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Challenges Faced During Designing, Simulation of Microstrip Patch Antenna in HFSS and Testing After Fabrication

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Abstract: The Microstrip antenna we are designing here needs to go through the following three stages theoretical calculations, simulation and testing after fabrication. In the process of testing we are comparing the obtained results with the ideal values of antenna characteristics but when we analyzed the compared results, we could see that the results diverted from the ideal values. This paper is mainly focused on the various challenges faced during the designing, simulation and fabrication of microstrip antenna.

Keywords-- HFSS, Patch Antenna, VSWR, S-Parameter, SMA connector

I. INTRODUCTION

Microstrip antenna is the good choice for wireless communication and wireless devices because of their properties like light weight, low cost, low-profile, small dimension easy fabrication, advantages, compactness and its efficiency . Though the antenna is small in size still it gives good results in terms of radiation pattern, return loss, VSWR.

In designing of MSA, first we have to calculate the different designing parameters of patch antenna by theoretical method. After calculating designing parameters, we design antenna on HFSS. After designing, we have got simulated results. Considering the dimensions of design, we have fabricated the antenna. Here, we have got some differences in simulated results and the tested antenna results. For the same, we have mentioned the reasons and results during the processes in the paper further.

II. DESIGN PROCESS

We are designing Microstrip antenna with 2.4 GHz. Frequency using glass epoxy as the substrate. Here are the three steps for designing of Microstrip antenna.

A. Designing Calculations

We are designing antenna for the frequency of 2.4 GHz using dielectric constant of 4.4 of height 1.6mm. Using this values we have calculated width and length of patch, effective dielectric constant, effective length. Considering these parameters, we have determined dimensions of substrate. The width of feedline is designed by considering the input impedance of 50 ohm.

B. Simulation Process

We have deigned antenna using HFSS with following steps for designing MSA in HFSS:

1) Draw the geometric models.
2) Create Perfectly Matched Boundaries
3) Add the Excitation
4) Setup Mesh Operations
5) Specify solution setting for the design.
6) Validate the design setups.
7) Run HFSS simulations.

C. Fabrication Process

After simulation of antenna, we have fabricated the antenna using the steps involved in the basic PCB designing. After fabrication, we have to connect SMA connector of 50 ohm for testing purpose.

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III. CHALLENGES

A. Designing Calculations

One of the important part of antenna designing is the selection of substrate which has particular dielectric constant and should not change its characteristics in any circumstances.

B. Simulation Process

Even a small change in dimensions of patch affects the fringing fields from the edges. It affects the effective length, thereby changing the resonance frequency. In the simulation process assigning of waveport is very important. The feed is fed with coaxial cable with proper calibration of antenna with short circuit and open circuit current and proper termination of transmission line whereas there is no such concept of feeding through cable present in the HFSS software. So, the energy is provided with the help of a sheet called as waveport, placed at the beginning of the feedline to provide excitation to the waveport. Assigning proper boundary conditions in simulation process is most critical parameter. A boundary can be assigned to any two-dimensional area such as a plane, a face of an object or an interface between two objects. Most boundary conditions are used to define electromagnetic characteristics such as conductivity or resistivity. This also includes exciting the structure, and hence any error can result in inaccurate results.

C. Fabrication and Testing Process

There is a little variation in the parameters studied in simulation process and results obtained after fabrication process.

After fabrication of antenna, antenna radiates in the atmosphere. At the time of radiation of antenna, there are many metallic objects present in the environment which affects the propagation of electromagnetic waves. Due to these objects, reflections of EM waves take place. This leads to the variation in radiation pattern of antenna. Thus, we get variation in the antenna characteristics.

The differences in the results after fabrication can also have a reason of manufacturing defects. It may contain impurities present in the material used for antenna fabrication. Also the environmental conditions like humidity; high temperature affects the charge distribution of patch which affects the characteristics of an antenna.

IV. RESULTS

A. Ideal Results

These are the ideal values considering which we have determined the values for simulation process.

