Analysis of Various Patch Antennas against Proposed Dual Polarized Patch Antenna

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Abstract: ***Using dual polarization we can effectively increase the efficiency of reception and reduce the bit error rate as the receiver gets an option for the signal to be received, it dynamically selects out of the available dual polarized signals which has better quality. Dual polarized transmission and reception can be achieved through a single micro strip antenna thus the input infrastructure required does not change significantly and hence the overall cost change is insignificant compared to the benefits achieved.In a signal receiver when such a signal with dual polarization is demodulated using luhn's algorithm the system gets two signals with vertical and horizontal polarizations. In this work, the proposed antenna acts as a receiver as well as a transmitter surpassing its predecessors in the areas of effective power by 18%, effective area 23%, directivity 15% and radiated power by 26%. Hence, a very effective antenna with easy manufacturing technique which can use already existing 48Nm technology is achieved, with overall efficiency of 84.78%.***

Keywords: ADS, efficiency, effective area, radiated power, polarization, gain, Directivity, S-Parameters

1. Introduction

Square Slot with Stub Loaded Slots

For enhanced area reduction central slot with extended arms can be used. By exciting the patch using a coaxial probe feed along the diagonal line of the square patch, it is expected that dual frequency operation based on the two resonant frequencies of the perturbed TM(10) and TM(01) modes can be generated. Figure shows the layout of the square slot antenna.

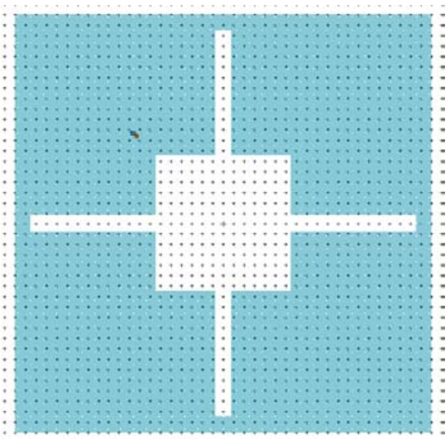

Figure 1: Cross Slot Antenna

2. Liu and Wu Design

Before, trying out with this design, few other slot antennas where also attempted like U-slotantenna. But they are difficult to fabricate by hand. Liu and Wu suggest a scheme for single layer dual polarised slotted patch antenna as shown in figure. It yields very good return loss but at cost of increased complexity. The modification suggested latter on and which was fabricated avoids such complexity and exploits the fact that as slot length tends to zero highest resonant frequency can be attained. The Liu and Wu design adds extra L-shaped slots to reduce the polarization loss from multiple reflections between transmitting and receiving polarizations at arbitrary angles. This design is suitable for application to modern wireless communication systems.

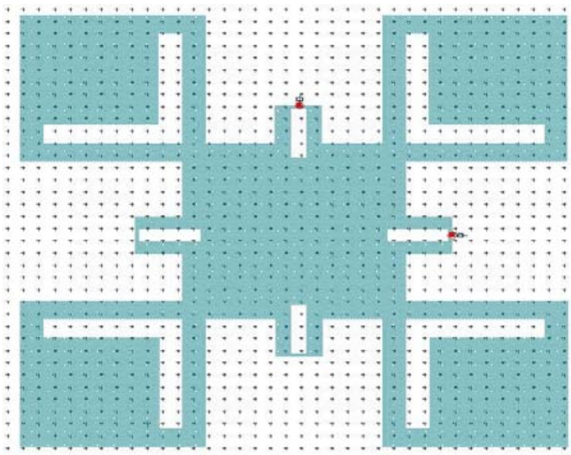

Figure 2: Liuwu

3. Antenna Characteristics

3.1 Directivity

If a three dimensional antenna pattern is measured, the ratio of normalized power density at the peak of the main beam to the average power density is called the directivity. The directivity of the antenna is given by:

$$D=Pmax/Pav$$

The relation between directivity and gain can be given as:

$$G=\eta D$$

where η is the antenna efficiency.

3.2 Gain

Antenna gain is the ratio of maximum radiation intensity at the peak of main beam to the radiation intensity in the same direction which would be produced by an isotropic radiator having the same input power. Isotropic antenna is considered to have a gain of unity. The gain function can be described as:

$G\theta,\emptyset = P(\theta,\emptyset)/Wt4\pi$

Where $(\theta,\emptyset)$ is the power radiated per unit solid angle in the direction$(\theta,\emptyset)$ and Wt is the total radiated power.

