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UWB VIVALDI ANTENNA BASED ON A SPLINE GEOMETRY WITH FREQUENCY BAND-NOTCH

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Abstract

A printed UWB Vivaldi antenna is presented in this paper. Its geometry is based on a novel spline shape and optimised by an efficient global optimisation algorithm. A U-shaped slot is introduced into the geometry to notch out the 5.1 GHz to 5.8 GHz WLAN band. This can be used to mitigate interference between WLAN and UWB systems.

Introduction

The allocation of the 3.1 GHz – 10.6 GHz band by the FCC [1] has initiated a lot of research activity for UWB antennas. This research focused mainly on miniature antennas with omnidirectional radiation patterns [2]. Vivaldi antennas are end-fire tapered antennas with a large bandwidth and gain. Printed Vivaldi antennas [3] are a low-cost solution and relatively easy to manufacture on standard PCB substrate. The shape of the tapered slot is usually defined by an exponential function. Elliptic curves, terminated in semicircles are described in [4].

In this paper the outlines of the flared elements are described by a quadratic Bézier spline function [5]. A U-shaped notch, also described by a spline, is inserted into the radiating elements in order to avoid interference in the IEEE 802.11a 5.15 GHz – 5.825 GHz wireless LAN band [6].

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Antenna Design

The antenna is fabricated on Rogers RO4350B substrate of 0.762 mm thickness and ε_r=3.48. A 50 Ω microstrip line is printed on the front of the substrate together with one flared element. The rear consists of the groundplane, tapered transition and the antipodal flared element.
The curved edges of the flared elements and the top edge of the ground plane are described by quadratic Bézier spline curves. The control points of these spline curves are placed by an efficient global optimisation algorithm.
A U-shaped slot is inserted into the flared elements to give the desired attenuation at the notch frequency. This slot is also defined by a quadratic Bézier spline curve. The antenna geometry and dimensions are shown in Fig. 1.

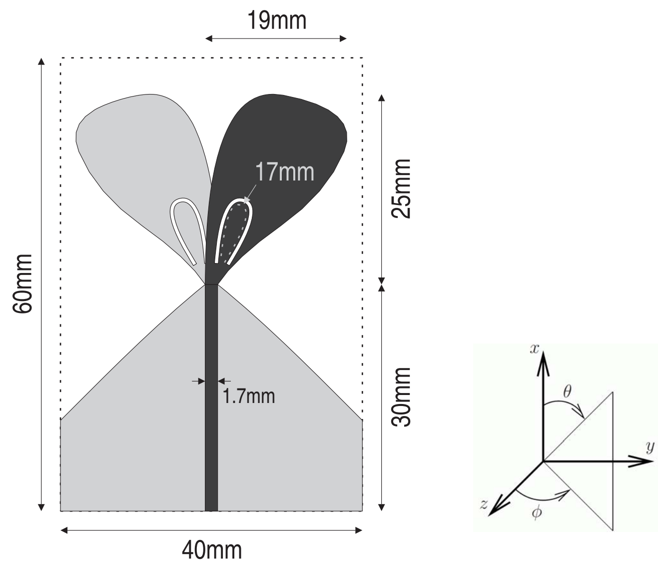

Fig. 1: Geometry of the spline based Vivaldi antenna with U-shaped curved slot.

Results

Two antennas were prototyped, one with and one without the U-shaped slot. Fig. 2 shows the measured VSWR performance of the proposed antennas with and without the U-shaped slot. It can be seen, that the VSWR remains less than 2:1 across the whole UWB band. The antenna with the slot provides a sharp band notch centred at 5.45 GHz.

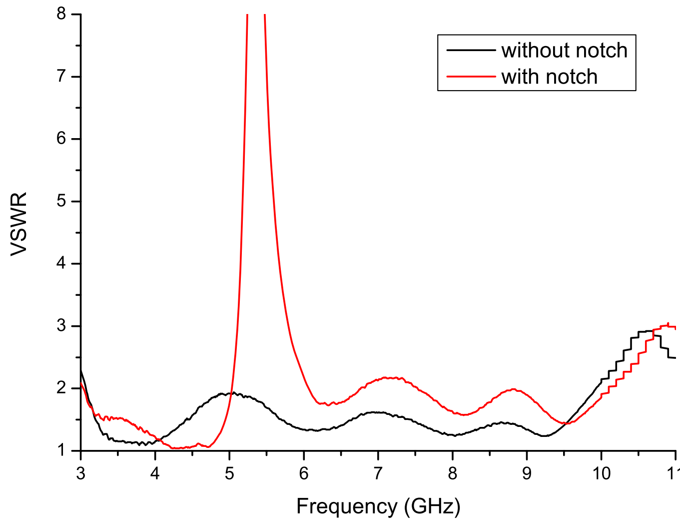

Fig. 2: Measured VSWR of the spline based Vivaldi antenna with and without notch.

