VALIDATION FOR THE ABSOLUTE RADIOMETRIC CALIBRATION OF THE HJ-1B CCD SENSORS OF CHINA*

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ABSTRACT

The satellite HJ-1B was launched into a sun-synchronous, near-polar orbit on September 6, 2008. It is one of the satellites of the small satellite constellation of China for environment and disaster monitoring and forecasting, and has two wide cover multi-spectral cameras (CCD) and an infrared sensor. The CCD sensor of the HJ-1B has four discrete bands ranging from 0.43 to 0.90 μm with the spatial resolution at nadir of 30 meters [1]. It is well known that many factors, such as the distortion of remote sensing system or the equipment aging may cause a greater deviation between the collecting radiation energy and the actual radiation energy [2]. So the radiometric calibration for the HJ-1B sensors is very important, which can help us to characterize the operation of the sensors, as well as, more importantly, it make the data of those sensors to be used in a wide sense for such applications as environment and disaster monitor and other uses.

In order to determine temporal changes of the absolute radiometric calibration of the HJ-1B satellite in flight, a program was carried out at DunHuang field calibration, Gansu province of China, from August 19 to 30, 2009. In this work, the spectroradiometric information of the ground and the atmosphere were measured simultaneously with the image acquisitions over that region. And then based on a great deal of work, the absolute calibration coefficients of the HJ-1B CCD sensors from band 1 to 4 were determined. As well-known, the accuracy of the radiometric calibration is critical to reduce the bias caused by the satellites, atmosphere, or the terrain effect et al. So in this paper, we aimed to validate the absolute calibration results of the HJ-1B CCD sensors as given in the Tab.1, which determined in this year [3], by means of comparing it with some field data. Those data come from the DunHuang calibration field, Gansu province and the BaoTou, Neimenggu province. The former were collected from august 20 to 28, 2009, including the spectrum of a cotton field, a cement place and a water body,

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and the meteorological data on the same day. The latter were measured from August 6 to 8, 2009 and at October 13, including the spectrum of different vegetation cover and bare land. In order to test the calibration results, the CCD images of HJ-1B corresponding with the field data both the time and the area were available. The DN values of those images were calculated to the field reflectance. At the same time, because the bandwidth of the HJ-1B CCD sensor is wider than the field spectrum data, all the field spectrum data were processed by integrating to the same wide with the bandwidth of CCD so as to the validation was effective.

Tab.1 The results of the absolute radiometric calibration of HJ-1B CCD sensors, 2009.

Where, A = gain factor (DN / ($W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$)), L0 = bias factor ($W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$).

Sensor	Gain Status	Parameter(A / L0)	Band			
			Band1	Band2	Band3	Band4
CCD-1	Gain factor 1	A （DN/($W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$)]）	0.4817	0.4728	0.6262	0.7007
		L0	1.6146	4.0052	6.2193	2.8302
	Gain factor 2	A （DN/($W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$)]）	0.7726	0.8092	1.117	1.1337
		L0	3.0089	4.4487	3.2144	2.5609
CCD-2	Gain factor 1	A （DN/($W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$)]）	0.5759	0.5488	0.7537	0.7753
		L0	3.4608	5.8769	8.0069	8.8583
	Gain factor 2	A （DN/($W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$)]）	0.8934	0.9006	1.2461	1.1261
		L0	2.2219	4.0683	5.2537	6.3497

From the comparison, it is clearly to reach the conclusion that the reflectivity calculated from the CCD images good matched with the field data, most of those had a high correlation coefficient. On the other hand, there also were some places where the match was not so good, especially the data collected from Neimenggu province. The reason is that in this region, because lacking the meteorological data, the compute for the field reflectance had more errors. What's more, another reason to this phenomena may be is that there were not the pure pixels in the remote sensing images because of the spatial resolution, but we considered it as a pure pixel either when made comparisons.

KEY WORDS: Radiometric calibration; validation; HJ-1B satellite; CCD

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