Microstrip antennas because of the poor radiation efficiency have poor gain. Numerous researches have been conducted in various parts of the world in order to obtain high gain antennas.

4. Critical Analysis

4.1 Directivity and Gain

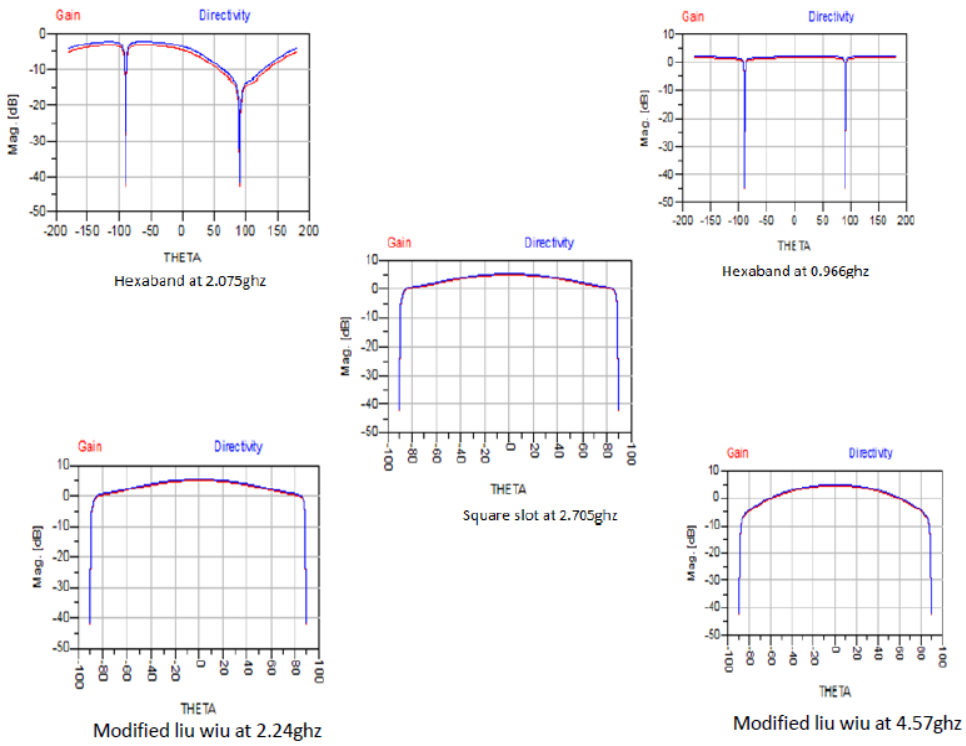

Figure 3: Directivity and Gain

Directivity of hexaband at 2.075 GHz at angle less than 100^0 has gain maximum at 40db with minimum reflection and have maximum directivity.
Directivity of hexaband at 0.966 GHz at angle less than 100^0 has gain maximum at 40db with minimum reflection and have maximum directivity.
Square slot antenna at 2.705 GHz gain approaches to unity and directivity also approaches to unity.
Modified liuwu at 2.24 GHz gain approaches to unity from +/- 100^0.the directivity approaches to unity at +/-100^0.
Modified liuwu at 4.57 GHz gain approaches to unity from +/- $100^0$the directivity approaches to unity at +/-100^0

