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The Use of Ground Penetrating Radar for Mapping Tree Root Systems in Urban Environments

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The importance of street trees in the urban environment is widely recognised. They provide several environmental, economic and social benefits, increasing the liveability of cities and improving people health. Nevertheless, the absence of proper urban planning, combined with the deficiency of resources and methodologies for road maintenance, have led to a conflict between the trees and the urban surfaces. The uncontrolled development of tree roots can cause extensive damages, such as the cracking and uplifting of pavement and curbs, seriously endangering the safety of pedestrians, cyclists and drivers. In this framework, ground penetrating radar (GPR) has already proven its effectiveness as non-destructive testing (NDT) method for the evaluation and monitoring of road pavements. Its ease of use and cost-effectiveness, together with the reliability of results, allow a comprehensive investigation of the subsurface conditions, thus allowing maintenance interventions to be planned. This research aims to demonstrate GPR potential in mapping the root system architecture of street trees. To this extent, data were acquired from various tree species, using different antenna systems and survey methodologies. Thus, a multi-stage data processing methodology was applied, in order to provide an effective mapping of tree root systems. In addition, information on the mass density of roots at different depths was provided. Results have proven the viability of the proposed method for root detection and mapping under road surfaces. Furthermore, potentially dangerous situations for road safety were successfully identified, demonstrating GPR potential in assessing the conditions of the subsurface.