PROCEEDINGS OF SPIE REPRINT

SPIE—The International Society for Optical Engineering

Sensors, Systems, and Next-Generation Satellites VII

8 September 2003
Barcelona, Spain

Volume 5234

Using the Moon for MODIS On-orbit Spatial Characterization

X. (Jack) Xiong[*a], J. Sun[b], S. Xiong[b], W.L. Barnes[c]
[a]Laboratory for Terrestrial Physics, NASA/GSFC, Greenbelt, MD 20771;
[b]Science Systems and Applications, Inc., 10210 Greenbelt Road, Suite 600, Lanham, MD 20706;
[c]University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD 21250

ABSTRACT

The moon is a very stable reference source that has been used for the space-borne sensors' radiometric calibration and/or radiometric stability monitoring. In this paper, we present an approach that uses the sensors' on-orbit lunar observations for their spatial characterization and apply the method to the MODIS instruments that are currently operating onboard NASA EOS Terra and Aqua satellites. Both MODIS instruments perform monthly lunar observations. The spatial characterization results derived from the lunar observations using this algorithm are compared with those obtained from the MODIS Spectro-Radiometric Calibration Assembly (SRCA), which is an on-board calibrator capable of performing spatial characterizations for all MODIS spectral bands. The new approach can be applied to other remote sensing instruments.

Keywords: MODIS, Moon, spatial characterization, BBR, Terra, Aqua

1. INTRODUCTION

The MODerate Resolution Imaging Spectroradiometer (MODIS), one of the key instruments for the NASA's Earth Observing System (EOS), is currently operating on the EOS Terra and Aqua satellites[1-3]. They were launched on December 18, 1999 and May 4, 2002, respectively. MODIS has 36 spectral bands with three different nadir spatial resolutions: 250m for bands 1-2, 500m for bands 3-7, and 1.0km for bands 8-36. Among them, 20 are reflective solar bands (RSBs) and 16 are thermal emissive bands (TEBs). The radiometric calibration of the RSB is performed with an onboard Solar Diffuser (SD) and Solar Diffuser Stability Monitor (SDSM) [4-7] while that of the TEB by an onboard Blackbody (BB)[5,8]. Another onboard calibrator, the Spectro-Radiometric Calibration Assembly (SRCA), is primarily used for the instrument's spatial and spectral characterization[9-11].

Band-to-band registration (BBR) is a key component of the MODIS spatial characterization. The BBR of the MODIS bands can be derived from SRCA spatial mode data[12]. Currently, the measurement of SRCA in spatial mode is performed once every two months for both Terra and Aqua. The SRCA results have shown that the BBR are quite stable for both instruments.

The moon is known to be a very stable radiometric light source for remote sensor's radiometric stability monitoring[13-17]. MODIS views the Moon through its Space View (SV) Port. Since the lunar irradiance strongly depends on the Sun-MODIS-Earth phase angle, we confine the phase angle to be in the region [55°, 56°] for MODIS lunar observations. To keep the phase angle in this region, a spacecraft roll maneuver is usually needed for each lunar observation[17]. Both Terra and Aqua MODIS have viewed the Moon approximately monthly since launch. So far, more than 30 and 10 lunar observations have been implemented for Terra and Aqua MODIS, respectively.

The moon is a point light source and thus can be used for spatial characterization of the on-orbit remote sensors. In this paper, an approach is developed to calculate the BBR of the MODIS along both the scan and track directions using lunar observations and applied to Terra MODIS RSBs. The results are compared to those derived from SRCA spatial mode data, showing good agreement. With the new approach, detector-to-detector registration (DDR) for a given band can also be calculated. The results of the DDR are discussed. This approach can also be applied to other remote sensing instruments.

[*] Xiaoxiong.Xiong-1@nasa.gov

Sensors, Systems, and Next-Generation Satellites VII, edited by Roland Meynart,
Steven P. Neeck, Haruhisa Shimoda, Joan B. Lurie, Michelle L. Aten, Proceedings of SPIE
Vol. 5234 (SPIE, Bellingham, WA, 2004) · 0277-786X/04/$15 · doi: 10.1117/12.510570