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Linear Polarized Non Uniform Shaped Patch Antenna

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ABSTRACT

In this paper a Non Uniform shaped patch antenna has been designed, simulated and optimized. Microstrip patch antennas with linear based on general requirement network have been investigated. All of the singles and arrays patch antennas are implemented in microstrip transmission line. Single patch non uniform antenna has also been investigated with enhancement factor i.e parasitic elements to investigate the parameter changes. All the designs are simulated and analyzed using Advanced Design System (ADS) software.

Keywords: Non-uniform, linear and Circular polarization; Antenna array; ADS

Introduction

Non Uniform shaped patch antenna has been designed, simulated and optimized as shown in figure 1.1. It has also been attempted to increase important parameters of the antenna using the parasitic effect which actually acts as an enhancement factor. The design specification is given in table 1.1

TABLE 1.1 Non Uniform Shaped Patch Antenna Design Specifications

Frequency	27.7 GHz
Substrate	Alumina
Dielectric Constant εr	9.6
Substrate Height	25mil

Figure 1.1 Non-uniform shaped patch antenna

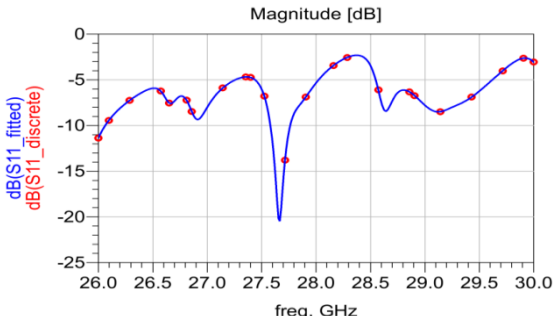
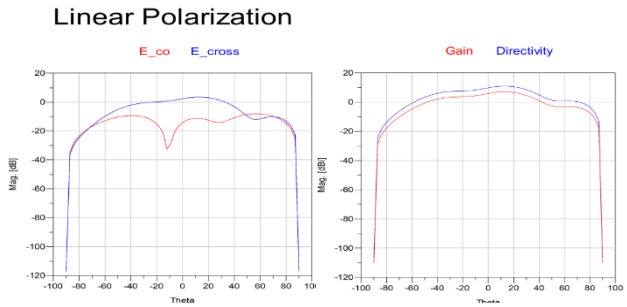


Figure 1.2 Frequency response of non-uniform shaped patch antenna

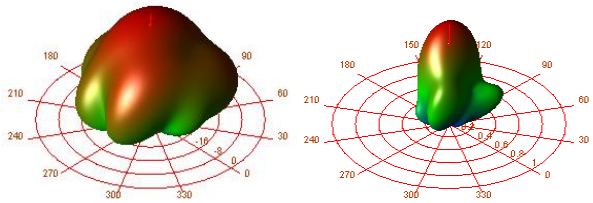
Figure 1.2 shows a return loss of -20.47 dB at 27.67 GHz. We can also see that the response has narrow bandwidth between 27.58 GHz and 27.76 GHz with reflection less than -10dB.

Thus the bandwidth is 0.2 GHz. This antenna is an excellent linearly polarized antenna as can be seen in figure 1.3(a).The 3D radiation pattern which is shown in figure 1.4 in logarithmic and linear scales indicates that it is almost uniform, while table 1.2 represents this antenna calculated parameters.



