VALIDATION OF THE LEICA XPRO RADIOMETRIC PROCESSING CHAIN USING ADS40 DATA

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ABSTRACT:

The special advantage of the new digital imaging technology in comparison to film-based imaging is in the excellent radiometric properties, including multi-spectral imagery, linear response, large dynamic range, high radiometric resolution, and low noise level.

Radiometric correction is crucial in order to quantitatively utilize the radiometric quality. In the physical correction chain the fundamental steps are to apply the radiometric calibration of the sensor, to eliminate influences of the atmosphere and optionally, to eliminate the influences of the object anisotropy by performing a BRDF correction.

ADS40 is a high-quality large-format photogrammetric mapping sensor. The requirements of quantitative radiometry have been taken into account in the sensor design and Leica Geosystems has also presented a processing chain from raw images to reflectance images for the ADS.

A comprehensive flight campaign was carried out with ADS40 (SH 52) at the Hyytiälä forestry test field in co-operation with Leica Geosystems, University of Helsinki, University of Joensuu, Estonian Land Board, and the Finnish Geodetic Institute (FGI) on 23 August, 2008. The test site is 3300 m x 8500 m in size and it contains more than 200 forest plots with over 20000 positioned trees in different forest conditions (density, age, species mixture, silvicultural history). A state-of-the-art weather station (atmospheric research) runs at the area of interest, the SMEAR II station (University of Helsinki, Dept of Physical sciences and Dept of Forest Ecology), which is used for atmospheric and flux measurements related to trees and soil. FGI's BRF calibrated reflectance targets and Siemens star were installed at the test field. The reflectance/radiance of the targets as well as various homogeneous land covers (asphalt, gravel, grass) were monitored by FGI and Leica Geosystems using field spectroradiometers during the flights. ADS40 data was collected in the uncompressed mode at 1000, 2000, 3000, and 4000 m flying altitudes providing 10 cm, 20 cm, 30 cm, and 40 cm GSD, respectively. The image data set is one of the image materials offered in the context of the European Spatial Data Research (EuroSDR) research project "*Radiometric aspects of digital photogrammetric airborne images*" (EuroSDR Radiometry, 2009, Honkavaara et al., 2009).

We present the results of the validation of the Leica XPro radiometric processing chain. Imagery corrected based on radiative transfer calculations were evaluated and the absolute calibration based on laboratory calibration and the reflectance based vicarious calibrations are compared. The performance of the methods was assessed using the BRF-reference targets available at the test site and the in-situ reflectance and radiance measurements. The results indicated that for the current algorithm and the evaluated challenging data set, up to 5% reflectance accuracy could be obtained. The accuracy was influenced by the flying height (1000-4000 m), channel (red, green, blue, NIR) and level of cloudiness. Leica Geosystem's ADS40 can be considered as an efficient and accurate, 3D, multi-angular, multi-spectral imaging radiometer, which opens new interesting prospects for 3D remote sensing and characterization of the Earth surface. Results also indicated the importance of the test field validation process, gave improvement ideas for the sensor post-processing software and provided information for the development of validation methods.

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