Effective Area

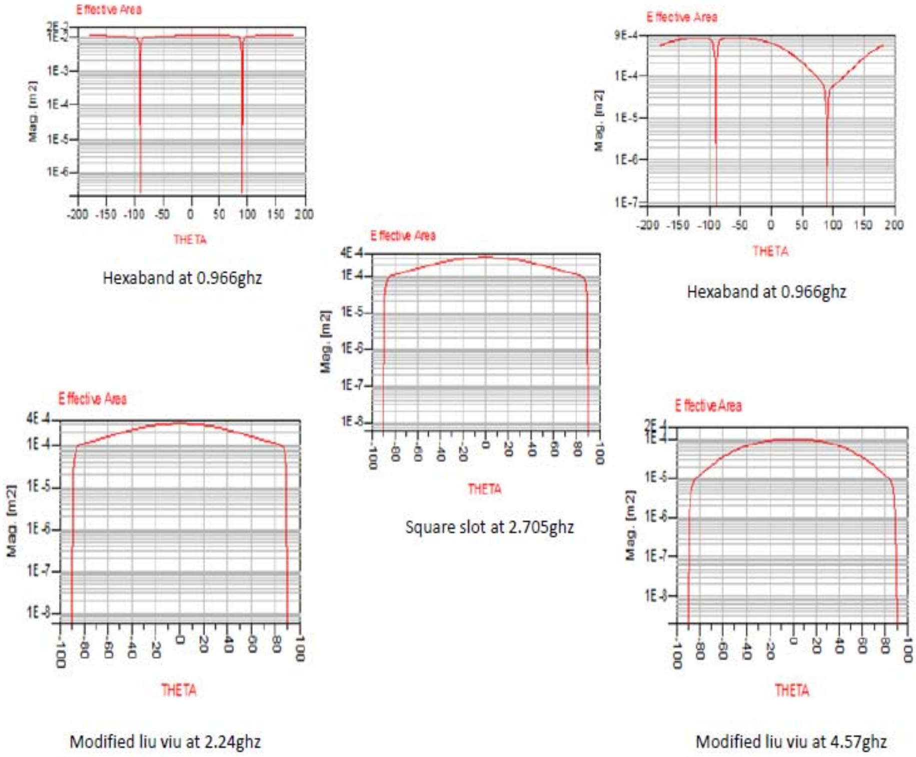

Figure 4: Effective area

4.2 Effective Area

Hexaband at 0.966 GHz
Effective area of hexaband at 0.966 GHz is 55.68*$10^2$$m^2$
Effective area of hexaband at 2.24 GHz is 63.63*$10^4$$m^2$

Effective area of square slot at 2.705 GHz is 222.7*$10^4$$m^2$
Effective area of modified liuwuat 2.24 GHz is 55.68*10^4
Effective area of modified liuwuat 4.57 GHz is 55.68*10^4

4.3 Efficiency

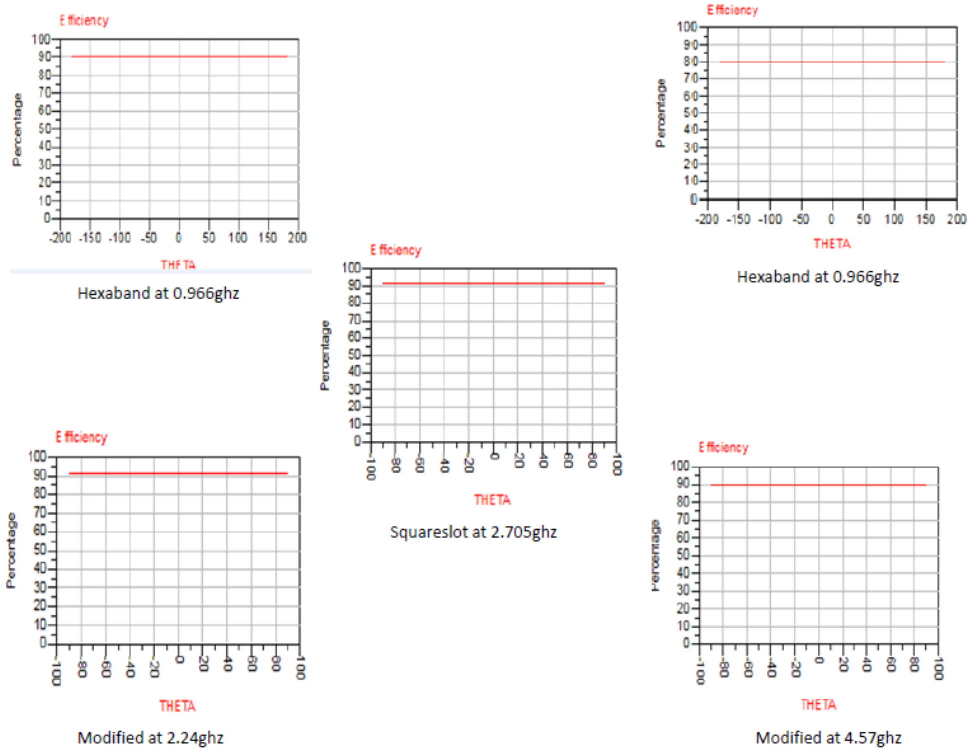

Figure 5: Efficiency

Efficiency of hexaband at 0.966 GHz is 90%
Efficiency of hexaband at 2.24 GHz is 80%
Efficiency of square slot at 2.705 GHz is 91.3%
Efficiency of modified liuwu at 2.24 GHz is 91.5%
Efficiency of modified liuwu at 4.57 GHz is 90%

