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TESTING NEW LUNAR COMPOSITION MAPPING TECHNIQUES FOR A 3U CUBESAT

Abstract

The objective of this work is to test a new composition mapping technique that uses an optical imaging instrument in combination with a simple spectrograph, for use on a 3U cubesat for lunar observation.

Firstly, a high resolution optical observation will be made of the moon with an Earth-based telescope. This will be done with a relatively small 200mm aperture 1m focal length Newtonian reflector telescope, with an ZWOptics ASI1600MM actively cooled monochrome camera. Speckle imaging technique will be used to counteract the turbulent effects of the atmosphere, by taking averages of many frames, in order to produce a high resolution image. Filters such as UV and IR will be used to produce an image with optimal color variation between different lunar regions. These color variations will be enhanced by increasing saturation.Then a fibre-optics simple single-pixel spectrograph will be used to scan in several strips across the lunar surface. The location of these scanning strips will be selected based on color variations found in the optical map. From this spectral data, analysis will be done to extract information about the composition of these areas of interest. Correlations between colors in the optical map and compositions found with the spectrograph will be drawn. If successful, this will give information about the lunar surface as a whole, by using the full resolution optical map.

Parallel to this observation technique, another observation of the lunar surface will be made with a hyperspectrograph. Multiple scans of the lunar surface will be performed with a hyperspectrograph attached to a 200mm aperture 2032mm focal length telescope. This hyperspectral data will be processed in order to extract information about the lunar composition, with the help of a machine learning algorithm currently being developed by Dr. M. Raouf. Comparing the lower resolution, but higher spectral accuracy information produced by the hyperspectrograph, with the higher resolution optical color map of the moon, will allow to evaluate which of the two options will produce the best results, based on resolution and composition analysis accuracy.

If the optical imaging technique proves viable, this can be considered for the 3U lunar observation cubesat.