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Evaluating the Internal Structure of Tree Trunks Using Ground Penetrating Radar

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Evaluating and assessing the internal structure of tree-trunks is of great importance both for industrial as well as environmental purposes [1]. Non-destructive geophysical techniques with minimum intrusion can assist on tree monitoring by providing fast and cheap tools for assessing the internal structure of tree trunks. In the current work we evaluate the capabilities of ground penetrating radar (GPR) on locating tree-decays in different stages and in different tree types.

GPR has been widely applied to smooth surfaces that can be sufficiently approximated as half-spaces. In that context, interpretation approaches like hyperbola detection make the assumption that the targets of interest are buried inside a dielectric half-space. Nonetheless, the shape of the tree trunks is rather stochastic and the only valid and safe assumption that can be made is that the shape of the tree is a closed curve with arbitrary shape.

Due to that, the reflection patterns arising from decays inside the tree deviate from the traditional hyperbolic features that often occur in typical GPR surveys. Under these conditions and without the usage of tomographic approaches a reliable interpretation is difficult to be made. Tomographic approaches are time-consuming with high computational demands that often applied to bespoke custom-made antenna systems that the end-user has no access to.

Our work tries to overcome these issues by suggesting a universal “hyperbola” fitting scheme that can be applied in any arbitrary given shape. Prior to the “hyperbola” fitting, a singular value decomposition (SVD) [2] is applied in an effort to decrease the ringing noise and the unwanted clutter. The validity of our method is tested through numerical and lab experiments. The minimum computational requirements of the proposed method combined with the fact that can be coupled with any commercial antenna, makes our approach commercially appealing for large scale applications.

Results presented in this abstract are part of a major research project that the authors have undertaken for the last two years.

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