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Beam-Tilting Improvement of Balanced Antipodal Vivaldi Antenna Using a Dielectric Lens

A. Molaei [1*], M. Kaboli [2], S. A. Mirtaheri [2] and S. Abrishamian[2]

[1] School of Electrical & Computer Engineering, University of Tehran, Tehran, Iran
[2] School of Electrical & Computer Engineering, Khaje Nasir University of Technology, Tehran, Iran

[*]Corresponding author: a.molaei@ut.ac.ir

ABSTRACT—Conventional "Balanced Antipodal Vivaldi Antenna" (BAVA) usually suffers from beam-tilting at upper working frequencies. For compensating the beam-tilting, we have proposed a New BAVA. By adding an oval-shaped dielectric lens at the end of the antenna, the beam titling in E-plane was improved within the higher working frequencies. Results show that the antenna has better than 10 dB return loss for the frequency range of 3 to 18 GHz. Simulated radiation patterns successfully verify the well behavior of the dielectric lens BAVA. For evaluating time domain characteristics, group delay and fidelity factor of the antenna is investigated.

KEYWORDS: balanced antipodal Vivaldi antenna (BAVA), ultra-wideband antenna, tapered slot antenna.

I. INTRODUCTION

Ultra-wideband is a radio technology which is used at a low power level for short-range, high bandwidth communications such as, radar-imaging, wireless monitoring, target sensor data collection and precision tracking [1, 2].

Vivaldi, introduced by P.J.Gibson in 1979 [3], is a broadband antenna which satisfies the requirements of UWB. Vivaldi's advantages are its planar structure, low profile and quite low impulse distortion in contrast to other UWB antennas.

From the time of VIVALDI introduction, several improvements to the primary design have been done [4, 5], and the balanced antipodal Vivaldi antenna (BAVA) is one of the first of these developments, which was first introduced by [6]. In contrast to the original Vivaldi, BAVA provides a more compact profile, much wider bandwidth and relatively high cross polarization.

In [5], a specially shaped dielectric with higher permittivity is placed around the aperture. By this means a narrower beam-width is achieved, and at the same time it keeps return loss better than 10 dB within the frequency range of 2.4 to 18 GHz. But the boresight gain still happens to subside significantly due to the beam-tilting at higher frequencies.

In order to improve the beam tilting over upper working frequencies, we employed a new BAVA and compared it's characteristics with the conventional BAVA. An elliptical shaped dielectric lens (hereafter we call it DL-BAVA) is added in front of the antenna's aperture. The conventional BAVA and DL-BAVA are