Vicarious calibration of CCD camera on CBERS02B using Gongger test site

Hui Gong(1)(2), Tao Yu(1), Guoliang Tian(1), Xingfa Gu(1), Hailiang Gao(1), Xiaoying Li(1)
(1): State Key Laboratory of Remote Sensing, IRSA, CAS, Beijing , China
(2): School of Civil Engineering,Beijing Jiaotong University,Beijing China
Corresponding author: Hui Gong, Institute of Remote Sensing Applications, P.O.Box9718, 100101, Beijing, China. Tel/Fax +86 10 64889562, email: gonghuiyue@sohu.com

ABSTRACT

on September 19 2007, CBERS02B, the third land resource satellite jointly developed by China and Brazil was successfully launched with three payloads on it, one of which is CCD camera. Calibration of CCD is a precursor for its quantitative application because there wasn't onboard calibrator for CCD. Then a comprehensive vicarious calibration and validation experiment of CCD was performed at Gongger test site located in Inner Mongolia , in the middle of October 2007.

Gongger test site is a quite flat uniform grassland with an area of 4×5km^2 , which is devious of grass in October. a area of 400×400m^2 at the site was chosen for CCD calibration.

Reflectance-based calibration method was used for absolute calibration of CCD in this calibration experiment. The ground reflectance of the test site was measured in the reflectance-based method during CBERS02B overpass. Atmospheric conditions, including solar extinction measurements and sounding and meteorologic observations were also measured at the same time. The data were analyzed to determine inputs to radiative transfer codes. It can be assumed that the measured surface reflectance was representative of the whole CCD pixel due to the site uniform characteristics. BRF needed not to be corrected due to on-nadir. By calculating relative reflectance with reference panel and surface measurement data and interpolating BRF of reference panel according to solar zenith angle at the view time, the surface absolute reflectance $\rho_T(\lambda)$ could be obtained as $\rho_T(\lambda) = \frac{v_T(\lambda)}{v_s(\lambda)} \rho_s(\lambda)$, where $\rho_s(\lambda)$ was spectral BRF of reference panel corresponding to solar zenith angle at the view time; $v_s(\lambda)$ and $v_T(\lambda)$ were respectively counts for reference panel and the target under the same view condition. By intergrating surface spectral reflectance data with CCD relative spectral response，the equivalent spectral reflectances ρ_i for band i were calculated as $\rho_i = \frac{\int_{\lambda 1}^{\lambda 2} \rho(\lambda) RSR_i(\lambda) d\lambda}{\int_{\lambda 1}^{\lambda 2} RSR_i(\lambda) d\lambda}$, Where $\rho(\lambda)$ was the measured spectral reflectance at λ; $RSR_i(\lambda)$ was the relative spectral response for band i. Data from the CE318 automatic sun tracking photometer measuring spectral solar direct irradiance were used in a Langley method to determine atmospheric optical depths. It was assumed that the aerosol size distribution was coincident with Junge law. Based on these data, aerosol optical depth for band 550nm was retrieved from aerosol optical depths of band 440nm and band 870nm. Total column water vapor was computed with sounding view outline. The content of ozone came from NASA TOMS data. The radiance at the sensor entrance pupil was calculated using a radiative transfer code, 6S, that accounts for multiple scattering. The area corresponding to the test site was selected according to GPS data and average digital count for pixels of the area was extracted from CCD data. Since spacial digital counts had been removed from CCD data, that is to say, offsets were zero, the calibration coefficients could be obtained by comparing the

TOA radiance with the corresponding average digital count, just as the expressions $L_i = a_{li} * DN_i$ and $\rho_i = a_{ri} * DN_i$, Where L_i and ρ_i were respectively the TOA radiance($Wm^{-2}sr^{-1}\mu m^{-1}$) and apparent reflectance for band i; DN_i was the digital number count for band i; a_{li} and a_{ri} were respectively calibration coefficients of radiance and reflectance for band i.

Last, Error sources effect were calculated for calibration coefficient. Main error sources were from the measurement of ground reflectance, the assumption of a lambertian characteristic for the ground, calibration of the radiometer and reference panel, the optical depths, aerosol mode, adsorption gases such as water vapor and ozone.

KEYWORDS: vicarious calibration; CCD; CBERS02B; reflectance-based method; Gongger test site;

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