(a) (b)

Figure 1.3 2D Radiation pattern of non-uniform shaped patch antenna
(a) Co and Cross Polarization (b) Gain and Directivity



(a) (b)

Figure 1.4 3D Radiation pattern of non-uniform shaped patch antenna
(a) Logarithmic scale (b) Linear scale

TABLE 1.2 Antenna Parameters of Non-Uniform Shaped Patch Antenna

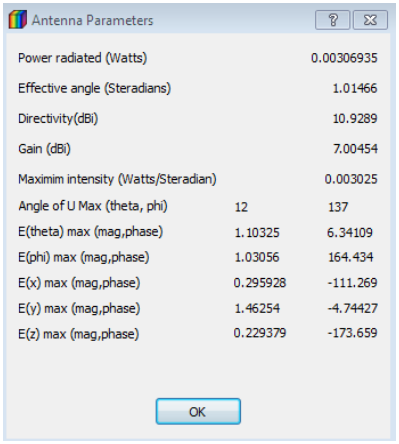


Figure 1.5 The Optimized non-uniform shaped patch antenna

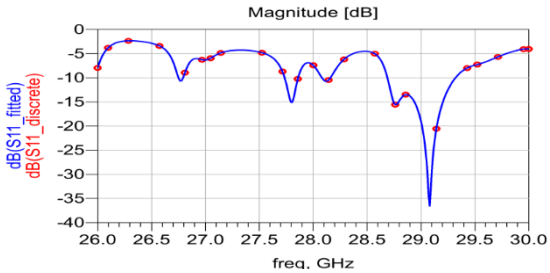
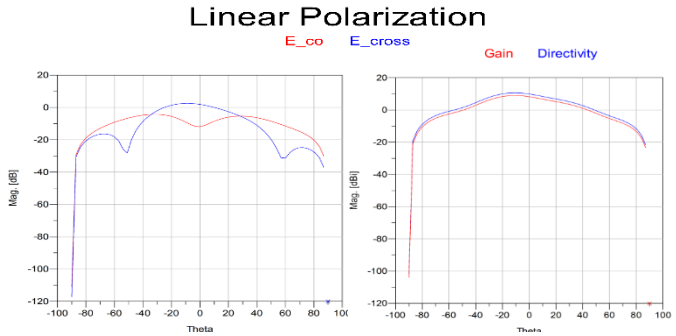


Figure 1.6 Frequency response of the optimized non-uniform shaped patch antenna

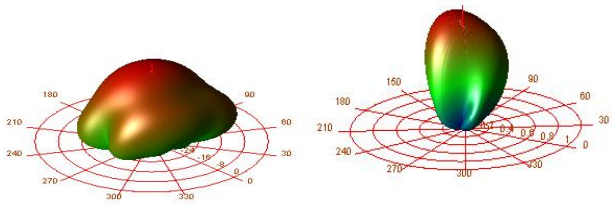
It is observed from figure 1.6 that the non-uniform shaped antenna operates as a dual bandwidth at 27.8 GHz and 29.08 GHz with return less of -15.11 dB and -36.64 have been obtained respectively. A high gain of 10.45 dB and 7.2 dB have been achieved respectively .This proposed antenna is suitable for Ka band application specially in satellite communication. The 3D radiation pattern which is shown in figure 1.8 indicates that it is almost uniform and good linearly polarized as can be seen in figure 1.7(a), while table 1.3 represents this antenna calculated parameters. This antenna is optimized and narrow bandwidths.



(a) (b)

Figure 1.7 2D Radiation pattern of optimized non-uniform shaped patch antenna

(a) Co and Cross Polarization (b) Gain and Directivity



(a) (b)

Figure 1.8 3D Radiation pattern of the optimized non-uniform shaped patch antenna

