A Dual Band Center-fed Sleeve Dipole Array for IEEE 802.11a/b Application

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Abstract— Traditional end-fed sleeve dipole array antenna will cause the current distribution to attenuate gradually along the antenna array. This phenomenon not only causes the lower aperture efficiency but also with frequency scan. Lower aperture efficiency and frequency scanning will degrade the antenna performance. In order to solve the lower aperture efficiency and frequency scan characteristics of the end-fed sleeve dipole array, a dual bands three elements printed sleeve dipole antenna array with beam direction at boresight direction has been developed for the application of IEEE 802.11 a/b/g. The size of sleeve dipole antenna array is 220 mm in length, 8 mm in width, and 0.4 mm in thickness The beam direction always points at the boresight direction even if for various frequency operation.

1. INTRODUCTION

The end-fed sleeve dipole array antennas are most used in traditional communication system for its easy fabrication. Due to the power radiation continuous along the antenna dipole array, the current distribution will attenuate gradually along the sleeve dipole array. Since the current distribution is triangular asymmetry shape instead of uniform shape along the array, the aperture efficiency of the array will be seriously degraded. Except for the current distribution decreased along the sleeve array, the antenna beam will also scan in the E-plane for the operating bandwidth. The higher the frequency is the larger the scan angle will be. Usually, the amount of scan angle is about percent of bandwidth. For example, the bandwidth of IEEE 11a is about 600 MHz (5.2 GHz $\sim$ 5.8 GHz) with fractional bandwidth about 12%. The amount of scan angle for this sleeve dipole array antenna is 12 degrees in the E-plane. If the E-plane antenna half power beamwidth is 12 degrees, the antenna gain will degrade 3 dB with maximum center frequency 5.5 GHz at broadside direction.

The current distribution of can be triangular symmetry or uniform distribution for the centerfed of the sleeve dipole array. The aperture efficiency of the sleeve dipole array with center-fed is improved if compared with that of end-fed. The amount of beam scan angle will be cancelled out even for larger frequency scan angle by using the center-fed of the array. The beam direction of the sleeve dipole array will always point at the boresight direction even if the frequency is changed. In order to solve the above two disadvantages of the end-fed sleeve dipole array, dual bands (2.4 GHz $\sim$ 2.5 GHz and 5.2 GHz $\sim$ 5.8 GHz) with high aperture efficiency and without frequency scanning center-fed sleeve dipole array antenna, is developed.

2. ARRAY SIMULATION AND MEASUREMENT

In order to have higher aperture efficiency, the sleeve dipole array with center fed IEEE 802.11a/b/g is designed and implemented. The sleeve dipole array with three dipole elements operates simulta-

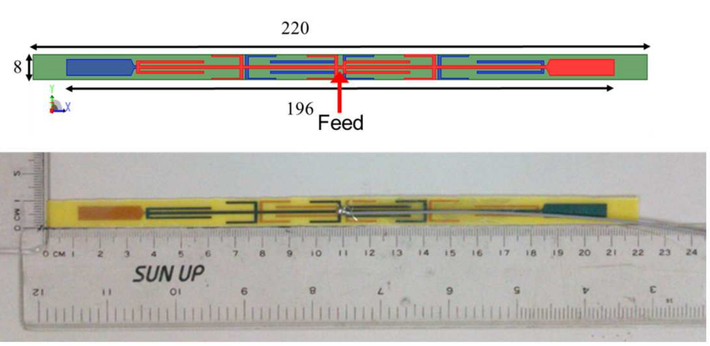
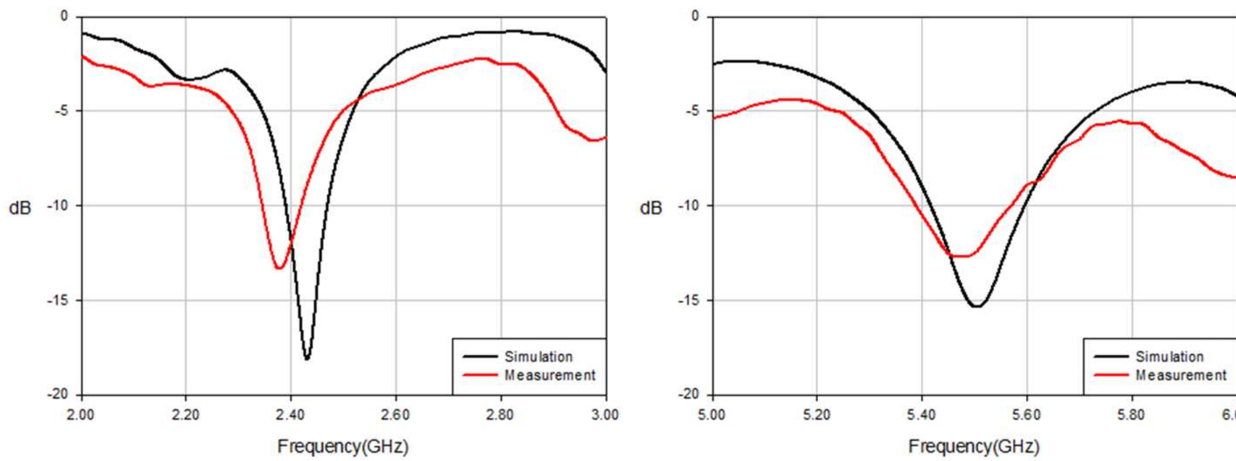


