ECE 4370 Project: Antenna Design

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I. Introduction

Directional antennas are a vital part of everyday life. Modern communications would not be possible without the dish antenna, nor would TV broad casts without the Yagi-Uda antenna. With the proliferation of wireless devices in everyday life, a very attractive option for the low power devices of the future (as well as for some devices today) is an RF Charge pump in conjunction with a directional antenna. in many cases, a microstrip antenna withd

II. Design and Antenna Structure

Yagi-Uda antennas have been demonstrated using microstrip technology using patch antennas [1]. Patch antennas allow improved couple between the driver and the reflector and directors, improved the performance of the antenna. Most microstrip Yagi designs feed the driver through the ground plane through a via, but if has also been shown that a microstrip line can be used to feed the driver patch [2]. Using this approach, a microstrip line connects to the reflector and then feeds to the driver as seen in Figure 1 (connecting the feedline to the reflector has no adverse effects).

The dimensions of the patch were first calculated using

$$\text{width} := \left(\frac{2}{e_r + 1}\right)^{\frac{1}{2}} \cdot \frac{c}{2 \cdot (f_r)} \cdot \qquad (1)$$

with the length being given by

$$e_{effective} := \frac{(e_r + 1)}{2} + \frac{(e_r - 1)}{2} \cdot \left(1 + 12 \cdot \frac{h}{width}\right)^{(-.5)}$$

$$deltaL := h \cdot .412 \cdot \left[\frac{(e_{effective} + .3) \cdot \left(\frac{width}{h} + .264\right)}{(e_{effective} - .258) \cdot \left(\frac{width}{h} + .8\right)}\right]$$

$$length := \frac{c \cdot 100}{2 \cdot f_r \cdot (e_{effective})^{.5}} - 2 \cdot deltaL$$

(2)

These dimensions were then used to create the design in CST Microwave Studio. All of the patches are square, and the reflector and director patches were scaled to be consistent with traditional Yagi-Uda Antenna design. The calculated dimensions showed a resonance around 5.8 GHz as desired in the S11 simulation. The geometric parameters of the antenna were then optimized using CST to attempt to both improve the bandwidth and improve the strength of the null in the S11 parameter. The final design yielded the simulation seen in Figure 2. The simulated gain pattern is shown in Figure 3.

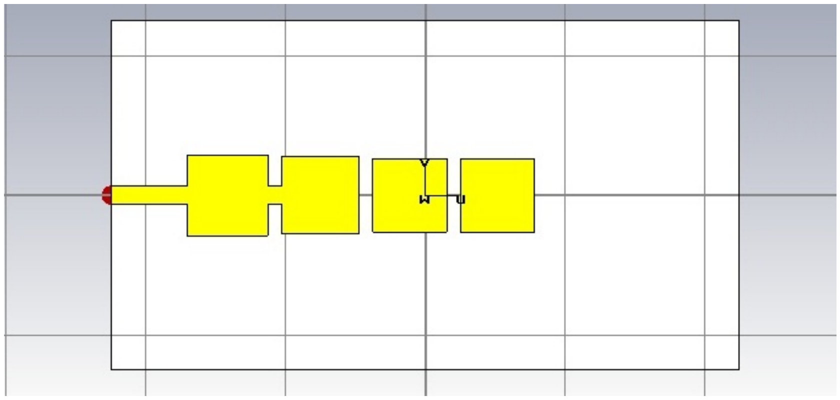

Figure 1 - Top view of the designed antenna.

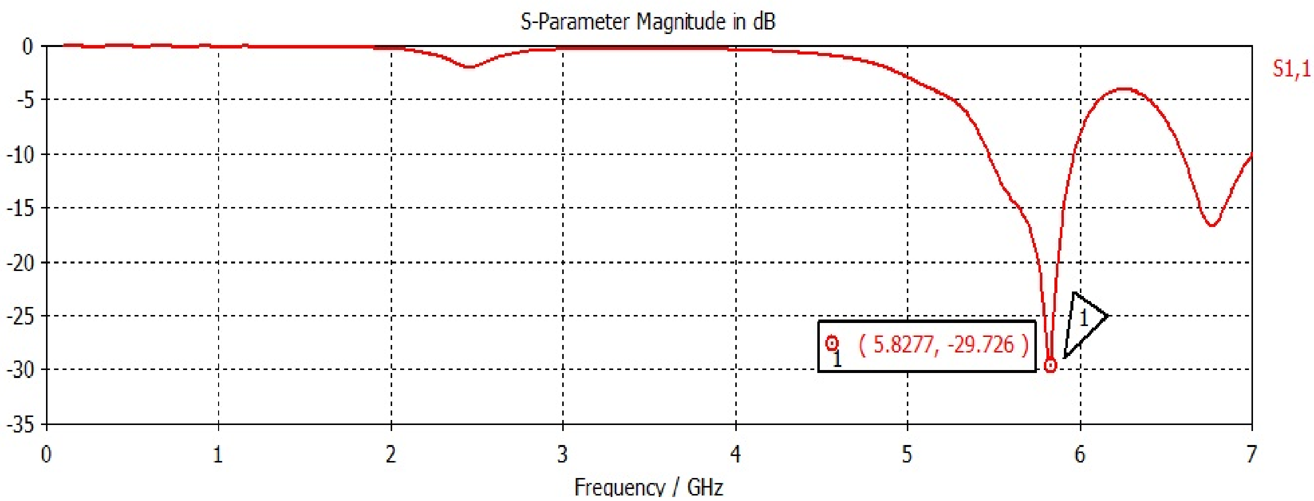

Figure 2 - Simulation of the S11 parameter from CST.

