

# EXPERIENCES OF CALIBRATION OF PERMANENT AND TRANSPORTABLE REFLECTANCE TARGETS FOR VICARIOUS RADIOMETRIC CALIBRATION AND VALIDATION

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### ABSTRACT:

The requirement for accurate radiometry is a thorough understanding of the measurement problem, a complete description and understanding of the instruments, and mechanisms for comparing and assessing results. The new digital, high-quality photogrammetric sensors are capable of performing quantitative radiometric measurements. However, the results of the query to several National Mapping Agencies in the context of EuroSDR project “*Radiometric aspects of digital photogrammetric airborne imagery*” showed that in general, there are still many problems in the operational radiometric processing chains (EuroSDR, Radiometry 2009; Honkavaara et al. 2009). This presentation discusses reflectance reference targets, which are crucial in the calibration and validation of radiometric performance of remote sensing imaging systems.

A feasible approach for the operational, vicarious radiometric sensor calibration/validation is to utilize permanent test fields with permanent reflectance and spatial resolution reference targets. FGI has been maintaining a permanent radiometric test field at Sjökkulla since 1994. It contains permanent reflectance targets of black, grey, white and red gravel, and permanent high-contrast (white/black) and low-contrast (grey/black) resolution bar targets made of gravel. For the campaign based applications FGI has developed transportable reflectance targets. (Honkavaara et al., 2008)

For any reflectance target, the reflectance, spatial uniformity and reflectance isotropy are fundamental quality indicators. For the permanent targets, the fundamental additional requirements are the durability against various external factors, such as sunlight, rain, snow and dirt. For the transportable targets the easy transportability is of importance.

Properties of various portable and permanent reflectance targets have been evaluated during several years at the FGI. During 2009, the potential of various permanent reflectance targets (gravel targets, painted and unpainted concrete targets) for the radiometric and colorimetric calibration was evaluated. The fading of the targets was monitored by measuring the targets in spring, in summer and in autumn. Influences of target moisture were evaluated by comparing reflectance and reflectance anisotropy of dry and wet targets. A

number of reflectance target samples are shown in Figure 1.



Figure 1. Various reflectance targets at Sjökkulla test field on summer 2009.

A workflow has been developed for the reflectance reference target calibration. The BRDF measurements are performed with several illumination angles in a laboratory using the FIGIFIGO goniospectrometer (Suomalainen et al., 2009). To enable the measurement in laboratory, special transportable samples have been constructed out of permanent targets. The full measurement data is stored in the FGI’s spectral library. Besides laboratory measurements, properties of the targets have been measured also in field conditions using spectroradiometers and in operational conditions using airborne imagery.

We will present the central results and conclusions of reflectance target evaluations in this presentation.

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## REFERENCES

EuroSDR Radiometry, 2009. <http://www.fgi.fi/EuroSDR>

Honkavaara, E., J. Peltoniemi, E. Ahokas, R. Kuittinen, J. Hyypä, J. Jaakkola, H. Kaartinen, L. Markelin, K. Nurminen, J. Suomalainen, 2008. A permanent test field for digital photogrammetric systems. *Photogrammetric Engineering & Remote Sensing*, 74(1): 95-106.

Honkavaara, E., Arbiol, R., Markelin, L., Martinez, L., Cramer, M., Bovet, S., Chandelier, L., Ilves, R., Klonus, S., Marshal, P., Schläpfer, D., Tabor, M., Thom, C., and Veje, N., 2009. Digital airborne photogrammetry — A new tool for quantitative remote sensing?—A state-of-the-Art review on radiometric aspects of digital photogrammetric images. *Remote Sensing* 1(3), pp. 577-605.

Suomalainen, J., Hakala, T., Peltoniemi, J., Puttonen E., 2009. Polarised multiangular reflectance measurements using Finnish Geodetic Institute Field goniospectrometer. *Sensors* 2009, 9(5), 3891-3907; doi:10.3390/s90503891