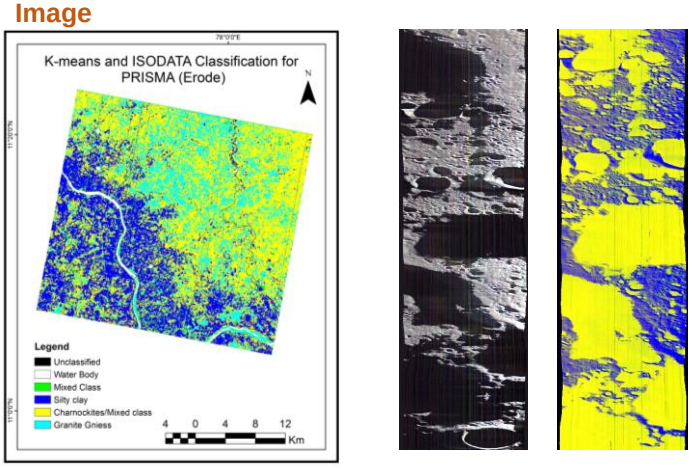
Recent advances in Hyperspectral remote sensors for Earth and Lunar observations

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Abstract

Hyperspectral remote sensing plays a crucial role in material characterization and identification. Hyperspectral sensors with hundreds of contiguous and sharp bands, can identify the minute and diagnostic absorption features against the mineral species on any surface in Visible to Near-Infrared region of Electromagnetic spectrum (400-2500 nm), thanks to very sharp bandwidth (~2 nm). Hyperspectral remote sensors can be divided into imaging and non-imaging spectroscopic sensors. Recently, there are lot of recent hyperspectral sensor were launched by different countries including India, USA, China, Italy, Germany for Earth and lunar observation separately. DESIS (DLR Earth Sensing Imaging Spectrometer hyperspectral) and PRISMA (PRecursore IperSpettrale della Missione Applicativa) by German (2018) and Italian space agency (2019) respectively are the most recently launched space borne hyperspectral satellite. In this work, few preliminary result from DESIS and PRISMA are discussed for geologically abundant areas from Northern and Southern India. Several imager processing techniques including unsupervised, data dimensionality reduction techniques and multivariate statistical techniques are discussed to check the ability of both hyperspectral sensors. The data from hyperspectral sensor named as VNIS (Visible and near-infrared imaging spectrometer) onboard Yutu-2 rover of Chinese spacecraft to moon, the Chang'4 mission (2019), also processed and few interesting features and physical processes from the far side of the moon are obtained including ejecta transfer and effect of space weathering. Here with VNIS, results from Moon Mineralogy Mapper (M^3) onboard Chandrayaan-1 mission of Indian space research organization (ISRO) also discussed for the same location, i.e., Von Karman crater in South Pole Aitken basin. This work, in brief, discusses about the recent advancement in hyperspectral sensor technology and how it is beneficial for present and future applications.

Image



(a) (b) (c)

Figure 1: (a) K-Means unsupervised classification for PRISMA data from Erode, India (b) M^3 hyperspectral sensor image for Shoemaker crater on lunar south pole (c) Integrated band depth image for M^3 hyperspectral sensor image for Shoemaker crater on lunar south pole

Recent Publications)

1. Heller Pearlshtien D, Pignatti S, Greisman-Ran U, Ben-Dor E. (2021) PRISMA sensor evaluation: a case study of mineral mapping performance over Makhtesh Ramon, Israel. International Journal of Remote Sensing. 3;42(15):5884-916.
2. Tripathi P, Garg R. D. (2020) First impressions from the PRISMA hyperspectral mission. Current Science 00113891: 119(8).
3. Gou S, Yue Z, Di K, Wan W, Liu Z, Liu B, Peng M, Wang Y, He Z, Xu R. (2020) In situ spectral measurements of space weathering by Chang'e-4 rover. Earth and Planetary Science Letters. 1; 535:116117.
4. Li C, Liu D, Liu B, Ren X, Liu J, He Z, Zuo W, Zeng X, Xu R, Tan X, Zhang X. (2019) Chang'E-4 initial spectroscopic identification of lunar far-side mantle-derived materials. Nature. 569(7756):378-82.
5. Qiao L, Ling Z, Fu X, Li B. (2019) Geological characterization of the Chang'e-4 landing area on the lunar farside. Icarus. 333:37-51.



Biography

Prateek Tripathi received his BE degree in electronics and communication engineering from Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, India, in 2016, and his MTech degree in remote sensing and geographic information system from Indian Institute of Remote Sensing, Dehradun, India, in 2018. Currently, he is pursuing his PhD in geomatics engineering group of Department of Civil Engineering at Indian Institute of Technology, Roorkee, India. His research interests include hyperspectral remote sensing, spectroscopy, lunar science, and exploration. He recently got featured on first ever Harris Geospatial ENVI student spotlight.



Biography

Rahul Dev Garg is a professor in the Department of Civil Engineering at Indian Institute of Technology, Roorkee, India. He received his BTech degree in civil engineering from the University of Roorkee, India, in 1989, MTech degree in remote sensing from the University of Roorkee, India, in 1993, and his PhD in civil engineering from the Indian Institute of Technology, Roorkee, India, in 1991. His research interests include remote sensing, GIS, land surveying, GPS, UAV, and LiDAR.

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