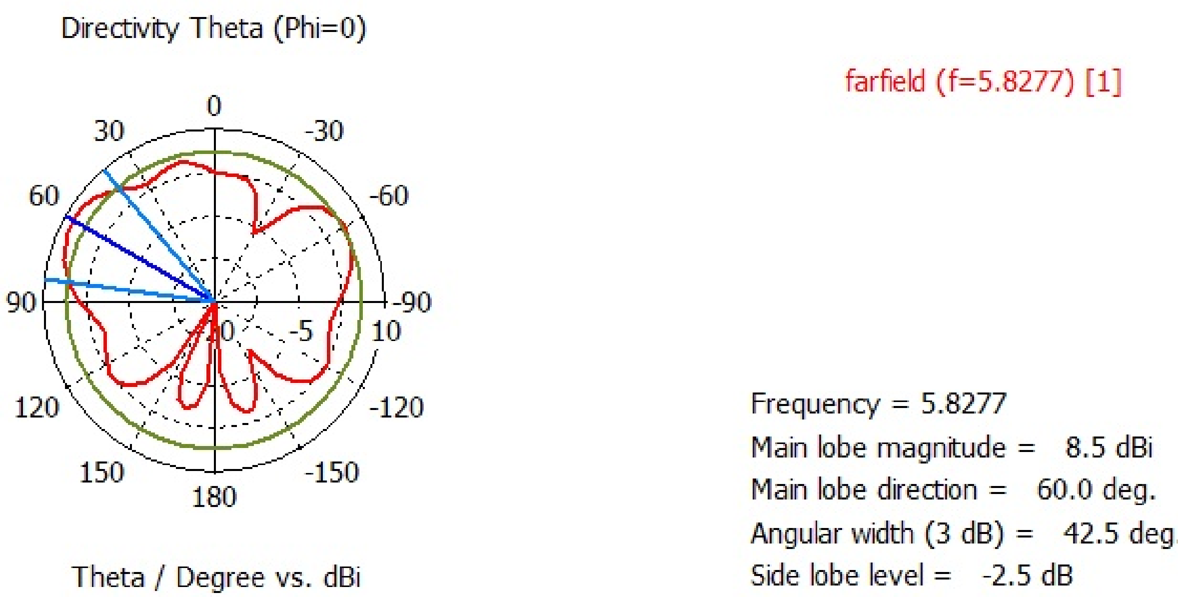

Figure 3 - Simulated Gain Pattern

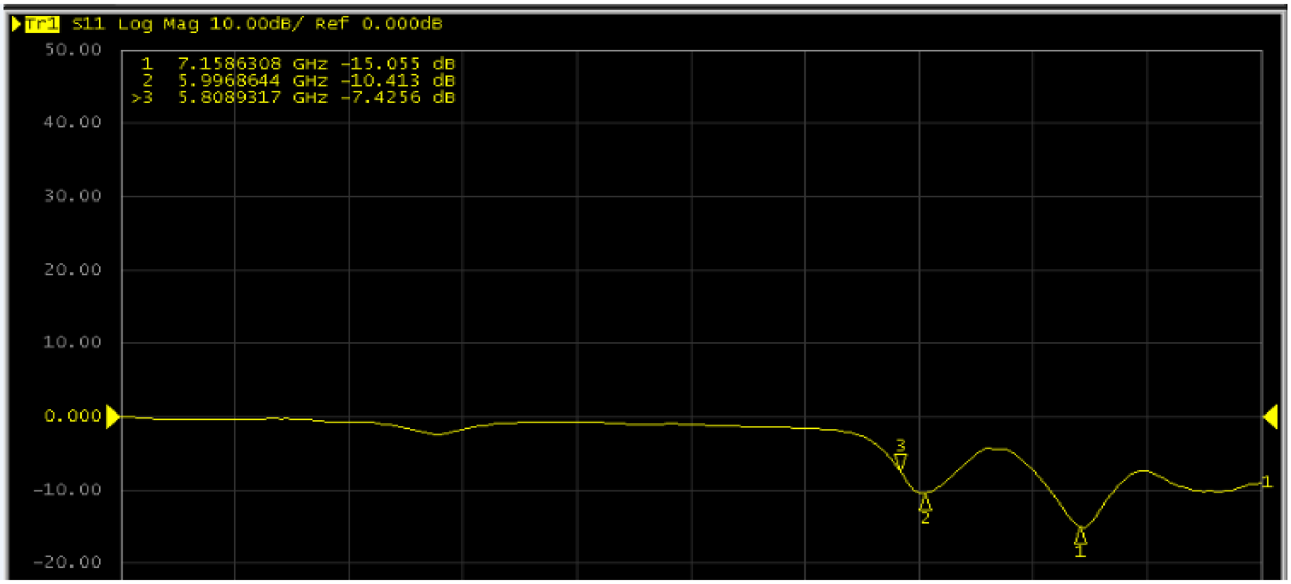

Figure 4 - Measured S11 parameters

Sources

[1] J. Huang, “Planar microstrip Yagi array antenna,” *IEEE Antennas and Propagation Society Int. Symp*., Jun. 1989, vol. 2, pp. 894–897.

[2] G. R. DeJean, M. Tentzeris, “A New High-Gain Microstrip Yagi Array Antenna With a High Front-to-Back (F/B) Ratio for WLAN and Millimeter-Wave Applications,” *IEEE Transactions on Antennas and Propagation*, Feb. 2007, vol. 55, pp. 298-304.