Geophysical Research Abstracts,
Vol. 11, EGU2009-6687, 2009
EGU General Assembly 2009

Measurement of target moisture from laser scanner intensity

S. Kaasalainen, A. Krooks, J. Hyyppä, H. Kaartinen, and A. Vain
FInnish Geodetic Institute, Remote Sensing and Photogrammetry, Masala, Finland (sanna.kaasalainen@fgi.fi)

Soil moisture is widely studied with microwave techniques and can be detected and measured from radar backscatter. There is also a clear effect of target moisture on the backscattered signal of airborne and terrestrial laser scanners, but since the study of laser scanner intensity is a somewhat new topic, there is little information available on moisture effects. Combining the effects of moisture, biomass, and surface roughness of a target from laser and/or radar observations is an important future object of study.

We have developed a practical approach for absolute radiometric calibration of airborne and terrestrial laser scanner intensity data, based on commercially or naturally available reference targets (such as sand and gravel) being used as reflectance standards. The laser backscatter reflectance is pre-calibrated for these targets either in situ or in the laboratory. Validation campaigns are underway, as well as the first tests and demonstrations of the calibration techniques in environmental applications, such as monitoring forest damages or snow change detection. In these studies, the role of surface moisture is crucial, since in the Boreal climate, the airborne laser scanning (ALS) applications often suffer from moisture due to weather conditions (e.g., flight campaign occurs shortly after rain). Information on the feasibility of reflectance measurement in wet conditions is therefore important concerning the increasing number of ALS activities in the Northern latitudes. We have studied the effect of moisture on the backscatter reflectance of mineral aggregate (such as sand and gravel) targets that are used as reflectance standards in the radiometric calibration of ALS intensity data. These targets also represent a variety of laser scanning land targets, such as roads, beaches, and fields. Laboratory and field experiments were carried out to find out how moisture affects the performance of these targets as reference standards. We found that even small amount of moisture has a crucial effect on target reflectance: a strong decrease in reflectance with up to 10% gravimetric water content was observed for most of our targets, after which the reflectance level mostly remained constant (this may not make a difference for ALS campaigns since other factors, such as atmospheric humidity, may restrict or even prevent the scanner operation in wet conditions, particularly when the water content of the targets increases over 10%). This effect has to be taken into account in the retrieval and calibration of laser scanner intensity data acquired in moist conditions.

We have also developed a method of measuring the surface reflectance at different moisture contents with a digital camera, and found out that surface moisture is measurable from the near-infrared images similarly to the laser measurement. The first results call for accurate field methods of surface moisture determination for ALS land targets, where a digital camera method can be used as ground reference. Further studies will focus on testing the performance of wet surfaces in laser scanner reflectance calibration, as well as the possibility of laser-based moisture determination or change detection. This would be possible by the use of controlled laboratory measurements as reference. These methods, as well as the use of ALS reflectance data in the first place, must be further evaluated in future ALS flight campaigns.