Review Paper on Vivaldi Antenna for UWB Application

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Abstract
This paper describes the design of vivaldi antenna and show different feeding techniques that is used to give feed to the tapered slot vivaldi antenna. This paper also discussed the antenna parameters and material properties. This paper presents the literature survey on UWB application using different feeding technique.

Keywords
Antenna, UWB Applications

I. Introduction
The Ultra Wide Band systems developed due to the rapid development of the satellite , wireless communication, remote sensing and radar [1]. UWB antenna capable of operating on the ultra wide bandwidth as allocated by FCC (Federal Communication Commission). The bandwidth of 7.5 GHz (from 3.1 GHz to 10.6 GHz) is used for the UWB applications. The broadband bandwidth, minimum distortion of received and transmitted pulses is the requirement for UWB technology.

The Tapered Slot Antenna (TSA) is the best for the UWB application as shown in fig. 1. These antenna has wide bandwidth, high gain, symmetric pattern. It has both co-polarization and cross polarization. The Exponentially tapered slotline in vivaldi antenna is introduced by Gibson. The types of TSA are Linearly Tapered Slot Antenna (LTSA), Constant Width Slot Antenna(CWSA), exponentially tapered slot antenna (vivaldi) [2].
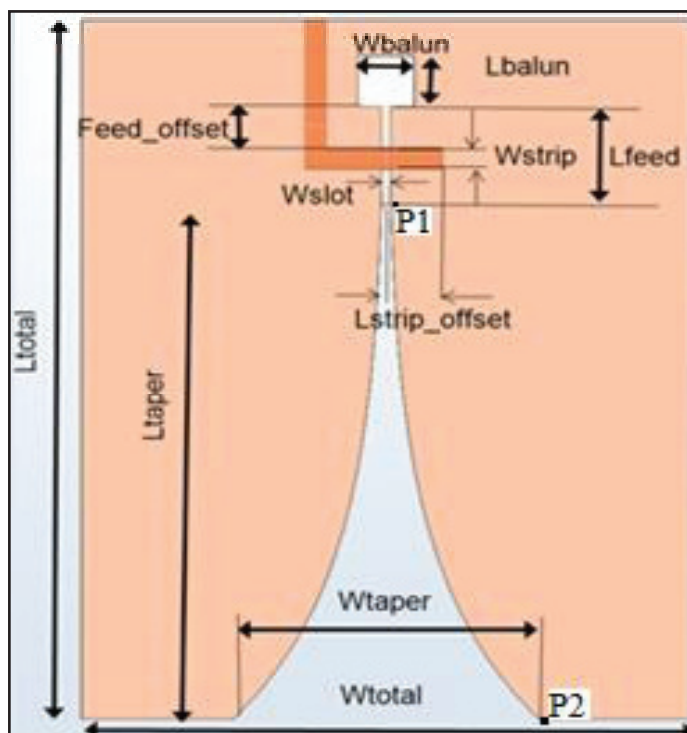

Fig. 1: Tapered Slot Vivaldi Antenna

II. Literature Survey
In this paper, survey of the Vivaldi antenna is discussed. Multiband Vivaldi Antenna is introduced for X and Ku band Applications. It used the frequency from 8 to 20 GHz and the antenna resonate at five different frequencies. Gain of 9 db bandwidth of 0.092% enhancement can be obtained from the model [3].

A Noval Low RCS Design Method is used for the application of X- Band Vivaldi antenna at the operating frequency of 10GHz. It used relative permittivity of 10.2 with substrate thickness of 0.635mm [4].

The small tapered slot Vivaldi antenna for the UWB application using FR4 substrate is designed. It shows that any change in width results a change in bandwidth of an antenna and that antenna must be greater than half of wavelength [5].

The Vivaldi Antenna for DVPT and UWB application has been presented. The antenna bandwidth extended from 450 MHz to 12 MHz with return loss is less than -6db.The proposed antenna is compact and the antenna gain varies from 1.5dbi to 5.5 dbi over the operating band with 80% average radiation efficiency [6].

The Triangular slot is added in Vivaldi antenna at the operating frequency of 10GHz. The return loss in triangular slot antenna is -18.495db better than without triangular slot antenna is -17.818db [7].

The Vivaldi Antenna is designed by loading of corrugation and grating element near the tapering profile of a compact antenna. Improved reflection coefficient is below -10db for frequency range from 2.9GHz to more than 11 GHz [8].

