Compact Vivaldi antipodal SIW antenna for GPR applications

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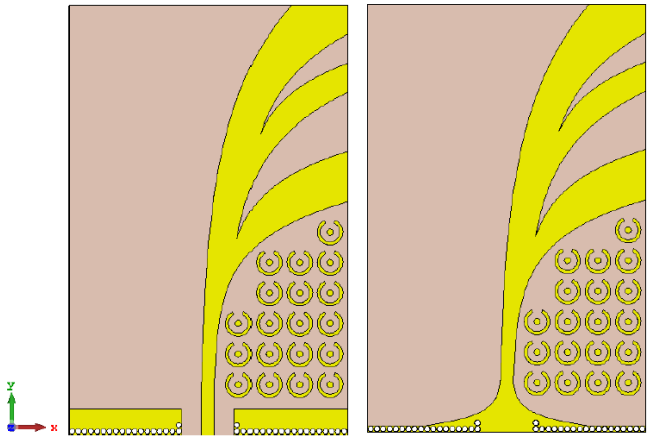
In this work, an ultra-wideband compact Vivaldi antipodal SIW antenna is designed and optimized by employing a ring resonator based metamaterial. Its performances promise Ground-Penetrating Radar (GPR) applications.

Ultra-wideband (UWB) antennas find large use in microwave image processing as a non-invasive technique. Ground-penetrating radar (GPR) is one of the most common techniques for underground investigation [1]. Usually, microstrip technology is employed, since it is low cost and allows compact and low-profile devices. Vivaldi antennas provide a wideband and high gain [2], enabling a multi-depth/multi-material detection in GPR applications. In this work, a Vivaldi antipodal antenna is designed and optimized by varying its geometry and by adding i) a metamaterial region and ii) metalized vias as in Substrate Integrated Waveguide (SIW) technology [3–4]. The used substrate is Rogers Duroid RO4003C ($\varepsilon_r = 3.55$). The antenna is very compact, with dimensions $73.71 \times 48 \times 1.07\ mm^3$. Figure 1 shows the designed antenna using CST Microwave Studio.



(a) (b)

Figure 1. Top (a) and bottom (b) view of the Vivaldi antipodal antenna designed with CST Microwave Studio.

The antenna operates in a very wide frequency band, $f = 3 - 10\ GHz$. As an example, the simulated antenna provides directivity $D = 9.25\ dB$ and gain $G = 8.95\ dB$ at $f = 6.76\ GHz$. The antenna prototype will be fabricated and characterized.

References

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