepiped ,binary encoding are ordinal to 35.53%、28.95%、 25%. Maximum likelihood is 11.84%. Of the spectral matching methods, SAM is more effective than SID in that the samples with the same spectral divergence couldn't be identified by SID while can be identified by the SAM method.The classification capability was different for the different size samples of the same materials. Of the four sizes, the classification precision of <45 $\mu m$ sample is highest. The classification precision of 0-20 $\mu m$ sample is low than that of <45 $\mu m$ sample, The identification precision of <10 $\mu m$ and 20-45 $\mu m$ is low comparatively. The identification precision is different for the different surface features. The samples with obvious diagnosed spectral characteristic can be identified effectively. Those without diagnosed spectral characteristic are sensitive to the mapping method. Besides the mapping methods, there are some other factors which may affect the mapping results, such as the physical and chemical component of the lunar soil, the lunar soil maturity, the particle size and the data preprocessing procedure.

To be concluded, SAM, Mahalanobis Distance and Support Vector Machine were recommended for the lunar mineral mapping. At the same time, some particular characteristics which may be ignored in the earth mineral mapping should be considered in the lunar mineral mapping.

Corresponding author: hehaixia1980@yahoo.com.cn

Telephone: (+86)013681582134