Measurement and Minimization of Optical Distortion/Smile in a Wedge Filter based Hyper Spectral Imager

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The Hyper spectral imager (HySI) onboard Chandrayaan-1 is a wedge filter based camera system specifically designed for the mineralogical mapping of lunar surface in 64 contiguous spectral bands. HySI, which employs push broom mode of imaging, uses a 512x 256 APS area array detector with an f/4 telecentric lens with a wedge filter used as the dispersive element. Use of wedge filter has facilitated significantly in making the system more compact and lighter than the grating/prism based systems. The main limitations of grating based systems are the need to use auxiliary optics, multiple diffraction orders and polarization effects. A wedge filter based imaging spectrometer is free from these disadvantages and exhibits very low spectral non-uniformity in the spatial direction termed as 'optical smile'. Smile, in grating based systems, originates from the change in dispersion angle with field position and manifests itself as slightly shifted wavelength centers for pixels in a given row in the spatial direction. This distortion limits spectral purity and in turn limits robustness of sub pixel discrimination or detection algorithm. Accurate calibration is crucial for the extraction of detailed quantitative information from the readouts. Smile values of as much as 1 to 2 pixels have been accepted in previous grating/prism based spectrometer (Ocean PHILLS Hyper Spectral Imager) designs. Here we report, optical smile observed in a wedge filter based system like HySI to be less than 0.3pixel. Moreover, most of the earlier measurements of optical smile have been carried out for grating/prism-based spectrometers. In this paper we report smile measurements on a wedge filter based system with discussions on the method of measurement and the challenges faced to minimize the smile.

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