# A Novel High-Gain Quasi-Yagi Antenna with a Parabolic Reflector


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***Abstract*—The simplicity and intuitive design of traditional planar printed quasi-Yagi antennas has led to its widespread popularity for its good directivity. In this paper, a novel quasi-Yagi antenna with a single director and a concave parabolic reflector, operating in S-band, is proposed. The impedance characteristic and radiation characteristic are simulated with CST-Microwave Studio, and the antenna is fabricated and measured. The measured results indicate that the antenna which can operate at 2.28-2.63GHz can achieve an average gain of 6.5dBi within the operating frequency range, especially a highest gain of 7.5dBi at 2.5GHz. The proposed antenna can be widely used in WLAN/TD-LTE/BD1 and so on.**



***Keywords—High-gain; quasi-Yagi antenna; parabolic reflector***


## I. INTRODUCTION

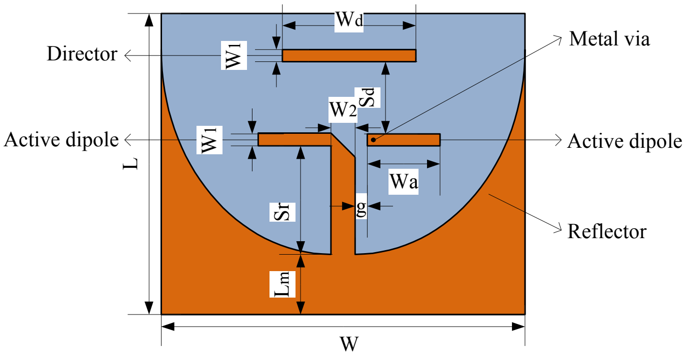
Traditional Yagi antenna is quite a suitable candidate in the fields of wireless communication and radar detection for its advantages of high-gain, ease of fabrication and low cost [1]-[2]. With the increasing demand of various portable devices, the planar printed antennas have drawn lots of attention from the academia and industry for its low profile, light weight and low cost [3].

In order to obtain a kind of antenna which can achieve high-gain and low profile, Qian proposed the quasi-Yagi antenna which combined the advantages of the Yagi antenna and the planar printed antenna [4]. A lot of studies have focused on quasi-Yagi antenna in the field of wireless communication so far [5]-[9]. It possesses good directivity and hence is suitable for directive wireless communication. Besides, it is easy for the quasi-Yagi antenna to construct compact antenna array, which is easy to integrate into microwave circuit [10]. Therefore, quasi-Yagi antenna will be popularly used in the future.

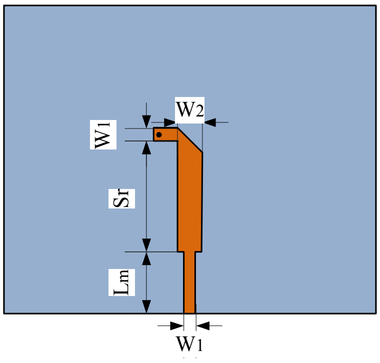
A sort of planar printed quasi-Yagi antenna with a single director and a concave parabolic reflector, operating in S-band, is proposed in this paper. The proposed antenna features its high-gain and simple feeding structure. The structural parameters of the proposed antenna are optimized with CST-Microwave studio to obtain good return loss and high-gain. Compared the simulated results with the measured results, the original design idea is verified to be feasible. Consequently, the antenna can be used in wireless communication system, especially WLAN/TD-LTE/BD1.

## II. PRINCIPLE

The geometry of the proposed antenna is described in Fig. 1. The antenna consists of an active dipole, a single director and a reflector. A reflector with a concave parabolic boundary can be applied to enhance the gain of the quasi-Yagi antenna [11]; that is, it can enable the radiated electromagnetic energy towards a specific direction. This novel reflector with the concave parabolic boundary located around the driven dipole's focus to modify a traditional quasi-Yagi antenna to attain a higher directivity. What's more, there is an additional dielectric substrate used as dielectric lens to further enhance the antenna's directivity. Moreover, the proposed antenna employs a metal via to simply the feeding network. The truncated corners in the two arms of the active dipole aim to improve the impedance matching. Finally, the major parameters which have effects on the antenna performance are carefully and elaborately designed to improve the antenna's performance.




(a) Top metal layer




(b) Bottom metal layer

Fig. 1. Geometry of the proposed antenna (all dimensions are in millimeter). L=72, $L_m$=18, W=122, $W_a$=34, $W_d$=34, $W_1$=3, $W_2$=4, $S_r$=18, $S_d$=20, g=0.8.