(a) Logarithmic scale (b) Linear scale

TABLE 1.3 Antenna Parameters of the Optimized Non-Uniform Shaped Patch Antenna

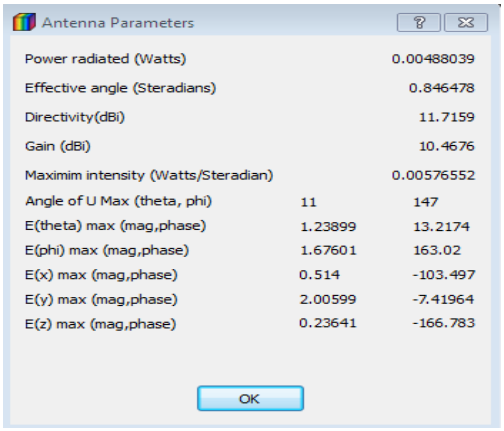


Figure 1.9 Non-uniform shaped patch antenna with parasitic elements

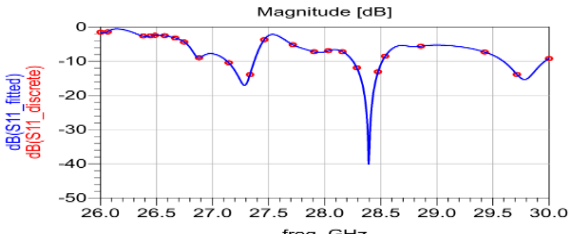
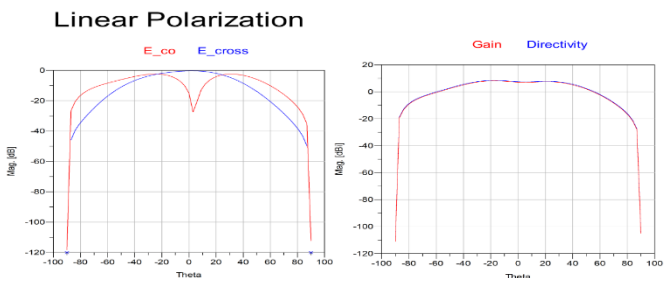


Figure 1.10 Frequency response of non-uniform shaped patch antenna with parasitic elements

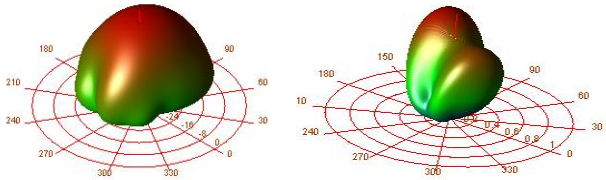
Figure 1.9 shows a non-uniform shaped patch antenna with parasitic elements has been designed and simulated to improve the antenna parameters. It is observed from figure 1.10 that the non-uniform shaped antenna with parasitic elements operates as a multiple bandwidth at 27.3 GHz, 28.4 GHz and 29.8 GHz with return less of -17, -40.2 and -15.4 dB have been obtained respectively. A maximum gain of 11.17 has been achieved .This proposed antenna is suitable for Ka band applications.

The 3D radiation pattern which is shown in figure 1.12 indicates that it is almost uniform and good linearly polarized as can be seen in figure 1.11(a), while table 1.4 represents this antenna calculated parameters.



(a) **(b)**

Figure 1.11 2D Radiation pattern of non-uniform shaped patch antenna with parasitic elements (a) Co and Cross Polarization (b) Gain and Directivity



(a) (b)

Figure 1.12 3D Radiation pattern of non-uniform shaped patch antenna with parasitic elements (a) Logarithmic scale (b) Linear scale

TABLE 1.4 Antenna Parameters of Non-Uniform Shaped Patch Antenna with Parasitic Elements

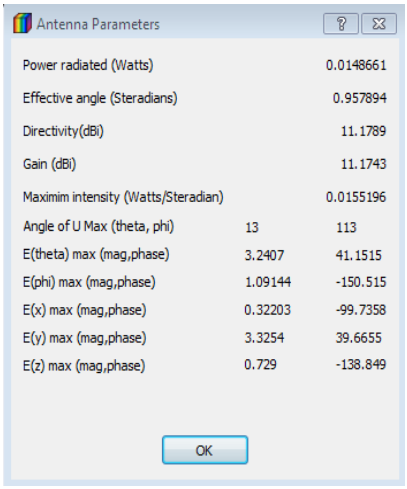


TABLE 1.5 Comparison of Performance Parameters for Non-Uniform Shaped Patch Antenna Geometries

Patch Antenna Type	(S11 < -10dB) BW GHz	Return Loss dB	Gain dB	Directivity dB	Remark
Single Element	0.2	-20.46	7	10.92	
	0.8	-36.64	10.46	11.71	after optimization
with parasitic elements	0.88	-40.24	11.17	11.17	Multi Bandwidth

The above summary table 1.5 shows the improvement in the antenna gain as well as directivity by using optimization and the parasitic elements. This antenna has multi bandwidth which is suitable for Ka band application specially in satellite communication.

