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Large-scale, high-definition Ground Penetrating Radar prospection in archaeology

I. Trinks (1), M. Kucera (1), A. Hinterleitner (1,2), K. Löcker (1,2), E. Nau (1), W. Neubauer (1), and T. Zitz (1)

(1) Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Hohe Warte 38, 1190 Vienna, Austria (immo.trinks@archpro.lbg.ac.at), (2) Central Institute for Meteorology and Geodynamics, Hohe Warte 38, 1190 Vienna, Austria

The future demands on professional archaeological prospection will be its ability to cover large areas in a time and cost efficient manner with very high spatial resolution and accuracy. The objective of the 2010 in Vienna established Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology (LBI ArchPro) in collaboration with its eight European partner organisations is the advancement of state-of-the-art archaeological sciences. The application and specific further development of remote sensing, geophysical prospection and virtual reality applications, as well as of novel integrated interpretation approaches dedicated to non-invasive spatial archaeology combining near-surface prospection methods with advanced computer science is crucial for modern archaeology. Within the institute's research programme different areas for distinct case studies in Austria, Germany, Norway, Sweden and the UK have been selected as basis for the development and testing of new concepts for efficient and universally applicable tools for spatial, non-invasive archaeology.

In terms of geophysical prospection the investigation of entire archaeological landscapes for the exploration and protection of Europe's buried cultural heritage requires new measurement devices, which are fast, accurate and precise. Therefore the further development of motorized, multichannel survey systems and advanced navigation solutions is required. The use of motorized measurement devices for archaeological prospection implicates several technological and methodological challenges. Latest multichannel Ground Penetrating Radar (GPR) arrays mounted in front off, or towed behind motorized survey vehicles permit large-scale GPR prospection surveys with unprecedented spatial resolution. In particular the motorized 16 channel 400 MHz MALÅ Imaging Radar Array (MIRA) used by the LBI ArchPro in combination with latest automatic data positioning and navigation solutions permits the reliable high-definition survey of two to three hectares per day with eight centimetres GPR trace spacing, both inline and cross-line.

Exact real time positioning of the motorized multichannel arrays with centimetre accuracy is of paramount importance for data quality and subsequent imaging, analysis and interpretation. Whereas traditional surveys are conducted along straight lines fixed on the ground, motorized survey systems require the use of more efficient data positioning and navigation solutions. A promising approach can be realized using real-time kinematic positioning technology based on GPS systems and robotic total-stations with centimetre accuracy. Due to the huge amount and complexity of the data unique software solutions for efficient, appropriate processing and data visualization have been developed permitting the generation of geo-referenced depth-slice images covering up to 70 hectares each. While our focus is on archaeological sites, the presented novel GPR technology and methodology are likewise applicable to Civil Engineering Applications.