High-Gain Modified Antipodal Vivaldi Antenna for Ultra-Wideband Applications

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***Abstract*—In this paper, the design of a high gain modified antipodal Vivaldi antenna (HG-MAVA) for ultra-wideband applications is presented. The proposed antenna designed on a low-cost FR4 substrate with a thickness of 1.6mm was realized by incorporating a combination of exponential slot edge corrugation on the radiating flare and a high permittivity dielectric director in the flare aperture of a conventional antipodal Vivaldi antenna (CAVA). Compared to the CAVA, the proposed antenna extends the lower end frequency limit of the CAVA to 2.15 GHz. Improvement in realized gain is also achieved throughout the 2.15 GHz to more than 11 GHz operating frequency band of the proposed antenna with the highest improvement of 1.61 dBi at 7 GHz. The surface current distribution and the radiation pattern of the proposed antenna were studied to further characterize the performance of the antenna.**

***Index Terms*—Corrugation; Dielectric Director; Surface Current; Ultra Wideband.**

I. INTRODUCTION

Since the commercial licensing of the ultra-wideband frequency (UWB) spectrum by the federal communications commission (FCC) was introduced in February 2002 [1], different types of UWB antenna designs [2], [3] have been proposed. Recently research attention in both academia and industry has beamed more search light on the Vivaldi antenna due to increase in the demand of commercial and military mobile wireless systems.

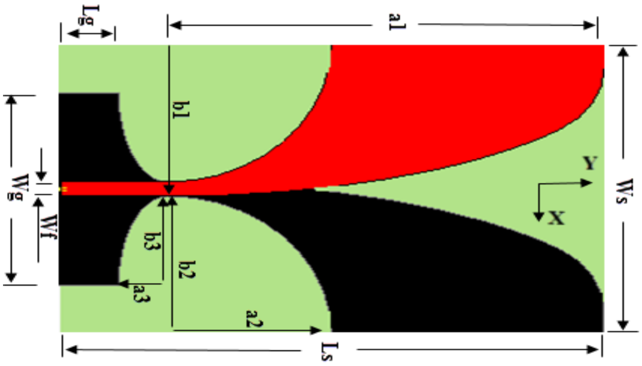
The Vivaldi antenna also known as the Vivaldi notch or the tapered slot antenna was first discussed by P. J. Gibson in 1979 [4]. Its unique feature is a microstrip to slotline transition feeding technique whose design was improved upon in 1988 by E. Gazit [5] using the antipodal Vivaldi antenna to broaden the operation frequency and later by J.D.S. Langley et al. [6] in 1996 for improved cross-polarization.

However the antipodal Vivaldi antenna despite its many advantages [7]–[9], still suffers from drawbacks such as tilted beam, low or inconsistent directivity and gain. Several techniques have being proposed in literature for improving the gain and directivity of the antipodal Vivaldi antenna including the use of high permittivity dielectric director [10]–[13], zero index and negative index metamaterials (ZIM/NIM) [14]–[16], as well as using array structures [17]–[20] among others.

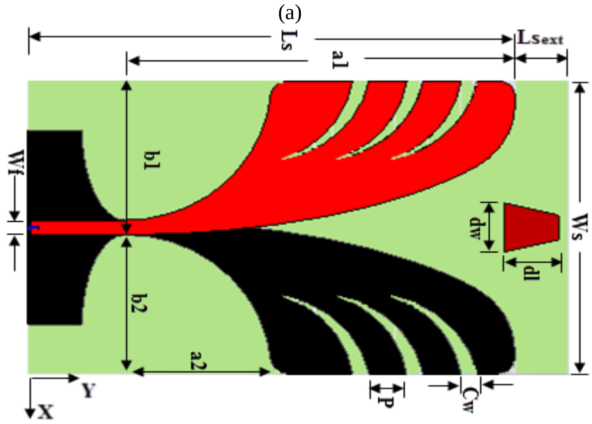
In this paper, a new method of improving the performance of the antipodal Vivaldi antenna based on incorporating a combination of exponential slot corrugations on the radiating arm of the antenna and a high permittivity dielectric director is proposed.

II. ANTENNA GEOMETRY AND DESIGN

A low-cost FR4 dielectric substrate with dielectric permittivity constant ε_r = 4.4, thickness h = 1.6mm, and dielectric loss tangent δ = 0.02 respectively has being used for the design of the antenna whose geometry is as shown in Figure 1(a). The antenna includes three main parts: feed line, feed transition and the tapered radiating flare sections. The shape of the radiating flares is designed in the form of elliptical curves because of its simple structure, offers wide impedance bandwidth and presents a smooth transition between the feeding line and the radiation flares. The arms are flared in opposite directions and symmetrically rotated around the antenna aperture axis.



(a)



(b)

Figure 1: Structure of (a) Conventional AVA and (b) Proposed AVA

The upper-frequency limit of a Vivaldi antenna is theoretically infinity while the lower frequency limit depends