EuroSDR project "Radiometric aspects of digital photogrammetric airborne images" – Results of the empirical phase

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The special advantage of the new digital large-format photogrammetric imagery is the excellent radiometry. Key aspects include multispectral imagery, reflectance calibration, stability, linear response, large dynamic range, great radiometric resolution, and low noise level. These properties open up new prospects for the utilization of the photogrammetric imagery, but also require new approaches for the data processing. The influences of sensor properties, illumination, atmosphere, and object have to be corrected from the imagery in order to obtain the full benefit of the image radiometry. Accurate radiometric processing is necessary for both visual and quantitative applications. The rigorous treatment of image radiometry is a new issue in photogrammetric processing lines.

EuroSDR launched project "Radiometric aspects of digital photogrammetric airborne images" in May 2008. The first phase of the project was a review and questionnaire, which were completed in 2009.

In the second phase empirical image materials were distributed to participants. Three types of materials were available:

- Institut Cartogràfic de Catalunya (ICC) and their collaborators executed extensive radiometric test flights with Intergraph DMC and Compact Airborne Spectrographic Imager (CASI) in Banyoles, Spain, in July 15, 2008. The images were collected from 820, 1125, 2250 and 4500 m flying heights and atmospheric observations and reflectance measurements of reference targets were carried out during the campaign.
- The National Land Survey of Finland carried out acceptance testing of their new DMC on September 1 and 25, 2008 at the Sjökulla test field, Finland. Images were collected from 500 m flying height and reference reflectance measurements were carried out during the campaign.
- The test flight with ADS40 (SH 52) was carried out at the Hyytiälä forestry test field in co-operation with Leica Geosystems, University of Helsinki, University of Eastern Finland, Estonian Land Board and Finnish Geodetic Institute. Images were collected from 1, 2, 3 and 4 km flying heights. Reference reflectance measurements and atmospheric information were collected at the test area during the campaign.

The extensive empirical image materials gave possibilities for many types of analyses. The vicarious radiometric sensor calibration was investigated using approaches based Atcor 4, Modtran 4 and 6S software. Atmospheric correction/image calibration was carried out using Pepita software of IGN France, ICC radiometric correction software, ReSe ATCOR 4 and Leica Geosystems XPro. Aspects of shadow removal and BRDF correction were considered. The application oriented considerations have concerned the use of multi-spectral photogrammetric data in tree species classification. Spatial resolution aspects have been considered as well.

The radiometric aspects were approached from different points of views. Three National Mapping Authorities, one software company and ten research organizations have been involved in the analysis of the empirical data.

Investigations indicated that the radiometric performance of the evaluated sensors was high (for example, high stability with respect to sensor settings and time, low noise). The atmospheric

correction methods have already a high performance level; for example, the reflectance calibration of images collected by radiometrically calibrated sensor could be carried with out with as high as 5% accuracy without any radiometric ground truth, by using a physically based correction approach. BRDF-correction, shadow removal and greater atmospheric optical thickness were identified as central challenges. The rigorous utilization of photogrammetric reflectance data in tree species classification faces many challenges; but nevertheless, the first evaluations indicated promising results and the use of multidirectional reflectance data provided improvements to the performance of tree species classification.

In this presentation we will summarize the results and conclusions of the experimental investigations carried out in the context of the EuroSDR project.