EVALUATION OF THE SIMULATED AT-SENSOR RADIANCE OF THE HYPER-SPECTROMETER PAYLOAD UAV PLATFORM USING MODTRAN MODEL

Yaokai Liu[1], Ning Wang[1], Lingling Ma[1], Lingli Tang[1] and Chuanrong Li[1]

[1] *Key Laboratory of Quantitative Remote Sensing Information Technology, Academy of Opto-Electronics, Chinese Academy of Sciences, Beijing, China, liuyk@aoe.ac.cn*

Abstract: Hyperspectral imaging has been an active research in remote sensing society in recent years. With the development of airborne and spaceborne hyperspectral imaging systems, more and more hyperspectral images have been applied in agriculture, mineral exploration, environmental monitoring and so on. However, to use the hyperspectral images effectively, the nature and limitations of the data and the strategies of data processing and interpreting are required to be well understood. Thus, it is important to evaluate the performance of the sensor and to investigate the capability in monitoring the key variables of surface and atmosphere before the data processing and retrieval methods are developed and improved. The aim of our study is to evaluate the performance of the simulated at-sensor radiance in various aerosol optical depth (AOD) and water vapor content (WVC) when using different reflected hyperspectral calibration targets to carry out hyperspectral data calibration, which is helpful in understanding the signal simulation scheme and needed for hyperspectral data processing namely, radiometric and spectral calibration. First, sensitivity of atmospheric parameters to simulated at-sensor radiance using moderate spectral resolution atmospheric transmittance (MODTRAN) model will be analyzed. Then, the at-sensor radiance over the four hyperspectral calibration targets will be simulated using MODTRAN model with the atmospheric parameters measured at the time of the unmanned aerial vehicle (UAV) overflights. And then, simulated at-sensor radiance over the four hyperspectral calibration targets will be compared with the radiance obtained from the hyper-spectrometer payload UAV. Finally, the simulated at-sensor radiance of the hyperspectral calibration targets was evaluated using noise equivalent delta radiance (NEΔL) and absolute error (AE). Sensitivity analysis of atmospheric parameters to simulated at-sensor radiance shows that the at-sensor radiance is significantly affected by the AOD and WVC, especially for the high spectral reflectance targets. An average relative deviation of 15.11 percent was observed for a variation of the water vapor content from 0.1 to 3.0 g/cm^{-2} and an average relative deviation of 4.6 percent with aerosol optical depth varying from 0.1 to 2.0 degrees. Conclusions can be drawn when evaluation of the simulated and measured at-sensor radiance with NEΔL and AE that the higher of the hyperspectral calibration targets reflectance, the more accurate of simulated at-sensor radiance. Results of this study also show that not all the hyperspectral calibration targets (for example, the H_2 hyperspectral calibration targets in this paper) are the optimal choice for the at-sensor radiance simulation though there are low average

relative errors between simulated and measured values. Therefore, it is very important to choose the proper hyperspectral calibration targets before simulating the at-sensor radiance to carry out the radiometric calibration, retrieval of surface reflectance and other studies.
Keyword: Hyper-spectrometer, MODTRAN, Simulated at-sensor radiance, Noise equivalent delta radiance, Atmospheric parameters