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As the Earth's lungs, trees are a natural resource that provide, amongst others, food, lumber, and oxygen. Therefore, monitoring these wooden structures with non-destructive testing (NDT) techniques such as ground penetrating radar (GPR) and ultrasound can provide valuable information about inner flaws and decays, which is an essential step for tree conservation.

In recent years, GPR and ultrasound have been used to delineate the interior architecture of tree trunks [1-3]. However, more research is required to improve results and consequently have a more reliable interpretation. Due to limitations in depth penetration and signal-to-noise ratio [4], these approaches have a limited capacity for resolving features. The use of gain functions and higher frequencies to compensate for wave attenuation may exaggerate events and reduce resolution, respectively.

In this context, an integration between GPR multi-frequency and ultrasound data can be used to address this issue. Data were collected on a tree trunk log at the Faringdon Centre for Non-Destructive Testing and Remote Sensing using two high-frequency GPR systems (2GHz and 4GHz central frequencies) and an ultrasound (supporting a wide range of transducers from 24 kHz up to 500 kHz) testing equipment. Internal features of interest in terms of extended perimetric air gaps at the bark-wood interface, natural cracks and small artificial cavities were investigated through electromagnetic and mechanical waves. After compilation of data, a joint interpretation strategy for data analysis is developed. The processed data were mapped against the cut sections of the tree for validity purposes.

Although study of stand tree trunks would be more challenging, the findings of this research may be applied for wood timbers and pave the way to future research for living tree trunks.

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