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# Non-destructive tree root detection with geophysical methods in urban soils

Mitja Johannes Vianden (1,2), Ulrich Weihs (1), Falko Kuhnke (1), and Steffen Rust (1)

(1) University of Applied Science and Art/ Hochschule für angewandte Wissenschaft und Kunst (HAWK), Göttingen, Germany, (2) corresponding author: vianden@hawk-hhg.de

To assess the safety of roadside trees or as part of ecophysiological research it is often important to investigate the spatial distribution and development of tree roots. Conventionally this is done by laborious excavations or by the application of root drills which in many cases do not allow a comprehensive data collection.
An indirect method for the investigation of subsurface features is ground penetrating radar (GPR). Its ability to detect tree roots has been shown by several studies (for example Hruska et al. 1999; Butnor et al. 2001; Barton et al. 2004). Another geophysical method which has been successful applied to study different aspects of tree roots is electrical resistivity tomography (ERT) (for example Hagrey 2007; Amato et al. 2008). These former studies by other authors mainly concentrated on a correlation between the measured parameters (signal amplitude and resistivity) and root-biomass on forest sites or controlled conditions. Results of Cermak et al. (2000), studying tree roots in urban areas with GPR, indicated that this method may also be useful for anthropogenic influenced areas.
As a continuation of these approaches the authors have been using both techniques to study the spatial root architecture of urban trees. This research is designed to elicit the possibilities and limitations of the methods in urban areas. Reference sites have been established to quantify the methods' resolution and assess possible fields of application. These test site measurements are the basis for the interpretation of results at urban tree sites. Their results highlight the importance of 3D-measurements in urban areas because in inhomogeneous soil other reflectors (like rocks, cables, pipes, etc.) cause similar signals and bear a risk of misinterpretation. This can be minimized if detected objects have a spatial continuation and are connected to a tree.
Here we present preliminary results from a combined application of both methods at the river bank of the Landwehrkanal in Berlin, Germany. At three urban tree sites - one tree group and two solitary trees - GPR and ERT were applied. Differences in the root architecture caused by variations of the groundwater level and site-specific soil as well as tree-specific features of the root architecture could be identified. The course of single coarse roots has been identified by the GPR results while the groundwater level and information about variations in soil properties have been deduced from the measured resistivity data. The results have been verified by excavations with the Air-Spade-technique.

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