High Gain Design of Yagi Uda Antenna

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ABSTRACT: Yagi-Uda is known for its high forward gain capability, low cost and simple design. This paper outlines the process of designing a four element Yagi-Uda antenna that consists of driven element known as dipole, gap, reflector and directors at 900 MHz for WLAN application. The designed antenna produced S_{11} of -25.72 dB at operating frequency 955.81MHz and bandwidth of 20.5256%. Yagi-Uda antenna also yield gain directivity of 5.923dBi.

Keywords: *Yagi Uda; high gain; 900 MHz; WLAN*

1. INTRODUCTION

Wireless local area network (WLAN) channels are frequently accessed using IEEE 802.11 protocols, and equipment that used mostly under the trademark Wi-Fi limitation. 900 MHz is a good penetration frequency of signal. Especially for public wi-fi access in the rural areas [1-3].

A Yagi-Uda consisting of a reflector, driven element and a single director. The driven element is typically a λ/2 dipole or folded dipole and is the only element of the structure that is directly excited (electrically connected to the feedline). All the other elements are considered parasitic which reradiate power received from the driven element. Yagi-Uda is chosen due to its high gain capability, low cost and easy to construct.

2. METHODOLOGY

2.1 Yagi-Uda Antenna

The Yagi-Uda is a directional antenna that consist of a row of parallel straight cylindrical conductors which only one (dipole) is driven by a source and all others are parasitic elements (director and reflector).

2.2 Antenna Designing

The equation (1) is used to calculate the basis parameters of the antenna designed.

$$C = f \times \lambda \qquad (1)$$

C= the speed of light (3x10^8 m/s)
f= the resonant frequency (900MHz)
λ= the wavelength

The length of the dipole of the antenna is equal to the half of the wavelength calculated by:
Dipole length= λ (wavelength) /2.

The length of the reflector element of the antenna is within 5 percent deviation than the driven element or dipole. The reflector element is spaced a distance (shifted to the left side of dipole) of 0.1 to 0.25 times the resonant wavelength (lambda) from the driven element. Therefore the chosen space value for the reflector away from the dipole is 0.25. The length of the directors elements of the antenna are equal to approximately about 5 to 30 percent shorter (-5% to -30%) than the driven element or dipole.

3. RESULTS AND DISCUSSION

Defining the parameters of the antenna. Also the calculated lengths of the elements are not used because they give results which are not near the desired results. Figure 1 is the dimension of Yagi-Uda Antenna.

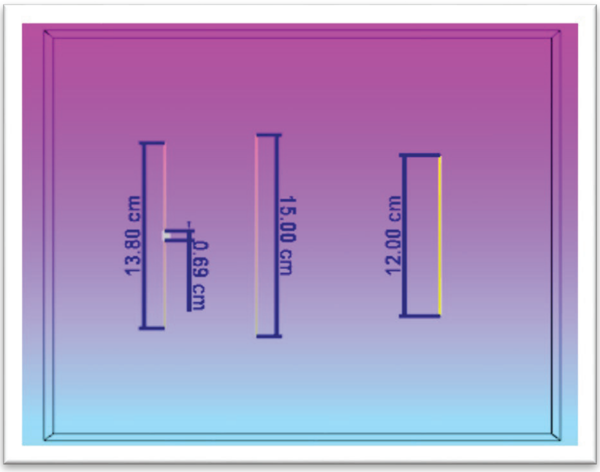

Figure 1: The dimension of Yagi-Uda Antenna

3.1 Final Design

The length of the dipole, directors and reflector in the antenna designed are changed from what was on to give a more accurate result (final design) that meets the requirements than the initial simulation. Also the spacing of the reflector and the directors are kept the same because they are placed as much as further from the dipole.

