Comparative Study of Coaxial Line Feeding Microstrip Patch Antenna with Different Substrate Materials

Sandhya KV
Dept of tele communication
CMR institute of technology
Bangalore, Karnataka, INDIA

Abhishek Javali
Dept of tele communication
CMR institute of technology
Bangalore, Karnataka, INDIA

Abstract- **Antenna is a transducer that is used for transmitting and receiving the electromagnetic waves which is used in many applications in our day to day life. When compared to other type of antennas micro strip patch antenna has more advantages, benefits and applications. This paper mainly deals with the designing of circular micro strip patch antenna (CMPA) with respect to coaxial line feeding and studying, analyzing its performance and then comparing the performance of this antenna for gain and bandwidth using five different substrate materials and stating the material with highest gain and bandwidth. According to the literature on paper I found the existing antenna is with the bandwidth of <140 MHz and gain of <7dbi. Aim of this project is to get the better bandwidth and gain and also to reduce the spurious radiations.**

Key words: Circular Microstrip patch antenna, gain , bandwidth, spurious radiations, substrate materials.

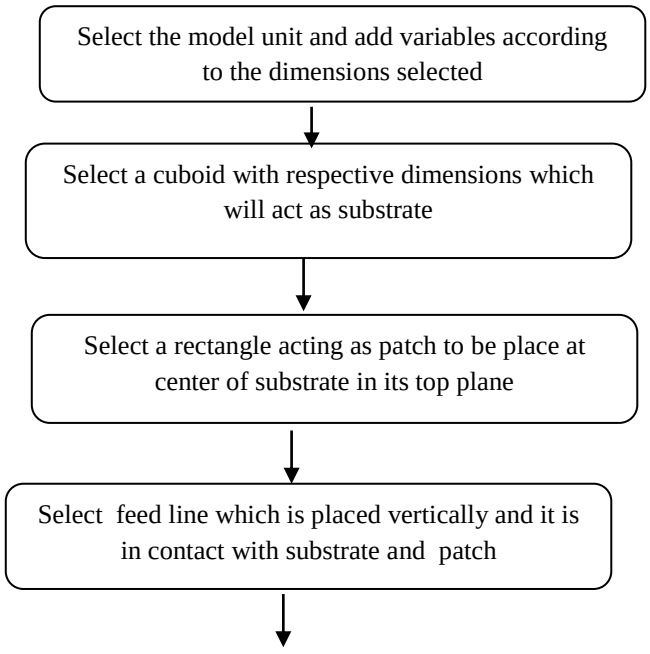
I. INTRODUCTION

Antennas are mainly six types they are aperture antenna, Microstrip antenna, array antenna, reflector antenna, wire antenna and the lens antenna. Among all these Microstrip antenna has many advantages like small weight , size, less cost, high performance , easy to install, aerodynamic profile, comfortable to planar and non planar surface and simple , inexpensive with modern technology and mechanically robust in rigid surfaces. And also have disadvantages like less efficient , narrow bandwidth , less gain and minimum power handling capacity [5]. since the disadvantages are very less when compared to advantages Microstrip patch antennas are efficient when compared to others[1]. Microstrip patch antennas are having lots of applications like aircraft, spacecraft, satellite, missile applications, mobile radio applications as well as wireless communications which makes these antennas a high priority among others[5].

Components of antenna which feed radio waves to rest of the antenna structure or collects incoming radio waves and converts them to the electric form and transmits to the receivers is known as antenna feed. In Microstrip patch antenna there are mainly two feedings they are contact feeding and non contact feeding. Coaxial line feeding and Microstrip line feeding comes under contact feeding and aperture and proximity coupled feeding comes under non contact feeding. Among these four feeding my research in involved with the coaxial line feeding with advantages like easy to fabricate , easy to match and low spurious radiations .

II. DESIGN ANALYSIS

Microstrip patch antenna is designed using the FEKO software . the procedure starts with the CADFEKO . in that the model unit to be set this design is with millimetre range in order to achieve miniaturization then the required variables are added like substrate length , width , height, frequency range , mesh radius, patch radius and feed distance. Then the substrate is created using the cuboid and then ellipse is created which act as the patch. The medium of the substrate converted to dielectric form and the ground plane of substrate is converted to perfect electric conductor. The patch is also converted to PEC them the line is placed vertically in contact with the substrate and patch and wire port is given after performing the union for substrate, patch and the feed line . then next is the applying the voltage source and requesting for the far flieds. This procedure is clearly explained in below flow chart.