Figure 1: Simulation model and implemented of sleeve dipole array.

neous at 2.4 GHz and 5.5 GHz. The size of sleeve dipole array as shown in Fig. 1, printed on FR4 substrate, is with 22 cm in length 0.8 cm in width and 0.04 cm in thickness.

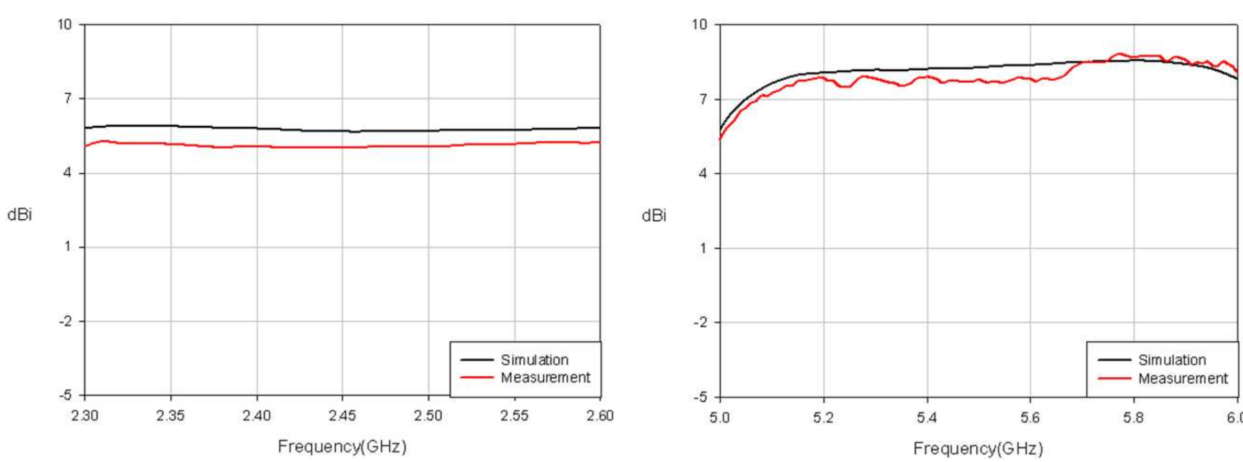
The simulated and measured return loss for dual bands is shown Fig. 2. The return loss for simulation is less than 10 dB for frequency in 2.4 $\sim$ 2.5 GHz and 3 dB for frequency in 5.2 $\sim$ 5.8 GHz.



(a) (b)

Figure 2: Simulated and measured return loss. (a) 2.4 GHz band, (b) 5.5 GHz band.

Figure 3 is the simulated and measured directivity for the two bands. Fig. 4 is the E-plane simulation E-plane pattern for different frequencies. The E-plane plane is composed of two sleeve dipole arrays with center fed. The E-plane beam direction will opposite for the sleeve dipole arrays with center fed. The final E-plane beam patterns are at boresight direction for all frequencies. At 5.2 GHz, the beamwidth is narrow and point at borsignt direction. Unfortunately, the beamwidth is wider at 5.5 GHz and 5.8 GHz. This is due to the beam scan angel is large for higher frequency. Fig. 5 is the H-plane patterns. The H-plane pattern is almost omnidirectional. Figs. 6 and 7 are the measured and simulated E-plane and H-plane patterns at 2.45 GHz and 5.2 GHz. The gain difference for measurement and simulation is due to the 1.13 mm mini coaxial cable and connector. It is supposed for the extra loss is 2 dB for measurement.



