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Anisotropic Electromagnetic Analysis Of Microstrip Patch Antenna

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Abstract:
Background: *The characteristic of anisotropy helps to use microstrip patch antenna in space. Microstrip patch antenna has higher level of cross polarization .*
Materials and Methods: *This research mainly aims at designing algorithm to calculate optimum power for microstrip patch antenna. Parametric analysis involves flowchart to explain Newton raphson method.*
Results: *Microstrip patch antenna shows better efficiency as compared to contemporary antenna's. Conformal antenna too offer lower gain. High directivity improves energy spectral density of microstrip patch antenna.*
Conclusion: *The parameters which determine any antenna are input impedance , resonant length and input power. Lightness and cost efficiency makes microstrip antenna better than others. Introducing auxiliary lobe will degrade robustness but improve efficiency.*
Key Word: *Anisotropy; Conformal antenna; Parametric analysis; Energy spectral density; Auxiliary lobe*

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I. Introduction

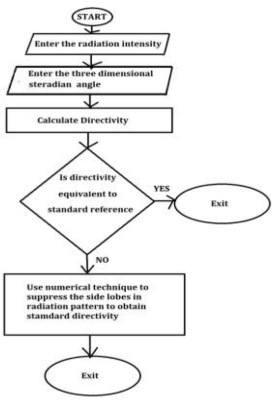
Microstrip patch antenna is one of the few antenna's that is used for those areas where we require maximum reception at minimum space. Mostly we use the microstrip patch antenna in space applications. When we talk about electromagnetic anisotropy , two important effects comes into picture. One is Zeeman effect and other is stark effect. Zeeman effect can be defined by magnetic nature of wave and stark effect can be defined by electric nature of wave. Polarization also influences electromagnetic anisotropy. Polarisation is defined by nature of electric field wave with respect to other wave parameters. MATLAB tool is used to mathematically model the antenna. Mathematical modeling can be defined as the way in which integral and differential solution define the whole nature of any physical system. An antenna is characterized by various parameters which determine it's radiation pattern. Analysis focus here is on study of microstrip patch antenna.

II. Material And Methods

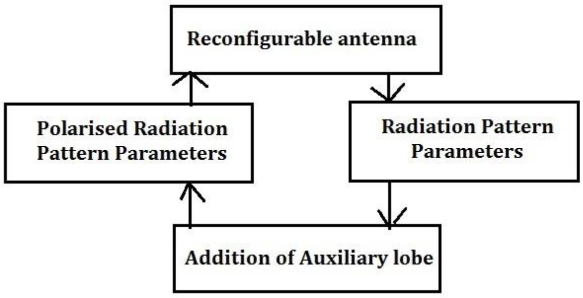
1. (i) Realisation of directivity for microstrip patch antenna: Directivity of an antenna can be defined by how much power does antenna radiate in desired direction. High directivity leads to low losses and low directivity leads to high losses.

(ii) Design approach: We will use the numerical methods in order to suppress side lobes in radiation pattern. As side lobes will be suppressed, the directivity of antenna will increase. Hence we will realize directivity of microstrip patch antennaby considering only major lobe.

(iii) Flow chart for realizing directivity of microstrip patch antenna:



(iv) Block diagram for realizing directivity of microstrip patch antenna:-

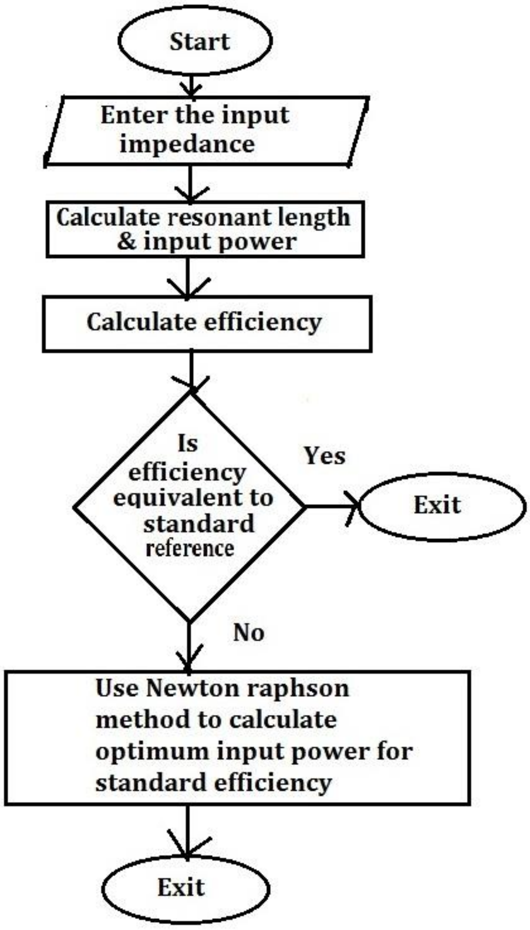


Realisation of algorithm for optimum power requirement in case of microstrip patch antenna:

