CHARACTERIZATION OF SOIL SURFACE ROUGHNESS FROM TERRISTRIAL LASER SCANNER DATA

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Abstract

In radar backscatter models for various kinds of forests, such as MIMICS (Michigan Microwave Canopy Scattering Model), SBM (Santa Barbara microwave backscattering model), etc., the direct backscattering of ground surface was calculated by SPM (Small Perturbation Model), POM (Physical Optics Model) or GOM (Geometrical Optics Model) depending on the roughness of the surface relative to the radar wavelength. The surface roughness parameters commonly used as inputs to these models are the root mean square heights (RMS) *s* and auto-correlation length *l*. These parameters were traditionally estimated from a one-dimensional surface profile with limited length. The complexity of natural surfaces makes it very difficult to explicitly describe the soil roughness. The development of Terristrial Laser Scanner (TLS) provides a new approach for the characterization of soil surface roughness. It has been successfully applied in archaeology, inverse engineering and three-dimensional reconstruction of architectures for it can provide high-resolution, three dimensional surveys of objects. In this paper we address the issue of soil roughness characterization from terrestrial laser scanner data.

The test site is located at Zhangye, Gansu province, west of China (38^o 32'N, 100^o 15'E). The elevation of the test site is about 2800m. The forest is a pure pine (Picea crassifolia) stand. The forest floor is covered by lichen. In this study the TLS data were acquired using Riegl LMS-Z360i laser scanner over more than 60 stations. At the same time the surface roughness were measured by 1 meter long surface profile in two perpendicular directions (south to north and east to west) at each station. An iterative method was used to extract ground points from entire points cloud. In this method, a serial of grid cell sizes and corresponding thresholds were used in descending order to filter the points cloud. If a proper set of grid cell sizes and corresponding thresholds were used, the ground points can be correctly extracted. Then the RMS height *s* and correlation length *l* were calculated using TLS data and compared with field measurements. The results show that the proposed method can be used to make soil roughness measurement so long as the data sampling frequency was high enough. The relationship between required sampling frequency and the wave length of Microwaves was derived. In addition to the soil roughness parameters, a high resolution three dimensional digital elevation model (DEM) was constructed. Based on this DEM, the soil roughness in any direction can be computed.