Analysis of Ultra-wideband Antennas for GPR Prospecting

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In recent applications in telecommunications and remote sensing at radiowaves, microwaves and terahertz frequencies, the exploitation of ultra-wideband (UWB) antennas is constantly growing up [1]. In particular, UWB antennas can provide higher imaging resolution and better target characterization in subsurface prospecting.

Design and analysis of such high-performance antennas exhibit significant challenges. In particular, in the case of GPR systems of our concern, typical requirements include not only a wide work bandwidth in order to provide short either "real" or "synthetic" pulse radiation, but also negligible interferences from undesired directions. All these features, moreover, have to be implemented in a portable systems. Still, we have to consider that, since the antennas work at close proximity or in contact with the investigated structure, their input impedance and radiated field are affected by it, so that the properties of the background medium must be taken into account in designing and analysing the antenna performance. Finally, mutual interactions between transmitting and receiving antenna must be also considered.

To directly measure the antenna properties in the operative GPR conditions, within an inhomogeneous variable scenario, is very difficult. This arises the need of a full-wave analysis of the antenna for the evaluation of its properties such as impedance, radiated field coupling, etc.

In addition, an accurate modelling of the antenna is crucial for the exploitation of inverse scattering approaches to GPR data, since the accurate knowledge of the incident field (i.e., the field impinging on the investigated zone in absence of scattering objects) is a key point to make the result of the inversion algorithm reliable.

In this contribution we present the modelling and characterization of different kind of antennas exploited in GPR applications such as bow-tie and ridged horn antennas.

The antennas are numerically analysed in different operative situations by means of the FEM-based software High Frequency Structure Simulator (HFSS), by Ansoft, which allows to model both the feeding and the radiating element of the antennas accurately.

REFERENCES

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