Geophysical Research Abstracts
Vol. 18, EGU2016-14884, 2016
EGU General Assembly 2016

Observing of tree trunks and other cylindrical objects using GPR

Jana Jezova and Sebastien Lambot
Universite Catholique de Louvain, Earth and Life Institute, GERU, Louvain-la-Neuve, Belgium (jana.jezova@uclouvain.be)

Trees are a part of our everyday life, hence it is important to prevent their collapse to protect people and urban infrastructures. It is also important to characterize tree wood properties for usages in construction. In order to investigate internal parts of tree trunks non-invasively, ground-penetrating radar (GPR), or in this case, ultra-wideband microwave radar as a general tool, appears to be a very promising technology. Nevertheless, tree trunk tomography using microwave radar is a complicated task due to the circular shape of the trunk and the very complex (heterogeneous and anisotropic) internal structures of the trunk. Microwave sensing of tree trunks is also complicated due to the electromagnetic properties of living wood, which strongly depend on water content, density and temperature of wood. The objective of this study is to describe tree trunk radar cross sections including specific features originating from the particular circumferential data acquisition geometry. In that respect, three experiments were performed: (1) numerical simulations using a finite-difference time-domain software, namely, gprMax 2D, (2) measurements on a simplified laboratory trunk model including plastic and cardboard pipes, sand and air, and (3) measurements over a real tree trunk. The analysis was further deepened by considering: (1) common zero-offset reflection imaging, (2) imaging with a planar perfect electrical conductor (PEC) at the opposite side of the trunk, and (3) imaging with a PEC arc at the opposite side of the trunk. Furthermore, the shape of the reflection curve of a cylindrical target was analytically derived based on the straight-ray propagation approximation. Subsequently, the total internal reflection (TIR) phenomenon occurring in cylindrical objects was observed and analytically described. Both the straight-ray reflection curve and TIR were well observed on the simulated and laboratory radar data. A comparison between all experiments and radar configurations is presented. Future research will focus on the design of an adapted radar antenna for that application to optimize living tree trunk tomography.
This research is funded by the Fonds de la Recherche Scientifique (FNRS, Belgium) and benefits from networking activities carried out within the EU COST Action TU1208 "Civil Engineering Applications of Ground Penetrating Radar".