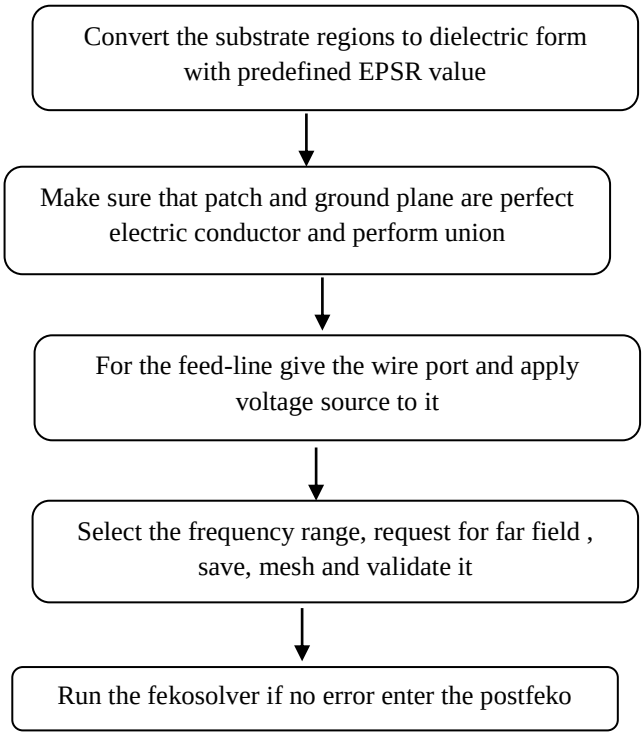


Fig. 1. Flow chart

The results can be found in the post feko tool using the voltage source and requested far fileds . gain bandwidth can be observed as the results. The dimensions used in designing the coaxial feeding Microstrip patch antenna are listed in the below table.

TABLE I. DIMENSIONS FOR DESIGNING THE COAXIAL FEEDED MICROSTRIP PATCH ANTENNA

Dimensions	Values
Substrate width	160mm
Substrate height	3.36mm
Substrate depth	160mm
Patch radius	57.9mm
Frequency	3 *e9 hertz
Mesh radius	0.8mm
Feed length	13.36mm
Type of port	Wire port

The resultant structure with these dimensions is shown below.

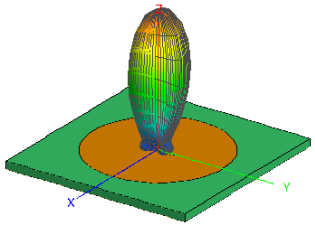


Fig. 2. Coaxial feeding Microstrip patch antenna

Substrate material gives us the good qualities for Microstrip circuit. High the permittivity of substrate and less will be the loss of power, spurious radiations can be reduced by decreasing the thickness of the substrate. Every material will have a unique dielectric constant mostly for the antenna application the material are considered whose range is in between 2 to 13.Substrate material used for comparison to find the best among them with respect to gain and BW with their respective dielectric constant values are listed below.

TABLE II. SUBSTRATE MATERIALS WITH THEIR DIELECTRIC CONSTRANTS USED FOR COMPARISON

Substrate material	Dielectric constant
Fr4	4.2
Teflon	2.1
RT/Duroid 5880	2.2
Silicon	11.7
GaAs	13.1

II. RESULT ANALYSIS

Feko tool is user friendly and many results can be obtained from this like gain, bandwidth, beamwidth, VSWR, return loss and so on among all , The gain and the bandwidth results obtained after the procedure is shown the below graphs.

