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Innovative TDR data processing: validation in coaxial cable with numerical FDTD data

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Time domain reflectometry technique has been widely used for the determination of the electric properties of the material under test, thus providing an interesting instrumentation for near-surface Geophysics as well as for applications in bio-electromagnetism and several other areas [1-2]. Recent theoretical studies [3-4] have shown that a TDR coaxial probe can be used to determine both the electric and magnetic properties of the material under test. For nondispersive materials, previous studies have shown that the frequency variation of the measurements can be replaced equivalently by varying the length of the probe. In this study, we focus on the characterisation of the dielectric properties of dispersive materials by considering reflection measurements using probes of different lengths, (achieved by means of an adaptable probe or an array of probes with the same cross-section properties). This can help in determining the dispersion law such that if a dispersion law of the material under test is assumed or known a-priori, a matching with multi-length measurements can drive to an accurate estimation of the parameters of the assumed dispersion law. This investigation was carried out using numerical simulations in CST Microwave Studio, a commercial software package based on the finite difference in time domain FDTD. Initially, a coaxial cable hosting the material under test (MUT) was designed such that on one side of the probe is alimented with a port with a fixed internal impedance and it is shunted at the opposite side. This model was validated with experimental data and eventually, the reflection coefficient at the beginning of the cable was used to extract the real and the imaginary parts of a nonmagnetic material all over a pre-chosen range of frequencies.

References

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