Measured radiation patterns are shown in Fig. 3 and 4 as contour plots. The main lobe is fairly wide and symmetrical in the x-z plane. In the x-y plane, the lobe is narrower and there is a slight skew between 5 GHz and 7 GHz. The effect of the notch on the radiation pattern is clearly visible around 5.45 GHz in Fig. 4.

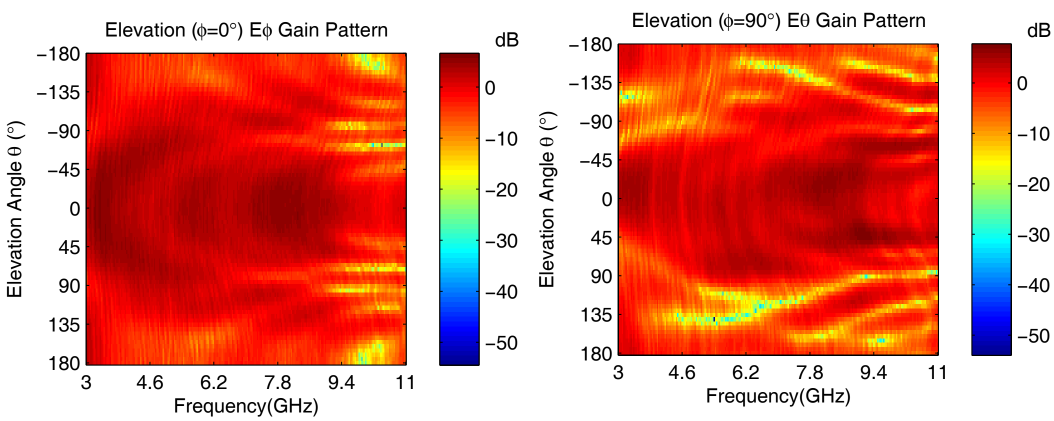

Fig. 3: Measured radiation patterns of the proposed antenna without U-slot in the x-z and x-y planes.

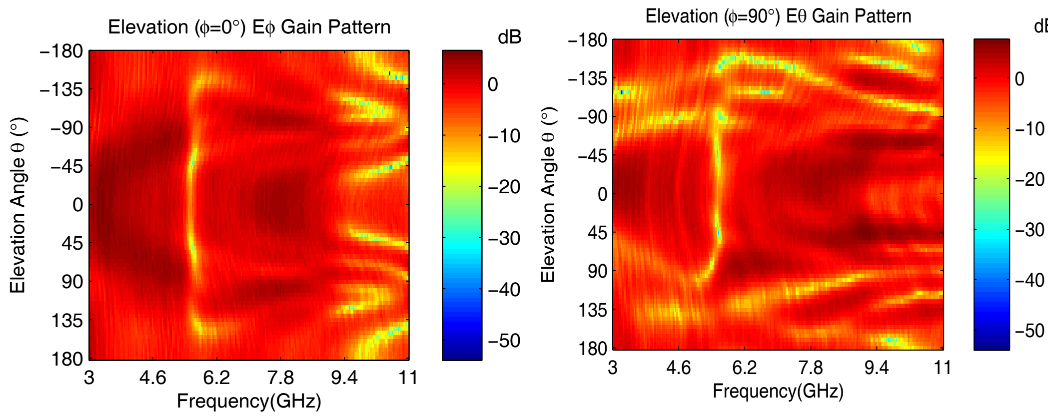

Fig. 4: Measured radiation patterns of the proposed antenna with U-slot showing the notch in the x-z and x-y planes.

Conclusions

A UWB Vivaldi antenna based on a novel spline-based geometry was presented. The antenna covers the 3.1 GHz – 10.6 GHz band. A U-shaped slot was inserted to notch out WLAN frequencies. The antenna shows good directional radiation pattern and gain of 2 –5 dBi.

Acknowledgements

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References

[1] Federal Communications Commission, *First Order and Report, Revision of Part 15 of the Commissions Rules Regarding UWB Transmission Systems,* FCC 02--48, April 22, 2002.

[2] H.G. Schantz, *The Art and Science of Ultrawideband Antennas,* Norwood, MA: Artech House, 2005.

[3] E. Gazit, “Improved Design of the Vivaldi Antenna”, IEEE Proc. H, vol. 135(2), pp. 89-92, 1988.

[4] X. Quing and Z. N. Chen, Antipodal Vivaldi Antenna for UWB Applications, Euro Electromag.-UWB SP7, Magdeburg, Germany, July 12-16, 2004.

[5] M. John and M.J. Ammann, “Spline Based Geometry for Printed Monopole Antennas”, *Electron. Lett.*, vol. 43, no. 6, pp. 317-319, Mar 2007.

[6] *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, High-speed Physical Layer in the 5 GHz Band,* IEEE 802.11a, 1999.