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Ground Penetrating Radar with Contact Horn Antennas

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1. Introduction

Ground Penetrating Radars (GPR) are popular instruments able to investigate the ground through electromagnetic waves. They are commonly used for detecting pipes under the floor or the asphalt [1], buried ancient artifacts [2] or parts of ancient buildings [3], as well as in many other applications [4].

A key element of any GPR is the antenna. While the antennas for TLC are designed for operating in the free space, the antennas for GPR must operate close or in contact of the ground. This is a strict constraint in their design. Coupling of antenna with the soil is key point. Furthermore, they have to be well-shielded in the back for avoiding to detect "air events", i.e. targets in the air that can be confused with targets in the subsurface. Many different antennas are proposed and tested for GPR [4], but bow-tie are probably the most used [5]-[13]. Their simple and robust design makes them effective in most applications.

Nevertheless bow-tie antenna have some important drawbacks: 1) their lobe is large, so the power is spread in a large solid angle reducing the penetration depth; 2) the coupling between TX and RX antennas is high; 3) the efficiency is reduced by the absorbing material on the back. The contact horn antenna could overcome them: 1) the lobe is narrower (using the same band); 2) the direct coupling is lower; 3) it does not need absorbing materials.

Therefore the aim of this paper is to model a horn antenna in contact with the soil, and to test it also in comparison with a bow-tie antenna operating in the same band. Furthermore, for improving the coupling between horn antenna and soil and to extend its lower band, the empty space inside the horn will be filled with a dielectric oil. Even in this configuration the antenna will be modeled and tested in order to assess its performances

4. References

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