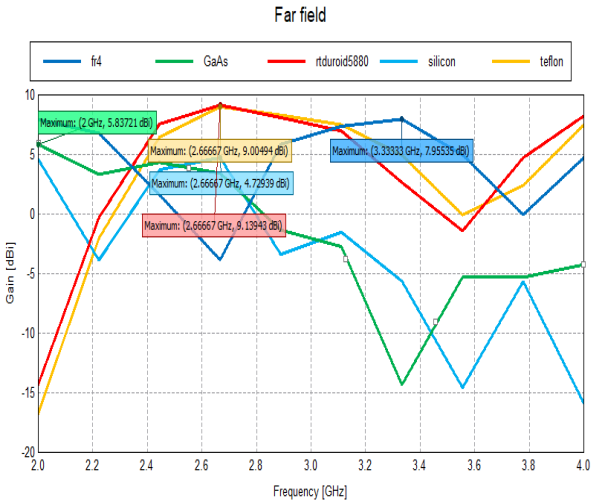


Fig. 2. Gain results for all five substrate materials

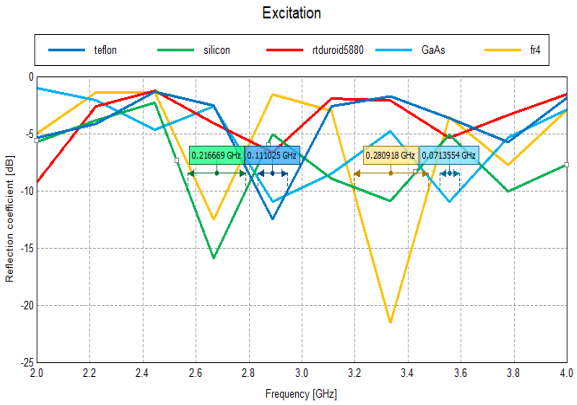


Fig. 3. Bandwidth results for all five substrate materials

TABLE III. GAIN AND BANDWIDTH RESULTS FOR FIVE SUBSTRATE MATERIALS

Substrate material	Gain	Bandwidth
Fr4	7.9dbi	0.280GHz
GaAs	5.8dbi	0.071GHz
RT/Duroid5880	9.1dbi	-
Silicon	4.7dbi	0.216GHz
Teflon	9.0dbi	0.111GHz

III. CONCLUSION

After comparing all five substrate material with respect to coaxial line feeding micro strip patch antenna the good performance is observed . the RT/Duroid material gave better gain of 9.1dbi and better bandwidth was with Fr4 that is 0.280GHz. even the Teflon material gave us comparitivily high gain so by observation we can say that materials will less dielectric constant will have high gain. Disadvantage is that same material cannot be expected with both gain and bandwidth based on application the substrate material can be selected with respect to gain and bandwidth.

FUTURE SCOPE

Since we are not getting gain and bandwidth with high output for a single substrate the process of optimization can be implemented for various dimensions to approximate them and get high gain and bandwidth for single substrate.

ACKNOWLEDGEMENT

Authors of this paper are pleasure to thank all the people who helped in carrying out this research successfully in a very effective way by sharing their valuable knowledge with us in all fields that are needed for us.

REFERANCE

[1]. DebajyotiChatterjee and Anjan Kumar Kunda "performance analysis and comparative study of MPA using aperture coupled and proximity coupled feeding methodology" in ICCCSP-2017.
[2]. Hamizon Yon, Aziati H. Awang, M.T.Ali, S.Subahir, S.N.Kamaruddin, "comparative analysis for multilayered stacked substrate MPA" APACE-2016
[3]. L.Chandica and K.Anusudha, "Performance analysis of pentagon shaped MPA "in ICCCSP-2017.
[4]. A. Balanis. Herscovici, N, "A wide-band single-layer patch antenna," Antennas and Propagation, IEEE Transactions on , vol.46, no.4, Apr 1998, pp.471-474.
[5]. Pozar, D.M.; Kaufman, B., "Increasing the bandwidth of a microstrip, antenna by proximity coupling," Electronics Letters , vol.23, no.8, April 9 1987, pp.368,369.
[6]. Matin, M.A.; Sharif, B.S.; Tsimenidis, C.C., "Probe Fed Stacked Patch Antenna for Wideband Applications," Antennas and Propagation, IEEE Transactions on , vol.55, no.8, Aug. 2007, pp.2385,2388.
[7]. FEKO Suite 6.1 User manual, EM Software and Systems S.A Pvt Ltd, 2010.
[8]. C. A. Balanis, "Antenna Engineering", 2nd ed., Willey, 1982
[9]. S. Makarov, "Antenna and EM modelling with Matlab", 2002.
[10]. R. Garg, P. Bhartia, I. Bahl and A. Ittipiboob, "microstip antenna design handbook", London, Artech House, 2001
[11]. R. F. Harrington, "Field Computation by Moment Method" , Wiley-IEEE Press, April 1993,
[12]. D. M. Pozar and D. H. Schaubert, Microstrip Antennas: "The analysis and design of microstrip antennas and arrays", IEEE Press, New York, 1995
[13]. J.-F. Zurcher, “The SSFIP: A global concept for high performance broadband planar antennas”, Electronics Letters, vol. 24, November 1988, pp. 1433-1435.