Analysis and Comparison of Various Types of Modified Microstrip Patch Antenna

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***Abstract*-In this paper, a new microstrip patch geometry, called modified Seljuk star, is proposed. The performance of the designed antenna is compared with the performances of modified pentagon, hexagon, rectangular microstrip antennas. Each antenna is designed with different modified geometry.FR4 Epoxy (Thickness= 1.6mm, Dielectric constant=4.4) is chosen as the substrate of the antennas which are expected to have a frequency between 7 to 9GHz. All antenna designs are simulated in Ansoft HFSS version 13.0 software. The proposed Seljuk star patch shape is believed to have a high potential to be used in future research. The different performance parameters such as return loss, radiation pattern, VSWR of this antenna were compared.**
***Index terms*-Seljuk, slotted and HFSS software**

I. INTRODUCTION

Antennas act as an interface for electromagnetic energy propagating between free space and guided medium. Microstrip patch antennas are widely employed in communication system because of its attractive features such as low profile, flexible, light weight, small volume and low production cost.

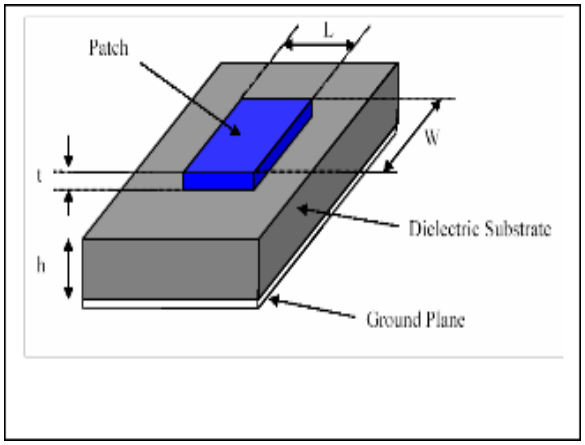


Figure: 1 Microstrip patch antenna

These advantages of microstrip antennas make them suitable for various applications like GPS,Wireless, RADAR and telemetry, communication device and etc… In its simplest form of microstrip patch antenna consists of patch of metal, generally rectangular or circular (any other) shapes may used. On the top of grounded substrate. Ground is used to avoid reflection. In common copper, silver or gold is used in ground and microstrip line. Substrate is used as a perfect interface between system and free space. The various available substrates are Rogers, RT/duroid, benzo cyclobutane, duroid 6010, nylon fabric, roger 4350, foam, FR 4. The substrate used here is FR4(Flame redundant type 4) because it is cheap and easily available though it has high loss. No feeding is necessary in modified shapes. The antenna array is designed using standard equations and simulated by high frequency structure simulators.

II. DESIGN OF ANTENNAS

Seljuk star is a special geometric shape which can be easily obtained by placing two equivalent squares . It has 8 corners that can be easily obtained by combining two same dimension squares located 45 degree relative to each other. Modified Seljuk star mean rectangular patch is placed over the substrate and the Seljuk star shape is removed from the patch for modified. Seljuk star microstrip patch antenna (SSMSA) has advantages in many ways in comparison to other patch shapes and gives opportunities to reduce antenna dimensions, so the new antenna design can be used widely in today's small sized mobile devices. All other antenna parameters are kept constant. They are simulated using HFSS and their performances are compared.

For designing in software,

Making a ground plane - Draw rectangle with the dimensions. Right click on the ground plane à assign boundary à Perfect E. Leave „infinite ground plane" unchecked. This makes the ground plane a conductor.

Making a substrate - Use Draw Box button to make a substrate of dimension . Right click on the substrate à Assign Material. Window is opened. Type „FR4" on the search field and click ok.

Making a patch - Draw a rectangle. Copy the drawn patch and paste it back. It will be placed exactly on the latter patch. Make a two square with 45degree.Select both the patched together, right click à Edit à Boolean à Unite. This will merge the two squares and make a star Select the patch and united shape of star and subtract it. Right click on the ground plane à assign boundary à Perfect E.