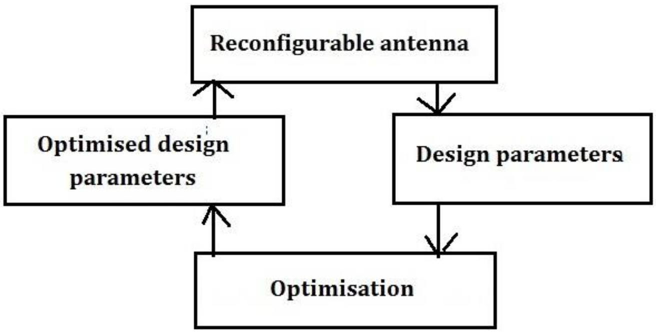
An antenna comprises of various parameters such as beam length, beam width, radiation pattern, auxiliary lobe. Study of radiation pattern will help us in knowing how much antenna is efficient in recepting the electromagnetic waves.

Design approach: We will use the numerical methods in order to determine the best input impedance so that the resonant length comes out to be very small. When resonance will be achieved at very small input impedance then the power requirement of the circuit is minimum. This will help us reach at optimum power requirement for microstrip patch antenna:

Flow chart for realizing optimum power in case of microstrip patch antenna:



Block diagram for realizing optimum power:



III. Result

On studying microstrip patch antenna in detail, few important notable results came forward. First is directivity and second is power requirement. They both are categorically illustrated one by one.

Study of directivity parameter of microstrip patch antenna: Directivity of an antenna can be understood by studying various accompanying parameters like beam length, beam width, minimization of side lobe, radiation intensity. Among various antenna's dipole antenna has been designed to specifically understand directivity of antenna.

Table no 1: Shows parametric comparison of microstrip patch antenna with dipole antenna.

r.No	Parameters	Microstrip patch antenna	Dipole antenna
.	Beam length	High	Low
.	Beam width	Low	High
.	Minimization of side lobe	High	Low
.	Radiation intensity	Low	High

Key features of tabular comparison:

1. Energy spectral density curve for microstrip patch antenna shows less fluctuations as compared with dipole antenna. In case of isotropic antenna this fluctuation is minimal.
2. Spectral dispersion is directly proportional to spectral efficiency.

Study of optimum power requirement in case of microstrip patch antenna: Power requirement of an antenna depends on various parameters like input impedance, resonant length, efficiency when we talk about power requirement of an antenna , we must compare that antenna with Isotropic antenna. Hence we need to compare the efficiency of microstrip patch antenna with that of Isotropic antenna.

Table no 2: Shows efficiency evaluation for Isotropic antenna.

Sr.no	Input impedance (in terms of ohm)	Resonant length (in terms of wavelength)	Efficiency
1.	20	0.5	0.705
2.	40	0.75	0.81
3.	60	1.1	0.88
4.	80	1.2	0.69
5.	100	1.4	0.61

Table no 3: Shows efficiency evaluation for microstrip patch antenna.

Sr.no	Input impedance (in terms of ohm)	Resonant length (in terms of wavelength)	Efficiency
1.	20	0.5	0.71
2.	40	0.75	0.85
3.	60	1.1	0.91
4.	80	1.2	0.79
5.	100	1.4	0.75

Key features of tabular comparison:

1. For both isotropic antenna and microstrip patch antenna,curve of efficiency shows it's peak for moderate input impedance.
2. Directional nature of microstrip patch antenna adds superiority to it's efficiency.

IV. Discussion

Microstrip patch antenna is better than than other antenna's. This antenna's integration in two dimensional array is possible. On the behalf of manufacturing aspect it's easy to design. Interfacing of this antenna with other microstrip antenna's and coaxial cable is easy. Microstrip patch antenna works on both double and triple frequencies. Radiation pattern includes both circular and linear polarization.

Simulation graphs for microstrip patch antenna:

Return loss: Antennas return loss is the ratio of waves that are rejected when compared with the waves that are accepted. Reurn loss is helpful in calculating absolute gain.

Figure 1: Graph of return loss.

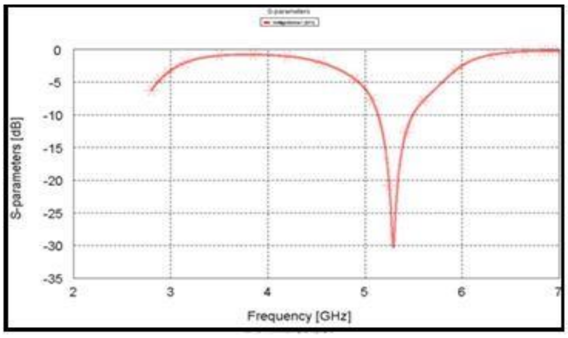


Figure 2: Graph of directivity.

