

# ANALYSIS OF LASER SCANNER DATA WITH REMOTE SENSING TECHNIQUES FOR DETERMINING SURFACE CHARACTERISTICS

Th. Geist<sup>a,b\*</sup>, B. Höfle<sup>b</sup>, M. Rutzinger<sup>b</sup>, J. Stötter<sup>b</sup>

<sup>a</sup> alpS – Centre for Natural Hazard Management, Grabenweg 3, Innsbruck, Austria – (geist@alps-gmbh.com)

<sup>b</sup> Institute of Geography, University of Innsbruck, Innrain 52, 6020 Innsbruck, Austria – (bernhard.hoefle, martin.rutzinger, hans.stoetter@uibk.ac.at)

**KEY WORDS:** Laser Scanning, Natural Hazards, Remote Sensing, Signal Intensity, Modelling, Classification

## ABSTRACT:

The poster presented gives an overview on background, goals, methods, milestones and expected results of a recently started project at the alpS – Centre for Natural Hazard Management. The aim of the project is the determination of surface characteristics from laser scanner data. A pronounced emphasis is laid on the analysis of the laser signal intensity with modern remote sensing methods. Expected results like the quantification of surface roughness can be used e.g. in modelling of geomorphodynamic processes.

## 1. BACKGROUND

There is a strong demand for high quality topographic data in modern natural hazard management, e.g. as fundamental input for process modelling (e.g. for avalanches, debris flows...). With airborne laser scanning (ALS), a well accepted operational method for the acquisition of topographic data exists, allowing the construction of high-resolution and high-accurate digital elevation models. Fundamental knowledge about the technical accuracy of this method and the quality of produced digital elevation data sets has evolved in recent years and has opened the use of airborne laser scanning to a wide range of application fields.

In addition to the pure collection of coordinates on the scanned surface, laser scanning data can provide information on characteristics and properties of the surface influencing the laser signal. This is supported by the ability of most modern laser scanning systems to record the intensity of the reflected signal.

## 2. PROJECT OUTLINE

At the alpS-centre of natural hazard management, a three year research project (7/2004-6/2007) is in its starting phase. The poster presented gives an overview on background, goals, methods, milestones and expected results of the project.

The main project goal is to determine surface characteristics from laser scanner data utilising both the digital elevation information and the signal intensity information. According to the philosophy of the alpS-centre as a platform for interdisciplinary natural hazard management, the project consortium comprises scientific partners as well as public authorities and private companies giving the project a high practical relevance. There is a distinctive synergy potential with other alpS projects.

Emphasis will be laid on the qualitative assessment and, if possible, both the quantification of surface properties (e.g.

surface roughness which is a key parameter in hydrological modelling) and the temporal change of these properties. The analysis will comprise a great variety of surface types with regard to alpine natural hazard management. Standard GIS and remote sensing tools will be used as well as more refined methods (e.g. object oriented analysis tools, classification and regression trees, fuzzy logic tools). The results will be validated and calibrated by integration of other datatypes (e.g. field data, high resolution optical data) as well as combined for improving the results.

## 3. FIRST PROJECT PHASE

The first project phase focuses on a) the building up of an information system for ALS data and b) the development of analysis strategies with object oriented remote sensing methods. The information system should contain of a database with a structure as flexible and open as possible and should allow for a fast and simple retrieval of laser scanner data sets and their descriptive statistics. Therefore, standards for data formats for laser scanner raw data are defined. Furthermore, a test of performance and, consequently, a tuning of the data base is part of this first project phase. The use of open source software for the single system components is emphasized.

The analysis strategies will be applied in selected test areas with a thematical emphasis on the derivation of forest parameters (e.g. tree height) for identifying objects and deriving surface properties in quality and quantity.

In the first project phase laser scanner data from the EU-project OMEGA can be utilized (4 multitemporal data sets from a high-mountain test site in Norway and 10 multitemporal data sets for a high-mountain test site in Austria) which allows the detection of seasonal surface properties. Further on, laser scanner data and high resolution imagery from different sites in the Austrian federal state of Vorarlberg will be used for developing and testing both the system and the methods. In later project phases, several specific data acquisition campaigns are planned.

---

\* Corresponding author.