EGU23-8384, updated on 25 Jul 2023
https://doi.org/10.5194/egusphere-egu23-8384
EGU General Assembly 2023

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

Livia Lantini[1,2], Federica Massimi[3], Saeed Sotoudeh[1,2], Dale Mortimer[4], Francesco Benedetto[3], and Fabio Tosti[1,2]

[1]School of Computing and Engineering, University of West London, London, United Kingdom of Great Britain and Northern Ireland (livia.lantini@uwl.ac.uk)
[2]The Faringdon Research Centre for Non-Destructive Testing and Remote Sensing, University of West London, London, United Kingdom of Great Britain and Northern Ireland
[3]Signal Processing for Telecommunications and Economics Lab., Dept. of Economics, Roma Tre University, Rome, Italy
[4]Tree Service, London Borough of Ealing, Perceval House, London, United Kingdom of Great Britain and Northern Ireland

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.

Acknowledgements

The Authors would like to express their sincere thanks and gratitude to the following trusts, charities, organisations and individuals for their generosity in supporting this project: Lord

Faringdon Charitable Trust, The Schroder Foundation, Cazenove Charitable Trust, Ernest Cook Trust, Sir Henry Keswick, Ian Bond, P. F. Charitable Trust, Prospect Investment Management Limited, The Adrian Swire Charitable Trust, The John Swire 1989 Charitable Trust, The Sackler Trust, The Tanlaw Foundation, and The Wyfold Charitable Trust. The Authors would also like to thank the Ealing Council and the Walpole Park for facilitating this research.

References

[1] Innes, J. L., 1993. □□□□□□/□□□□□□□/□□□/□□□□□□□ □□□/□□□□/□□□□□. CAB International.

[2] Lantini, L., Tosti, F., Giannakis, I., Zou, L., Benedetto, A. and Alani, A. M., 2020. "An Enhanced Data Processing Framework for Mapping Tree Root Systems Using Ground Penetrating Radar," Remote Sensing 12(20), 3417.

[3] Lantini, L., Massimi, F., Tosti, F., Alani, A. M. and Benedetto, F. "A Deep Learning Approach for Tree Root Detection using GPR Spectrogram Imagery," 2022 45th International Conference on Telecommunications and Signal Processing (TSP), 2022, pp. 391-394.