## III. Antenna Configuration

The structure of the proposed antenna is displayed in Fig. 1. The antenna is composited by 3 layers. The top metal layer and the bottom metal layer is printed on the top and the bottom of the dielectric substrate separately. The substrate used is the FR4 with the relative permittivity of 4.4 and the thickness of 1.6 mm. The director, the reflector, the active dipole and a part of the feeding line are printed on the top layer of the substrate as Fig. 1(a). The radius of the metal via in the substrate is 0.5 mm. The boundary of the reflector is described by the function of $y=x^2/84$. On the bottom layer, there is only the other part of the feeding line as Fig. 1(b). The central frequency of the antenna is 2.45GHz.

## IV. Simulated and Measured Results

Simulations of the proposed antenna are performed by the simulator CST-Microwave Studio. The prototype has been fabricated as Fig. 2 and measured. The comparison of the simulated and measured impedance characteristic is shown in Fig. 3. The impedance bandwidth is from 2.28-2.63GHz with the reflection coefficient less than -10dBi. The gain changes from 6dBi to 7.5dBi with an average gain of 6.5dBi within the operating frequency range and especially a highest gain of 7.5dBi at 2.5 GHz. The simulated and measured radiation patterns of the antenna at 2.5GHz are displayed as Fig. 4. The curves of the simulated and measured results having the same tendency means they match with each other well, which verifies the design idea is feasible.

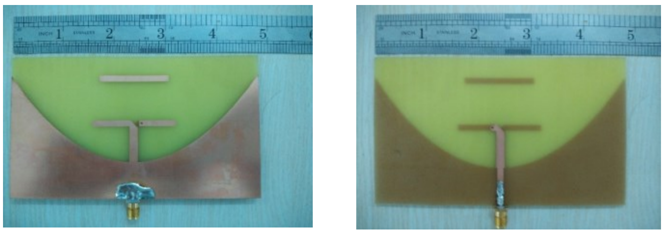


Fig. 2. Fabricated antenna (top view and bottom view)

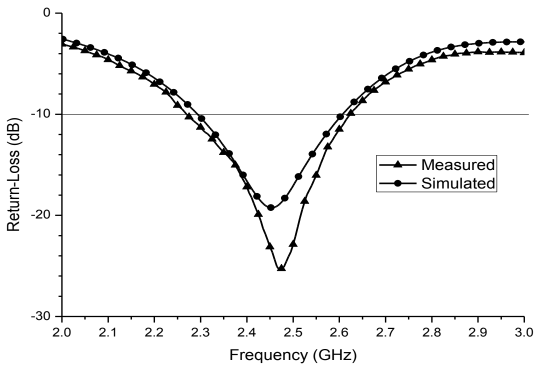
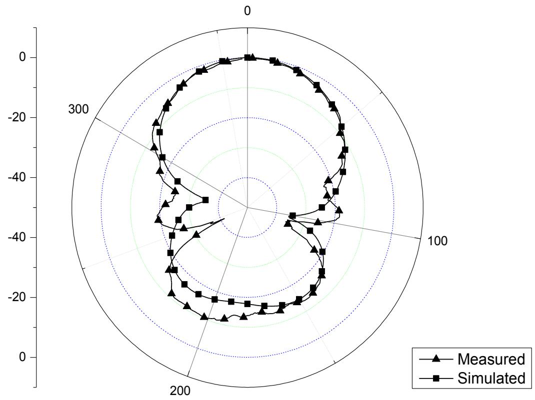
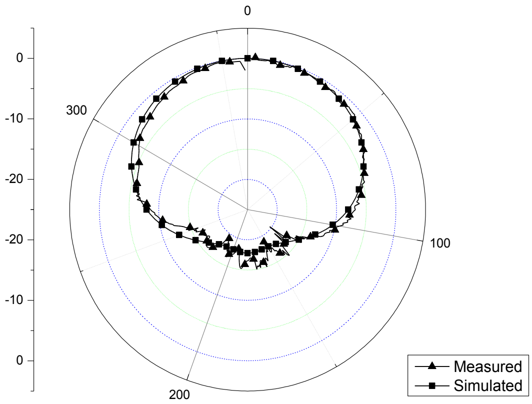



Fig. 3. Simulated and measured return-loss of the antenna




(a) E-plane radiation pattern




(b) H-plane radiation pattern

Fig. 4. Simulated and measured radiation patterns of the antenna at 2.5 GHz

## V. Conclusion

A sort of planar printed quasi-Yagi antenna with a single director and a concave parabolic reflector, operating in S-band, has been proposed in this paper. The performance of the proposed antenna has been presented. The simulated results and the measured results are well matched. The antenna can achieve the average gain of 6.5dBi within the operating frequency range of 2.28-2.63GHz, especially a highest gain of

7.5dBi at 2.5GHz. The size of the antenna is 72×122mm$^2$ with 1.6mm thickness. Furthermore, the size of the antenna can be reduced by some innovative design, such as meander technology and high permittivity substrate. Above all, the proposed antenna can be widely used in wireless communication system.

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