Geoinformation extraction from 3D pointclouds – current status and future perspective

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In recent years the LiDAR technology, also referred to as laser scanning, has evolved into an established and widely-used method for the three-dimensional acquisition of the Earth surface. The primary product of LiDAR is a raw 3D point cloud of all scanned objects and the underlying terrain. Additionally to the geometric description of the topography, LiDAR enables capturing radiometric information (e.g. signal amplitude/intensity). By applying radiometric correction, the reflectance characteristics in the laser's wavelength of the sampled surface can be extracted, whichare valuable for improved surface classification and landscape feature detection. Having access to the original 3D point cloud and additional laser point attributes (e.g. full-waveform observables) offers the possibility to derive custom digital terrain models (DTMs) with varying definitions of "terrain". There is no single DTM definition and different applications have divergent requirements for filtering off-terrain objects. Geomorphological applications might prefer removing e.g. building artifacts from the DTM, whereas archaeological prospection aims at detecting such structures in a tailored DTM. In such a DTM high vegetation should be removed but features close to the terrain are kept and should be even emphasized.Apart from the possibility to derive different variants of DTMs, one further evident advantage of full access to the 3D laser points is the possibility to detect 3D structures in the point cloud directly. In particular vertical or even overhanging structures are not expressed in raster elevation models and thus cannot be detected.However, dense 3D LiDAR point clouds allow for object extraction in 3D and are a suitable data model for data fusion, such as combining terrestrial and airborne LiDAR point clouds.

Recent development in LiDAR sensor technology can be directly beneficial for geoarchaeological studies. In particular, improved DTM generation and surface classification using full-waveform LiDAR and the capability of small-footprint bathymetric LiDAR to capture structures under water with high resolution are definitely the most prominent and promising developments of the last years.There is still a lack of geoprocessing methods and analysis workflows already available for GIS raster and vector data, which can be applied to huge point clouds.This fact hampers the utilization of LiDAR data in many domains where the extraction of (3D) information from the point cloud would be beneficial.Furthermore, methods to fusion and analyze multi-source datasets of e.g. 3D surface and subsurface information are still to be developed and exploited in detail in the context of geoarchaeology.

This paper will address the innovations and challenges outlined above by presenting new methods for tailored DTM generation and GIS-based surface feature detection. Furthermore, a workflow for fusion of surface and subsurface data will be explained. In order to promote the LiDAR point cloud paradigm, the possibility to use GeoWeb service infrastructures to present 3D LiDAR data in standard Web browsers will be shown. Furthermore, first results from applying low-cost devices that are able to provide point clouds with moderate accuracy but high temporal resolution, for example from image matching and/or laser sensors (e.g. MS Kinect), will be presented.