1) Frequency = 2.4 GHz
2) S-Parameter (Return Loss) = less than -10dB
3) VSWR = in between 1 and 2

B. Simulation Results

1) Frequency = 2.3976 GHz
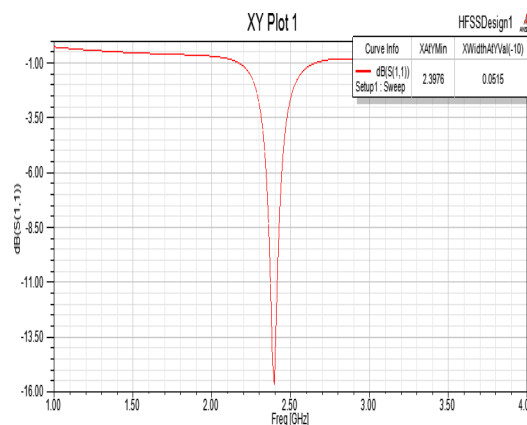2) S-Parameter (Return Loss) = -15.70dB
3) VSWR = 1.5

Fig.1 S-Parameter

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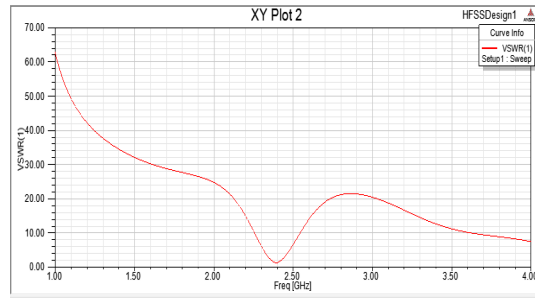

Fig.2 VSWR

B. Practical Results

It could be seen that the simulated and fabricated results are almost similar.

1) Frequency = 2.53 GHz
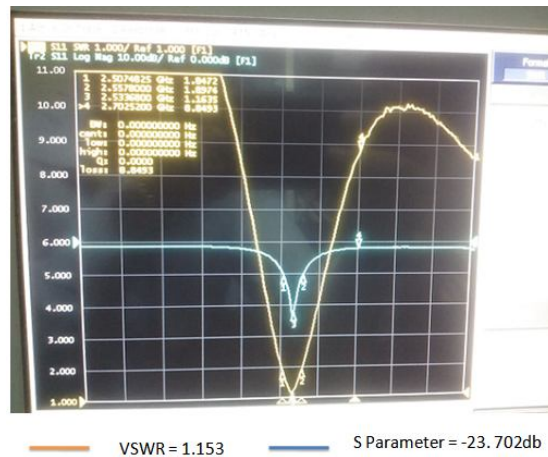2) S-Parameter (Return Loss) = -23.703dB
3) VSWR = 1.15

VSWR = 1.153   S Parameter = -23.702db

Fig.3 VSWR and S-Parameter

V. CONCLUSION
TABLE I
SUMMARY FROM RESULTS

Parameter	Theoretical	Simulation Result	Testing Result	Comments
Frequency	2.4 GHz	2.3976 GHz	2.533 GHz	Shifted
S-Parameter	-10	-15.70	-23.703	Improved
VSWR	Between 1 and 2	1.5	1.15	Improved
BW	Up to 60 MHz	51.5 MHz	50.3175 MHz	Approx.

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There is variation in simulated results subject to change in boundary conditions and size and position of waveport with respect to feedline. The variations in testing results are subject to real time boundary conditions in present medium, various reflections from objects and external EM interferences.

REFERENCES

[1]   Constantain.A. Balanis,Antenna Theory Analysis and Design. III Edn, Wiley-Interscience.AJohnWiley&sonsInc.Pulication, 2005.

[2]   Kunal Parikh, "Simulation of Rectangular, Single Layer , Coax Feed Patch Antenna Using Agilent High Frequency Structure Simulator", 2003

[3]   Calafell, P. J. Ferrer, J.M. Gonzalez-arbesu and J.Romeu, "Microsrip Patch Antenna Design Using Artificial Material Loadings", Antenna Lab- TSC, Universitat Politecnica de Catalunya (UPC) c/ Jordi Girona, 1-3, D3-212, 08034 Barcelona, Spain

[4]   A. D. Yaghjian, S.R. Best, "Impedance, Bandwidth and Q for antennas", IEEE Tran. Antennas Propag., vol. 53, no. 4,pp.1298-1324, April 2005.

[5]   Keith R. Carver, James w. Mink, Member, "Microstrip Antenna Technology", IEEE Transactions On Antennas And Propagation, Vol. "-29, No. 1, January 1981

[6]   Dalia Nashaat, "Hala A. Elsadek,Esmat Abdallah,Hadia Elhenawy, Magdy F.Iskander, " Electromagnetic Analyses and an Equivalent Circuit Model of Microstrip Patch Antenna with Rectangular Defected Ground Plane", 978-1-4244-3647-7/09/$25.00/2009 IEEE

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