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### **A Study on the Effect of Target Orientation on the GPR Detection of Tree Roots Using a Deep Learning Approach**

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## A Study on the Effect of Target Orientation on the GPR Detection of Tree Roots Using a Deep Learning Approach

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Monitoring and protection of natural resources have grown increasingly important in recent years, since the effect of emerging illnesses has caused serious concerns among environmentalists and communities. In this regard, tree roots are one of the most crucial and fragile plant organs, as well as one of the most difficult to assess [1].

Within this context, ground penetrating radar (GPR) applications have shown to be precise and effective for investigating and mapping tree roots [2]. Furthermore, in order to overcome limitations arising from natural soil heterogeneity, a recent study has proven the feasibility of deep learning image-based detection and classification methods applied to the GPR investigation of tree roots [3].

The present research proposes an analysis of the effect of root orientation on the GPR detection of tree root systems. To this end, a dedicated survey methodology was developed for compilation of a database of isolated roots. A set of GPR data was collected with different incidence angles with respect to each investigated root. The GPR signal is then processed in both temporal and frequency domains to filter out existing noise-related information and obtain spectrograms (i.e. a visual representation of a signal's frequency spectrum relative to time). Subsequently, an image-based deep learning framework is implemented, and its performance in recognising outputs with different incidence angles is compared to traditional machine learning classifiers. The preliminary results of this research demonstrate the potential of the proposed approach and pave the way for the use of novel ways to enhance the interpretation of tree root systems.

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