The Vivaldi antenna is designed at the frequency from 3.1 to 10.7 GHz using FR-4 material .Rectangular Shaped Slot is designed having 11 slots with length of the first slot is 15mm and the second slot length is minus 11mm long and multiplies for the next slot. After modified the amount of gain is affected by approximately 7.6 dbi from gain of 4.8 to 8.02dbi and bandwidth design has not reached the 8 GHz [9].

III. Feeding Technique
The Bandwidth is infinite in vivaldi antenna. The Physical size of the antenna and the fabrication capabilities are the limitation on the bandwidth. The proper feeding structure is essential to maximize the bandwidth. Different feeding are used. The Two feeding techniques are Directly coupled transition and electromagnetically coupled transition. The Methods which are commonly used are the coaxial line feed and the microstrip line feed. I discuss the microstrip feed line in this paper.

The Microstrip to slotline transition is the medium best for the feeding the TSA. The Slotline is on the one side of the substrate and the microstrip is etched on the another side of the substrate. The Microstrip and slotline crossing each other at right angle in their construction. When the stripline and slotline crossing each other, the slots are extends by λ_s /4 beyond the microstrip and λ_m /4 beyond the slotline as shown in fig. 2. The main drawback is reduction in the bandwidth but improved the radiation pattern.
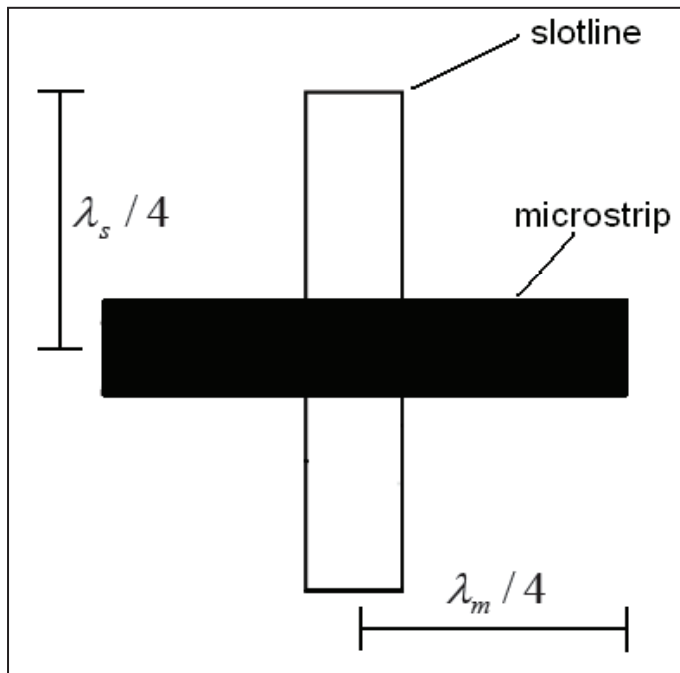
Fig. 2: Micro Strip to Slot Line Transition

IV. Antenna Parameters

A. VSWR

VSWR stands for voltage standing wave ratio. It is also called standing wave ratio. VSWR describes the power reflected from the antenna in terms of reflection coefficient is given as

$$VSWR = \frac{1+|r|}{1-|r|}$$

r = Reflection Coefficient.

B. Return Losses

Return losses is a reflected or returned signal by a discontinuity in a transmission line which leads to loss in the power of the signal. It is usually expressed as a ratio in db.

$$RL(db) = 10 \log 10 \frac{p_i}{p_r}$$

p_i = the incident power
p_r = the reflected power
RL(db) = the return losses in db.

C. Directivity

Directivity is a parameter which measures power density of the antenna in the direction of its strongest emission versus the power density radiated by ideal radiator.

D. Antenna Efficiency

Efficiency of antenna is ratio of the power delivered to the antenna relative to the power radiated from the antenna. The antenna efficiency is the ratio of radiated power to the input power of the antenna.

$$E_{R} = \frac{P_{radiated}}{P_{input}}$$

E. Antenna Gain

Gain simply measure that combines antenna efficiency and directivity.
G = E$_{antenna}$. D

F. Bandwidth

Bandwidth of antenna is the range of frequencies at which antenna is operated correctly. Bandwidth is calculated in hertz. The percentage of the center frequency of the band is

$$BW = \frac{f_h - f_l}{f_c}$$

V. Conclusion

This paper presented theoretical survey on Tapered slot vivaldi antenna. After study of the literature survey, it conclude that increase in bandwidth, gain and improved radiation pattern can be obtained by adding the slots in the geometry of antenna, using different material of antenna. By changing the feeding technique, improved in the antenna parameters can be obtained.

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