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Characterization of the decay of a wooden trunk through electrical resistivity

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Abstract –
This paper presents a resistivity-based spatio-temporal imaging method for the analysis of tree trunk.
ERT data have been acquired on a cut tree trunk to examine its internal structure. The results of the ERT measurements in time-lapse mode well describe the high potential of this method in illustrating the internal distribution of resistivity in the trunk related to its decay process.

I. INTRODUCTION

The measurements of electrical properties of wood, mainly the resistivity have been widely used among wood technologists and wood scientists. The main aim of the measurements was either to distinguish the wood type [1, 2] or to find some decays [3, 4]. These techniques use two or four electrodes with different lengths and injecting pulsed or continuous current and measuring a difference of potential. In these last years, with the development of technologies, a new way of making electrical measurements on wood has been tried: multielectrode tomography.
It was decided to explore the possibility of using electric tomography to detect tree decay within a study performed as test on a cut tree trunk. Therefore the electrical resistivity technique using a ring array was applied to image the internal electrical structures of the trunk. Measured electrical resistivity data were inverted using a 2D iterative finite-element algorithm that incorporates the cylindrical geometry of the trunk. The technique is successfully tested and show that the resolution obtained when mapping anomalous zones inside the trunk is higher for the dipole-dipole configuration.

II. RESULTS AND DISCUSSION

In this preliminary study using ERT to obtain images of sample trunk, it was apparent that the internal water content was measured at 2%.
The ERT surveys were carried out with the Syscal Kid resistivitymeter with 24 electrodes arranged in a non-conventional array (Fig. 1) .
Laboratory tests allowed us to define the order of magnitude of the electrical characteristics of wood with different degrees of decay. The estimation of the behavior both of the resistivity and induced polarization of the trunk sample drove a better understanding of the trunk conservation state. The ERT results (Fig. 2a and b) show that the strong strong decay of the trunk is related to high resistivity and high induced polarization values.
This observed relationship between trunk decay and high electrical resistivity corresponds to the presence of voids.

III. CONCLUSIONS

The non-invasive technique proposed for standing tree investigation turned out to be effective tools for internal decay detection and characterisation. Besides this, the quality and the detail of the information obtained are doubtless a significant improvement concerning the ones achievable by the investigation technique which are normally used in the practice of tree assessment. The possibility of accurately detecting the extension of decay, even in the case of very complex shapes of the tree perimeter and of the decay itself, makes this technique a considerable improvement. A limit of resistivity tomography is, however, the possibility of infecting trees with the nails used as electrodes; in this case, each set of electrodes should be used only once. Thanks to its non-invasive character, it would be preferred a diagnostic tool. The nails would, in fact, be substituted by plates applied to the trunk perimeter.

Fig. 1. The cut tree trunk

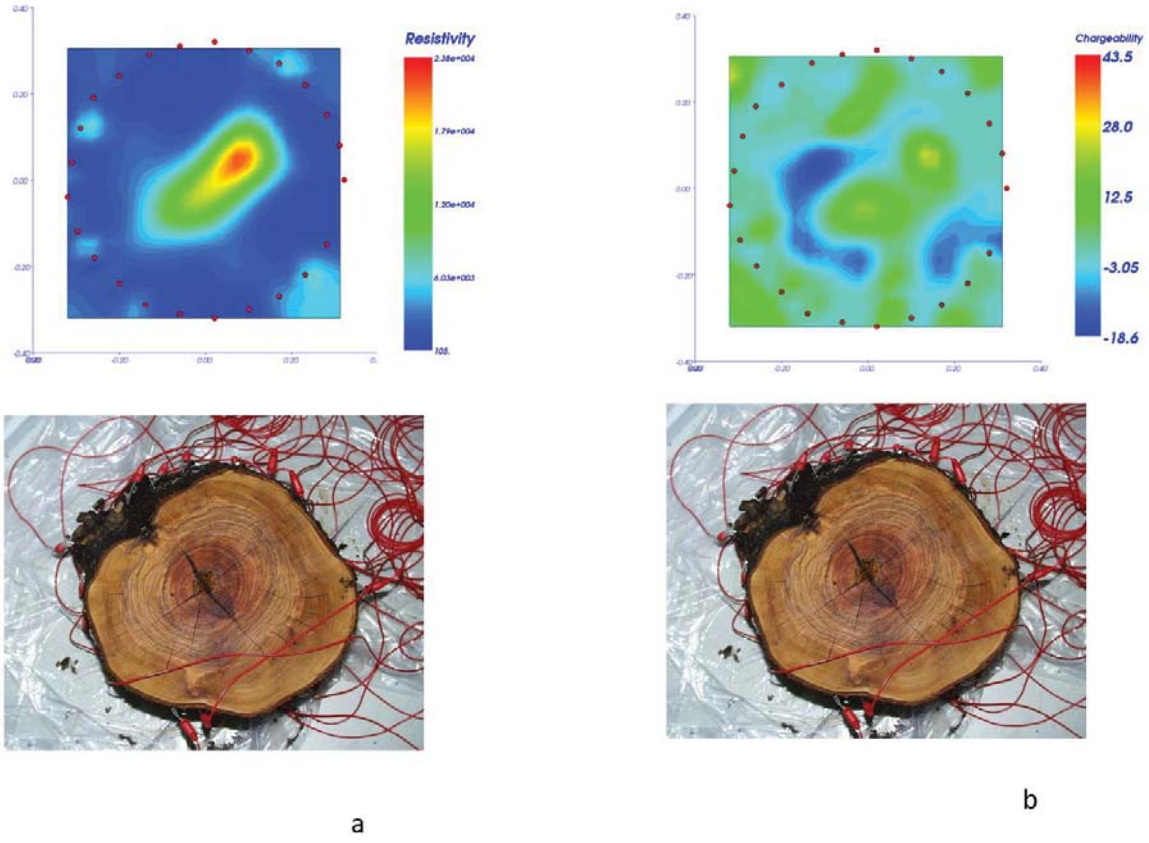

Fig. 2. a) resistivity distribution; b) induced polarization distribution

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