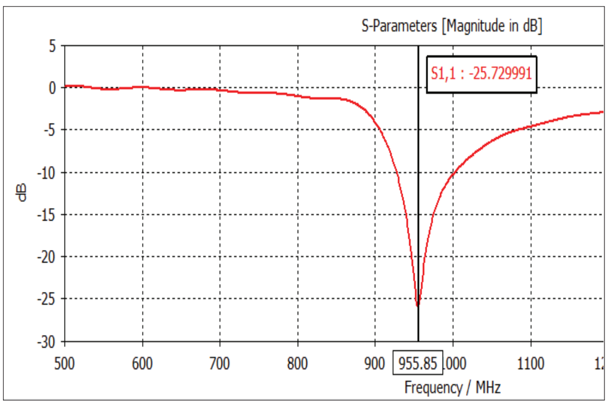

Figure 2: The S-Parameter Result

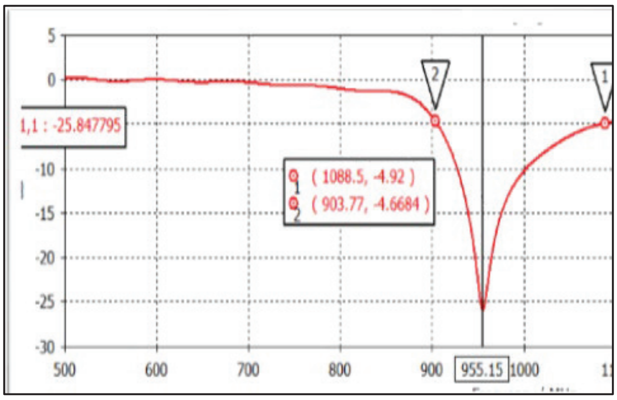

Figure 3: The pick point for bandwidth

Based on figure 2, the S- parameter that shown on this Yagi-Uda antenna is operates on 955.85MHz which is achieve the the target which is 900MHz. The return loss as shown in figure have -25.729991 dB, as shown in figure 3, the pick point for calculated the percentage bandwidth is by using the formula;

BW percentage: (Fh-Fl)/Fr x 100%
=20.5256%

Based on this percentage bandwidth the requirement that needed at least 20% bandwidth is achieved.

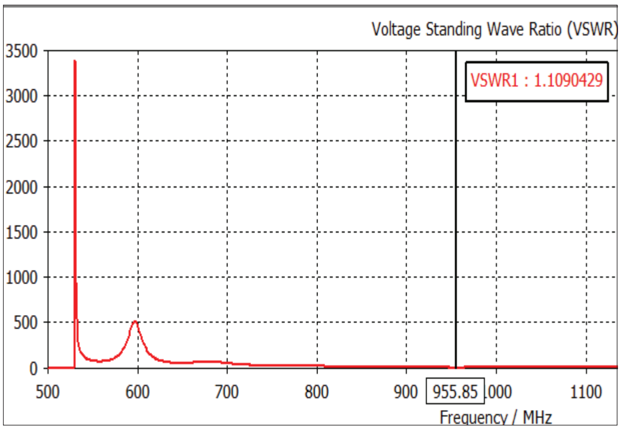

Figure 4: The VSWR value

From the Figure 4, is showing the value of VSWR based on the operating frequency at 955.85MHz is 1.1090429.

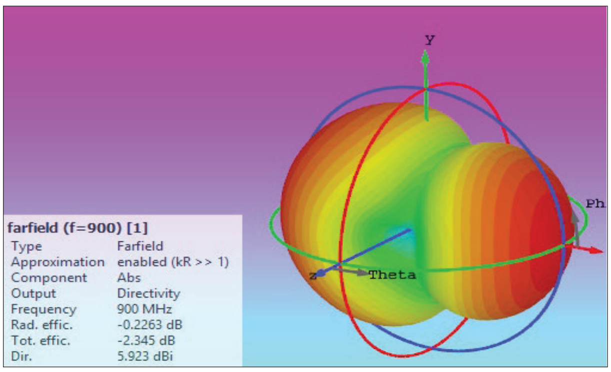

Figure 5: The Directivity Gain in 3D

Figure 5 shows the result of the gain based on 3D form. The gain for this Yagi-Uda Antenna is 5.696 dB, Then at frequency 900MHz, for Polar based on the result got the main lobe magnitude got -3.87dB in main lobe directions 90.0 deg and the angular width in 3dB is 83.8dB. The directivity gain in this antenna design is 5.923 dBi.

4. CONCLUSION

As conclusion, the designed Yagi-Uda antenna successfully achieved S_{11} of -25.722991 dB at operating frequency 955.81MHz. The antenna also generate bandwidth and gain of 20.5256% and 5.923dBi respectively.

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