(a) (b)

Figure 3: Directivity for simulation and measurement. (a) 2.4 GHz band, (b) 5.5 GHz band.

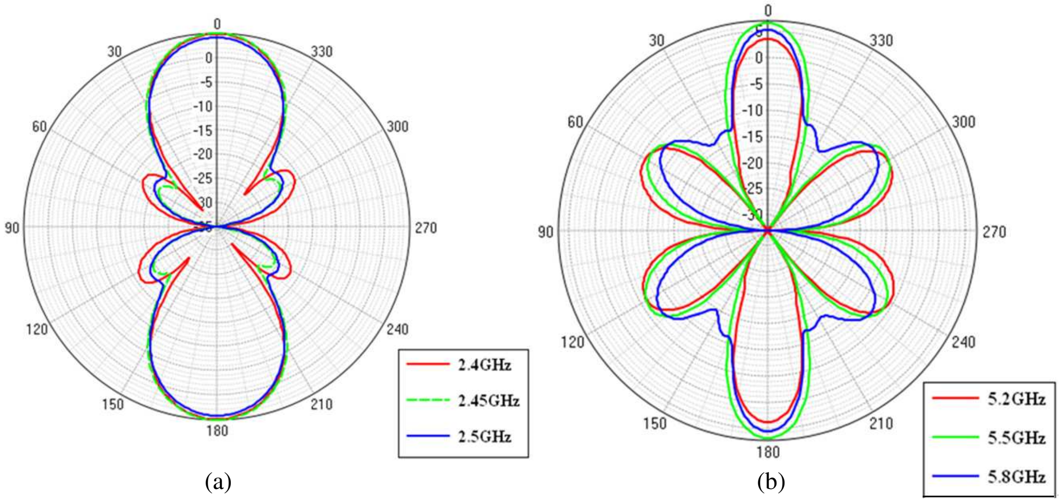


Figure 4: Simulated E-plane patterns for different band. (a) 2.4 GHz band, (b) 5.5 GHz band.

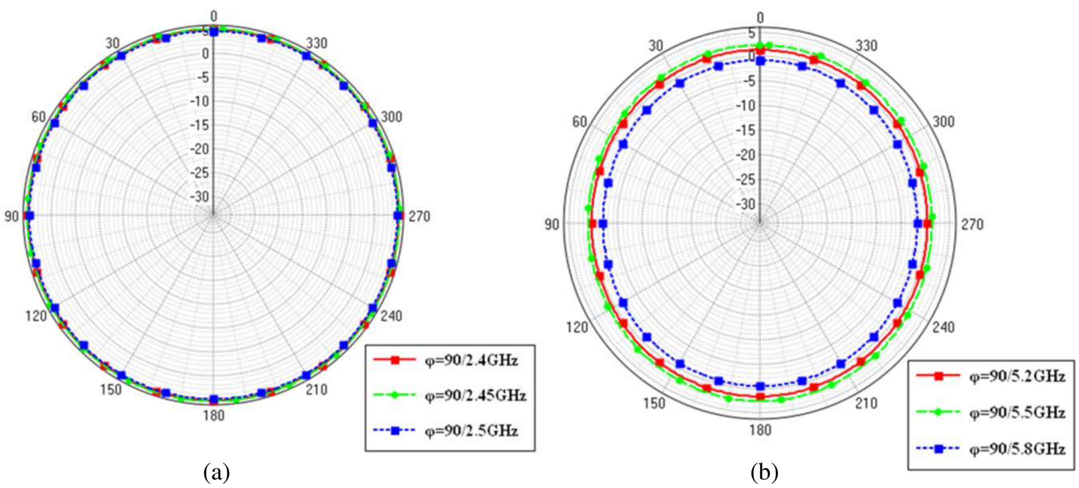


Figure 5: Simulated H-plane patterns for different band. (a) 2.4 GHz band, (b) 5.5 GHz band.