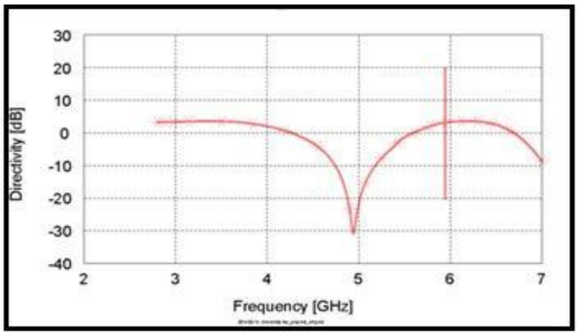
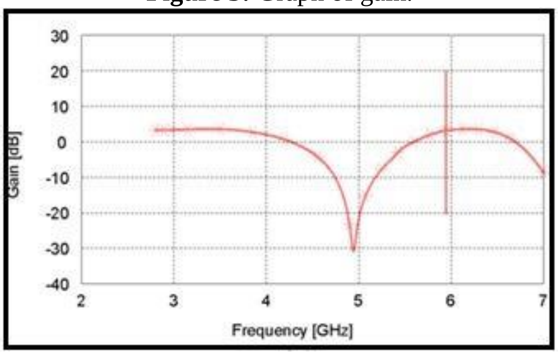


Figure 3: Graph of gain.



Radiation pattern for microstrip patch antenna: Analysis shows broad radiation pattern. Radiation power is low. Feeble directivity is seen. Narrow bandwidth is found in it's radiation pattern.

Figure 3: Radiation pattern on two dimensional plane.

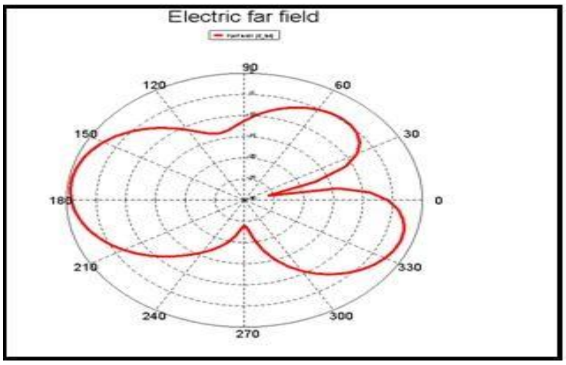
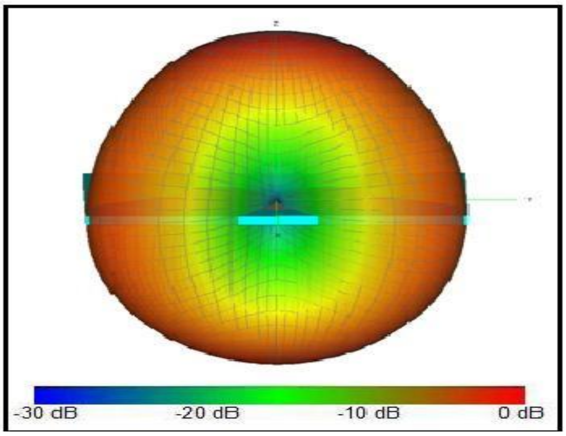


Figure 4: Radiation pattern on three dimensional plane.

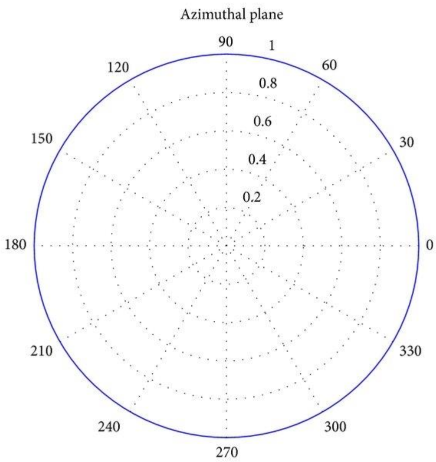


Analysis of microstrip patch antenna with respect to isotropic antenna: With less processing steps and easier placement of circuit components, microstrip antenna can handle more complexity than isotropic antenna.

Radiation pattern parameters:

1. **Gain :** It is defined as the ratio of intensity of antenna in the desired direction with respect to the intensity of isotropic antenna in the same direction.Gain also helps in defining how much intensity will be required to provide essential power to the antenna. Gain also helps in modulating frequency in the antenna. Gain also shows how much directivity loss is there.
2. **Directivity :** It is defined as the ratio of power radiated by antenna in given direction to the average power radiated by antenna. Directivity also calculates how much power will be required to to give essential gain to antenna. Phase modulation is being monitored by directivity.

Radiation pattern of Isotropic antenna:



Analysis of microstrip patch antenna with respect to dipole antenna: Three dimensional radiation pattern of dipole antenna is in form of sphere whereas that of microstrip patch antenna is in form of hemisphere.

V. Conclusion

The microstrip patch antenna finds various applications irrespective of it's design. This paper emphasizes on various important advancements in the field of microstrip antennas. Reconfigurable antenna shows remarkable efficiency. Using numerical methodology we have improved the consistency of the system and hence we find that the description of electric field nature in case of microstrip patch antenna is good. Dipole antenna shows better magnetic behavior. Isotropic antenna describes universal nature for both electric field and magnetic field.

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