Port- Draw a port and assigning Excitation Right click on the circle à Assign Excitation à Just Click ok.
Radiation Box - Draw a box of the dimensions. Right click on the structure à Assign Boundary à Radiation. Assign the material as air. Right click on setup1 à Add frequency sweep. Set Sweep Name

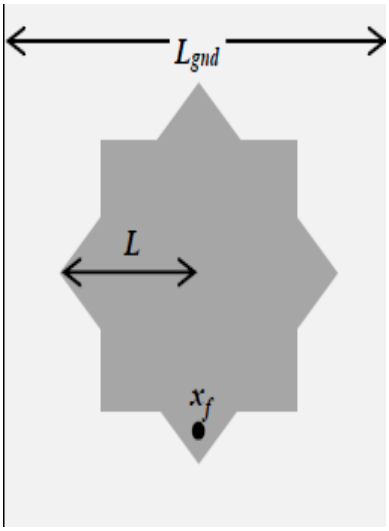


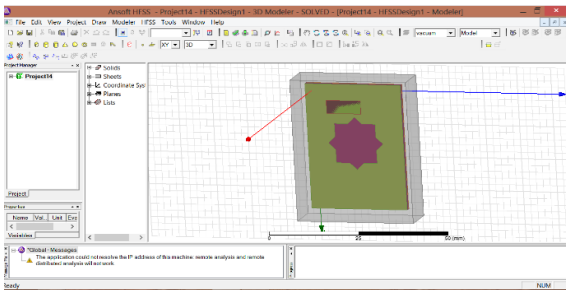
Figure: 2 Seljuk star shape

III. COMPARISION AND ANALYSIS

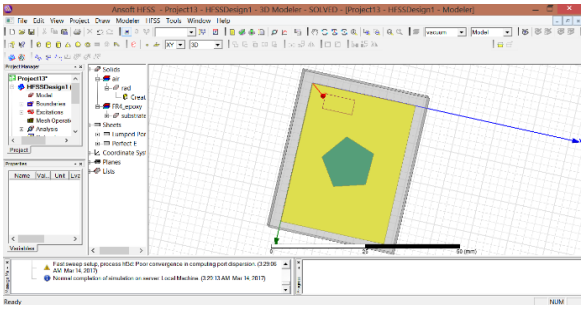
The designing of microstrip antennas with various modified shapes such as rectangular, square, circular, triangular, pentagonal, hexagonal and Seljuk star is done with HFSS software. The positions and the dimension of the substrate is kept constant throughout.The rectangular patch of length 38mm and breath 28mm is placed over the substrate. The following shapes (with measurements) is cut from the patch.

- Seljuk star
- Pentagon
- Hexagon
- Rectangle

After designing the simulation is carried out and the performance parameters such as return loss, radiation pattern and VSWR. These results are then compared to find the best of these microstrip antennas.



(a)



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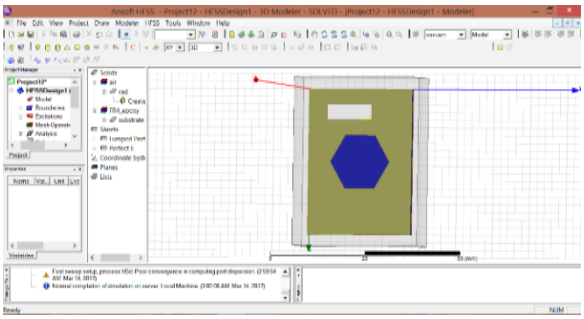

