Automatic mapping of morphology and mineralogy from planetary hyperspectral remote sensing images: A case study of Lunar hyperspectral images

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With increasing volume of planetary hyperspectral (HS) remote sensing data, there is a need of robust and automatic techniques for processing and interpretation of images. In this paper, we address automatic detection of surface morphological parameters and mineralogy from planetary hyperspectral remote sensing images of lunar surface. This study employs the detection of impact craters and their spatial structures (crater rim, wall, crater floor, and ejecta) and basic composition in and around the impact craters using machine learning approaches. We implemented convolutional neural networks (CNN) for the detection of morphological parameters. The performance and the accuracy of model depend on both spatial and spectral information of HS images. Further, to reduce the computational complexity, we applied a hybrid spectral and spatial convolutional neural networks (HSSCNN) method. For modeling any machine learning based approaches ground truth or labeled data and large numbers of training samples are required. Hence, the labeled data from previous lithology and morphology maps are considered and trained the HSSCNN method. We tested this model on Chandrayaan-1 HySI and M3 images of Schrodinger basin, which is located in South Pole Aitken basin of Lunar surface. The predicted outputs generated from the HSSCNN model are validated with visual interpretation. To prove the accuracy of this method, results are compared with the state-of -the art hand-crafted machine learning based methods. The accuracy of detection of the morphological parameters and mineralogy is very satisfactory when validated with other approaches also.

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