IMAGE QUALITY EVALUATION ON CHINESE FIRST EARTH OBSERVATION HYPERSPECTRAL SATELLITE

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ABSTRACT

A Micro-satellite Constellation for Environment and Disaster Monitoring was successfully launched in China on September 6th, 2008, which includes two small satellites as Satellite-A (HJ-1A) and Satellite-B (HJ-1B). It is the first time for China to launch such kind of remote sensing satellites especially for the earth environment and disaster monitoring. The payloads of HJ-1A include a CCD camera and an interferometric imaging spectrometer; the payloads of HJ-1B include a CCD camera and an infrared scanner. The interferometric imaging spectrometer installed on HJ-1A is the first earth observation imaging spectrometer of China. Its spectrum range covers from 0.45μm to 0.95μm with 115 spectral bands. The average spectral resolution of the 115 bands is about 5 nm. The nominal ground sample distance is 100m with an image swath of about 60km.

As a new satellite sensor, the image quality of the interferometric imaging spectrometer is evaluated in this paper, which is of basic importance and high related with its further applications. For assessment of the image quality of the hyperspectral imager of HJ-1A, a field measurement campaign was carried out at the Dunhuang calibration site (40° 05′ 25″ N, 94° 23′ 35″) on October 16-24th, 2008. Dunhuang calibration site is a standard calibration and validation site of China. It is wide and flat and has good reflectance homogeneity. The ground reflectance is few varieties from 0.10 to 0.35 during 0.35-2.5μm. In the field measurement campaign on October 20th, 2008, the field spectra were measured simultaneously with HJ-1A passing right over by using an ASD field spectrometer, with a spectral response range of 350 nm to 2500 nm. Several typical ground calibration targets at Dunhuang site were measured, including gobi, water, vegetation, and cement ground. In addition to the surface reflectance, atmospheric measurements were acquired by a CE318 spectrophotometerat at Dunhuang site. The air temperature, humidity, and pressure were measured by using handheld weather station.

With the surface reflectance, atmospheric measurements, water vapor constraints, and other field data, the 6S radiative transfer code is used to model the upwelling radiance incident at the interference imaging spectrometer of HJ-1A. The raw image of interference imaging spectrometer is well atmospheric corrected and then translated into reflectance image. By comparison of the HJ-1A radiance spectrum with the radiative-transfer-code-predicted spectrum for the several calibration targets, the radiometric and spectral performance of the interference imaging spectrometer is evaluation. Many parameters such as the dynamic range, linearity, and radiometric precision are calculated and assessed. From the homogeneous image of the HJ-1A hyperspectral imager, the Signal-to-Noise Ratio (SNR) is estimated based on high between-bands correlation.

Multiple linear regressions are used to remove the predictable information in the image, and leave 'unexplained' residuals approach the noise. This noise estimation results can be well used to estimate noise covariance matrix for hyperspectral data dimension reduction, such as Maximum Noise Fractions (MNF).

Based on the assessment results, it can be seen that the interferometric imaging spectrometer of HJ-1 has good radiometric and spectral performance and will be promising in the applications of environment and disaster monitoring.

REFERENCES

[1] Chen Z.C., Zhang B., Zhang L.M., et al. In-flight Calibration and Assessment of Beijing-1Microsatellite. The 3 rd International Symposium on Future Intelligent Earth Observing Satellites (FIEOS), Beijing, 2006.

[2] Green, R.O., Pavri, B.E., Chrien, T.G. On-orbit radiometric and spectral calibration characteristics of EO-1 Hyperion derived with an underflight of AVIRIS and in situ measurements at Salar de Arizaro, Argentina. IEEE Trans Geosci Remote Sens, 2003,41(6):1194-1203.

[3] Hu X.Q, Zhang Y.X, Liu Z.Q, et al. Optical characteristics of China Radiometric Calibration Site for Remote Sensing Satellite Sensors. Proc. SPIE, 2001, 4151:77-86.

[4] R. E. Roger and J. F. Arnold. Reliably Estimating the Noise in AVIRIS Hyperspectral Images. International journal of remote sensing, 1996, 17(10): 1951-1962.

[5] Vermote E F, Tanre D, Deuze J L, et al. Second simulation of the satellite signal in the solar spectrum, 6S: an overview. IEEE Trans Geosci Remote Sens, 1997, 35:675-68.