SEMI-AUTOMATED DETECTION OF GROUND MONUMENTS IN AIRBORNE LASER SCAN DATA (LiDAR)

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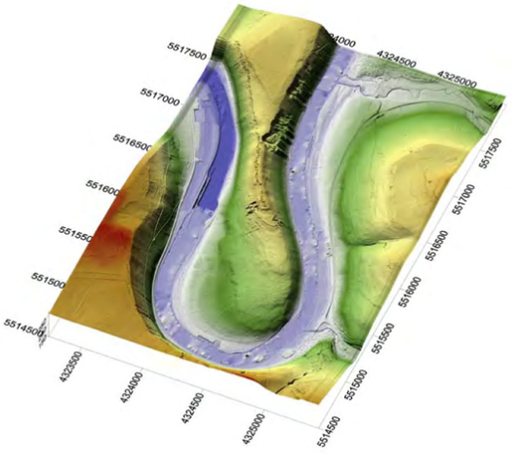
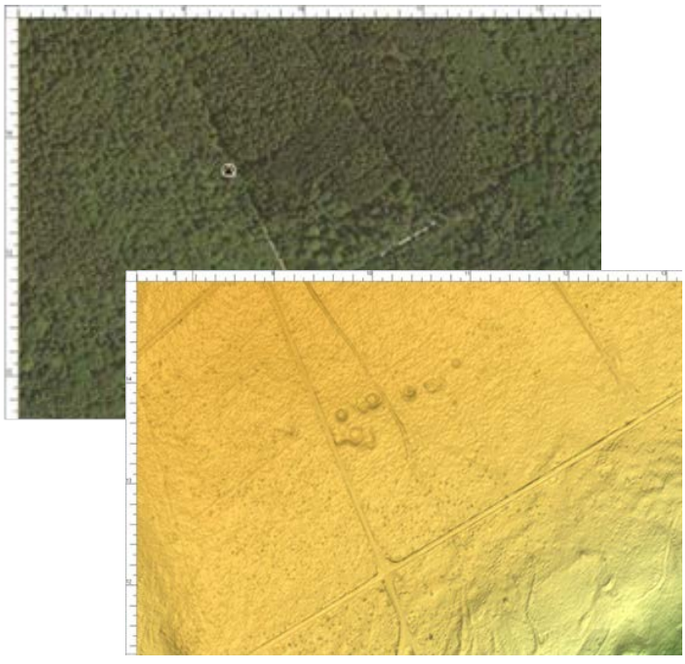
LiDAR data provides a novel approach for locating and monitoring cultural heritage in the landscape, especially in areas of logistical complications, such as forests, rough terrain, and remote areas. However, the utilization of LiDAR presently lacks standardized and sustainable approaches for proper handling, developing, and processing within the field of archeology and cultural heritage management. Additionally a majority of stakeholders encounters various problems regarding macro- and micromanagement, often resolving in quantitative assessment being impractical or even impossible. Thus in order for LiDAR data to become a truly competent method for heritage management, a large scale quantitative and sustainable approach for handling, developing, and processing needs to be defined and established.

In recent years LiDAR (Light Detection And Ranging) scanning has become a widely used tool for understanding the cultural and natural landscape surrounding us. As a result new three-dimensional point based LiDAR data is steadily generated more precise and detailed (raw point clouds), consequently increased amount of data becomes available for analysis.