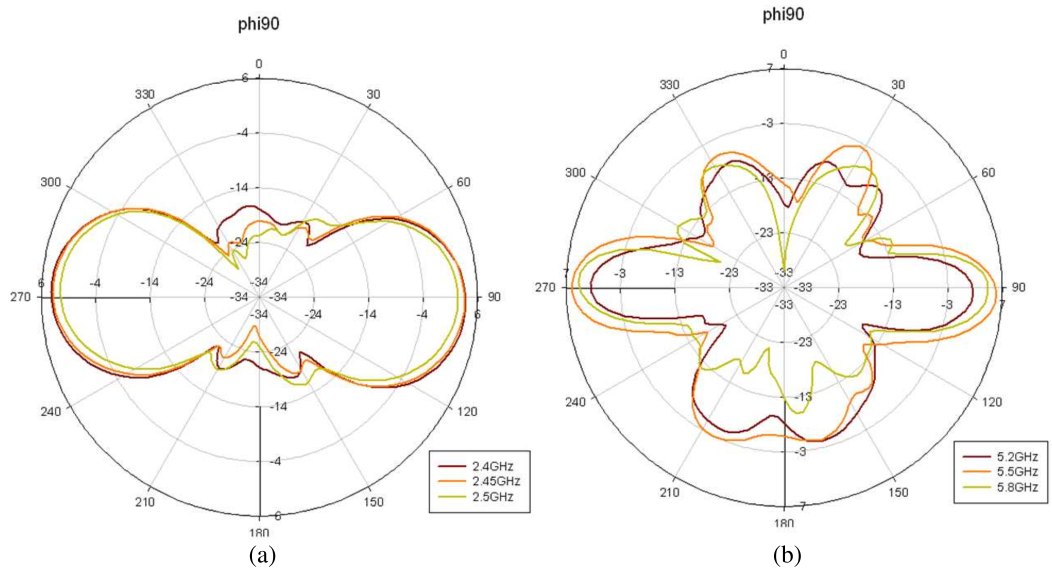
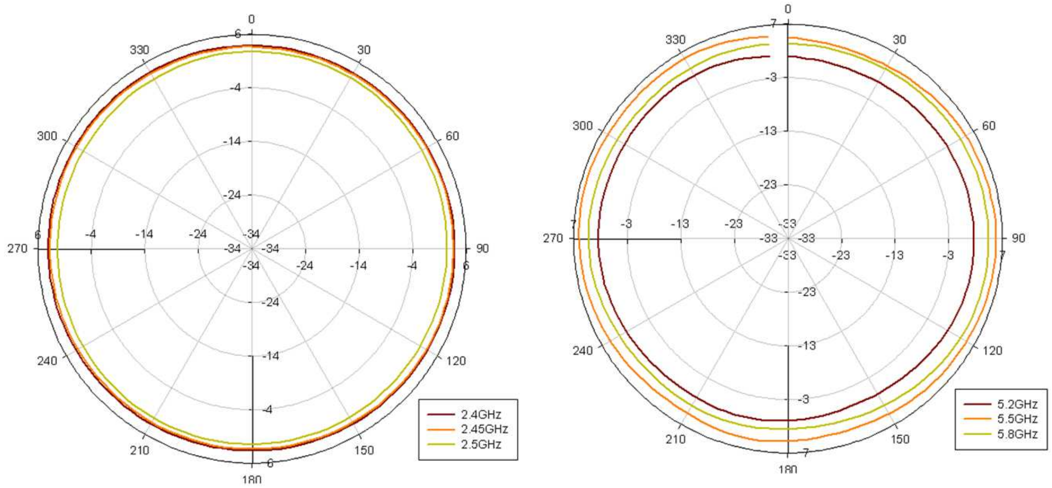


Figure 6: Measured E-plane patterns at 2.4 GHz and 5.5 GHz bands. (a) 2.45 GHz, (b) 5.5 GHz.



(a) (b)

Figure 7: Measured H-plane patterns at 2.4 GHz and 5.5 GHz bands. (a) 2.45 GHz, (b) 5.5 GHz.

3. CONCLUSION

High aperture efficiency of sleeve dipole array with three elements for 2.4 GHz and 5.5 GHz are designed and implementation. The simulated directivity for three elements array is 5.6 dBi for 2.4 GHz and 8.3 dBi for 5.5 GHz band. The E-plane beam direction will not be tilted off boresight direction for the band. Detail results will be presented. The measured efficiency, directivity, and gain are 76.7%, 5.01 dBi and 3.87 dBi at 2.45 GHz respectively. And measured efficiency, directivity, and gain are 67.4%, 7.78 dBi, and 5.95 dBi at 5.5 GHz.

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