4.4 Radiated Power

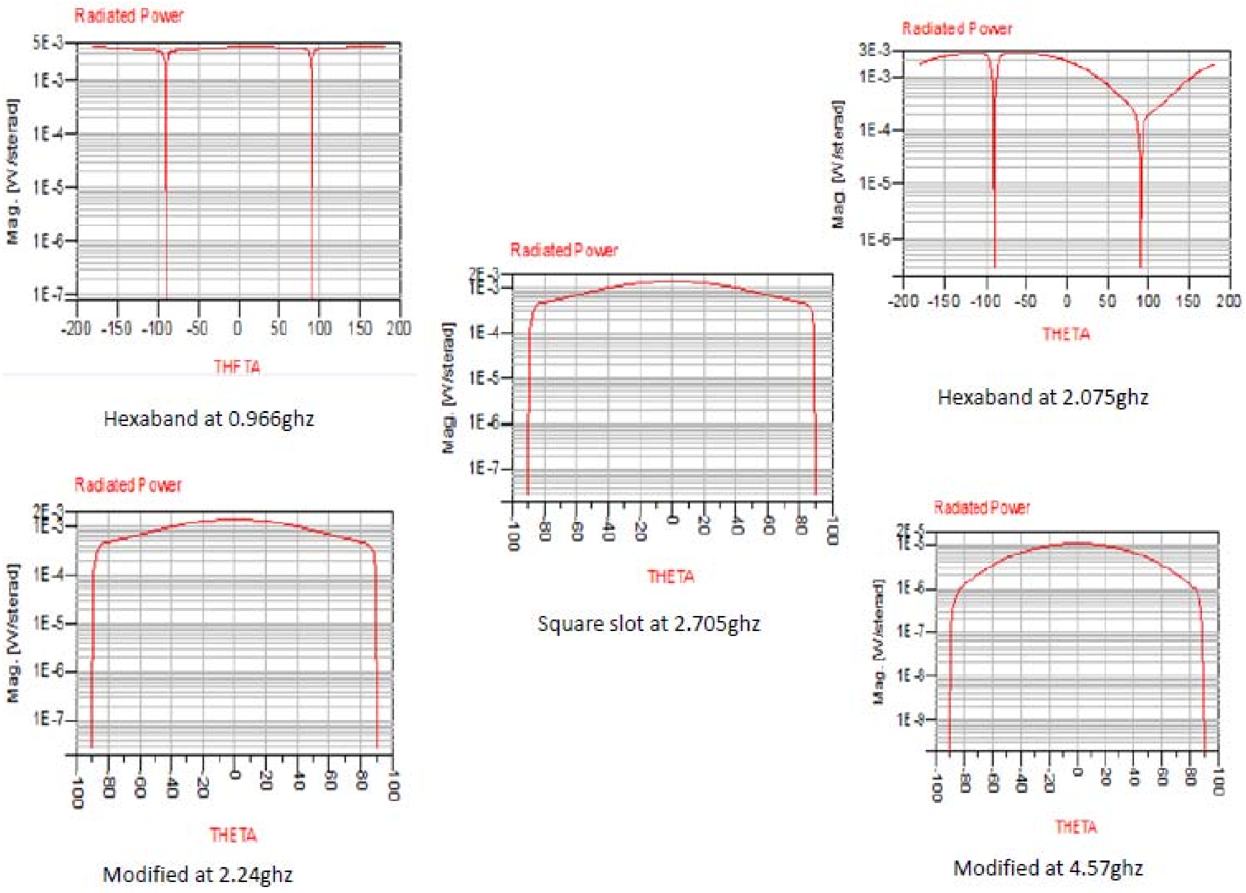

Figure 6: Radiated Power

Hexaband at 0.966 GHz has radiated power $278.4*10^3$w
Hexaband at 2.075 has radiated power $135.2*10^3$w
Square slot at 2.705 GHz from $+90^0$ to -90^0 is $111.3*10^3$w
Modified at 2.24GHz from $+90^0$ to -90^0 is $111.3*10^3$w
Modified at 4.57GHz from $+90^0$ to -90^0 is $55.68*10^5$w

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