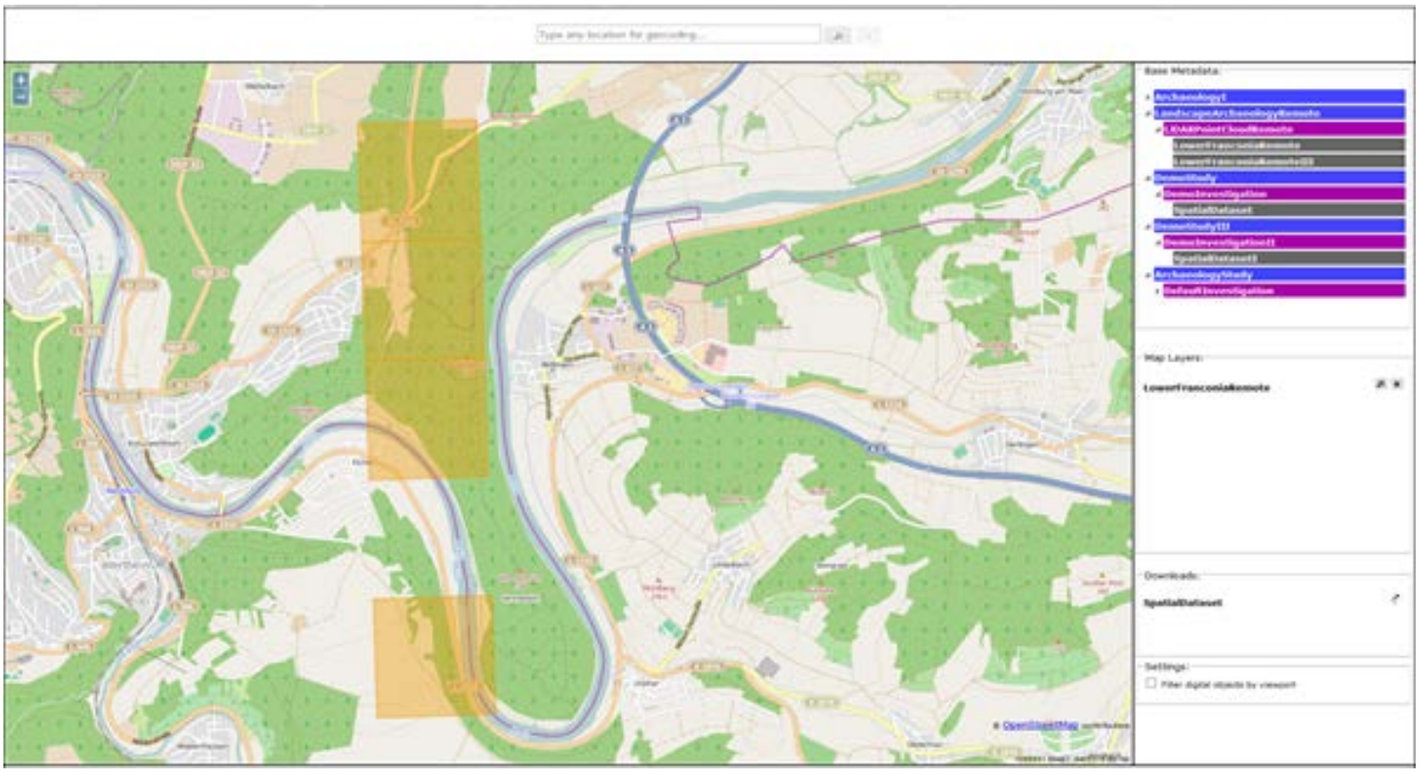
“Urpharer Mainschleife” on the river Main with the late antique and early medieval “Wettenburg” in a three-dimensional terrain model



Forested area around Urphar (Lower Franconia) with no visible cultural remains in aerial imagery. LiDAR scans reveal a previously unknown group of prehistoric burial mounds and later grave robbery.

Airborne laser scan data includes terrain and surface information. This gives the possibility to remove vegetation and modern structures to reveal hidden structures.

For analyzing and improving means of handling and processing LiDAR data for cultural heritage detection and management, the area of Lower Franconia is used as a benchmark study. Available LiDAR scans for the district of Lower Franconia consist of 8531 km^2 of landscape information of some 5 ppsm. This amasses 2.8 TB of data in raw point cloud form. An expert digital surveyer familiar with the LiDAR data, can process approximately 30 km^2 per day, resulting in a time consumption of 1.2 years for a first analysis of Lower Franconia. For the entire area of Bavaria, this would amass to ten years. Continuous and iterative explorations increase the amount of information to be handled, which consequently leads to time frames not feasible for large scale investigations.



Prototype of a data repository for geospatial laser scan data with map-based exploration.

In order to cope with the heterogeneous spatial and radiometric data, a systematic and semi-automated process needs to be defined to control and handle the amounts of otherwise unrestrained information. Thus the current development of technology and methodology focuses on the creation of an interactive research data gateway. The objective is to build-up a large scale data infrastructure managing and processing laser scan data as well as archeological information, allowing semi-automatic extraction of cultural heritage. A customized data repository is a crucial part of such an infrastructure and should include:

- A searchable and secure data organization depicting the structure of the data,
- A comprehensive feature extraction feasible for different ground monument types,
- A visualization allowing intelligent zooming and map generalization
- Access to high performance computing for effecting processing of the data.

Particular emphasis lies on pattern recognition algorithms in order to define quantitative methods for three-dimensional LiDAR vector data and subsequent two-dimensional raster data by implementing standardized and state of the art systematic and semi-automated approaches for cultural heritage detection and management.