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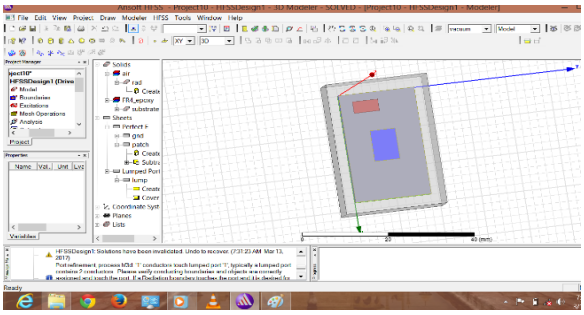
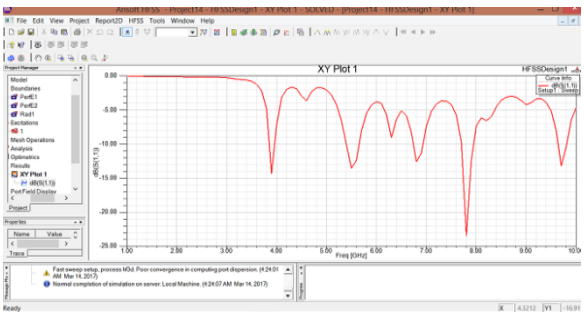
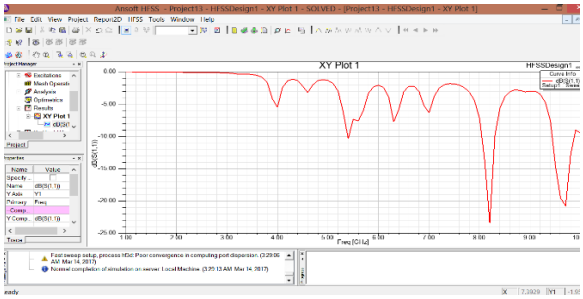


(d)

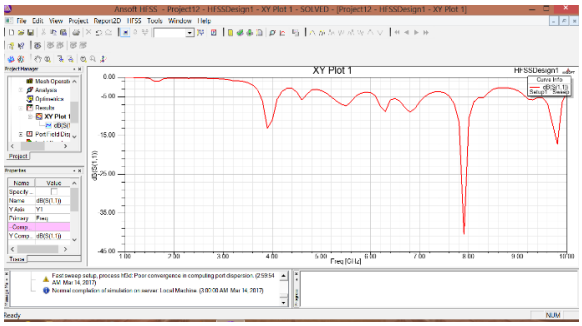
Figure: 3 Modified (a)Seljuk star,(b)pentagon,(c)hexagon,(d)rectangular microstrip patch antenna.



(a)



(b)



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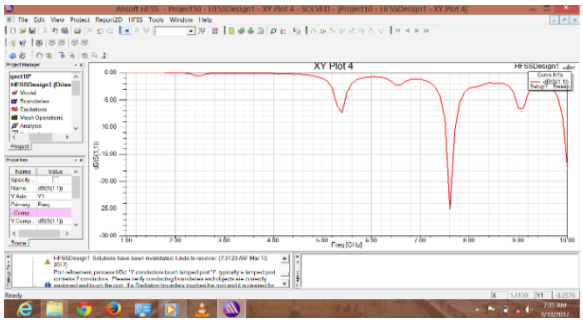

(d)

Figure: 4 Return loss of Modified (a)Seljuk star,(b)pentagon,(c)hexagon,(d)rectangular microstrip patch antenna.

Geometries	Frequencies (GHz)	Return loss (dB)
Seljuk	7.8	-24
Pentagon	8.2	-23.5
Hexagon	7.8	-36
Rectangle	7.8	-25.5

Table: 1 comparison of frequencies and return losses of proposed microstrip patch antenna

IV. RESULTS AND DISCUSSIONS

The variation of return loss with the frequency range 7 to 9GHz for the different geometries of microstrip patch antenna. The return loss curve shows that the -24dB for modified Seljuk patch antenna, -23.5dB for the modified pentagon patch antenna,-36dB for modified hexagon,-25.5dB for modified rectangular patch antenna. This shows that all the modified designed patch antennas are obtained in the frequency range between 7 to 9GHz. The frequency range between 7 to 11GHz has a radar applications ,ultra wide band applications, WI-MAX, optical communications and the frequency range 8.2GHz has RFID applications, 6.0 to 10.6GHz in UWB in frequency range could be utilizable to WBAN applications.

V. CONCLUSION

A Modified Seljuk star microstrip patch antenna is designed as a new geometric shape then performance of modified Seljuk star, pentagon, hexagon , rectangular microstrip patch antennas are compared. The four different types of modified patches microstrip antenna have operating in the same frequency range of 7 to 9GHz.This type of frequency range is widely used for radar applications, UWB, WI-MAX and WBAN applications. It is observed that at 7.8GHz of operating frequency the modified Seljuk star, pentagon, hexagon, rectangular microstrip patch antenna gave the best results.

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