2. Non Uniform Shaped Patch Antenna Array

Another type of non-uniform shaped patch antenna has been used to generate arrays in order to improve the antenna parameters. As shown in figures below the designs combine between (2,4,8) elements of the non-uniform shaped patch antenna array to measure the main criteria and compares the results.

Figure 2.1 Two elements non-uniform shaped patch antenna array (Corporate Feed)

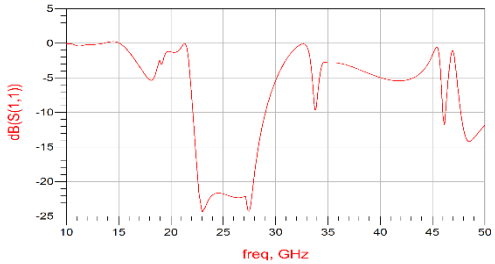


Figure 2.2 The return loss of the two elements non-uniform shaped patch antenna array (Corporate Feed)

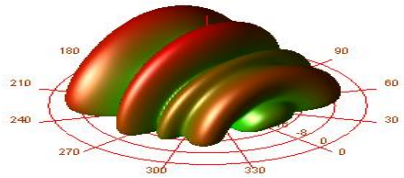


Figure 2.3 3D Radiation pattern of the two elements non-uniform shaped patch antenna array (Corporate Feed)

TABLE 2.1 Antenna Parameters of the Two Elements Non-Uniform Shaped Patch Antenna Array (Corporate Feed

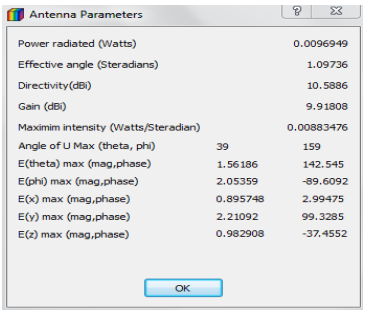


Figure 2.4 Four elements non-uniform shaped patch antenna array (Corporate-Series Feed)

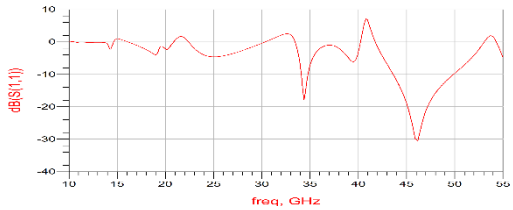


Figure 2.5 The return loss of the four elements non-uniform shaped patch antenna array (Corporate-Series Feed)

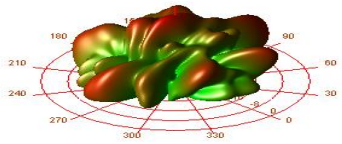


Figure 2.6 3D Radiation pattern of the four elements non-uniform shaped patch antenna array (Corporate-Series Feed)

TABLE 2.2 Antenna Parameters of the Four Elements Non-Uniform Shaped Patch Antenna Array (Corporate-Series Feed)

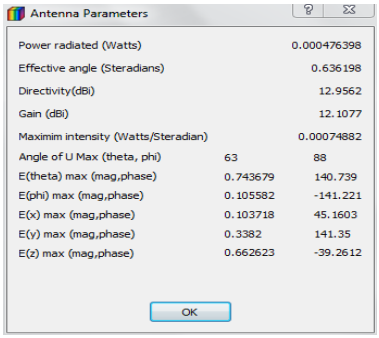


Figure 2.7 Eight elements non-uniform shaped patch antenna array (Corporate-Series Feed)

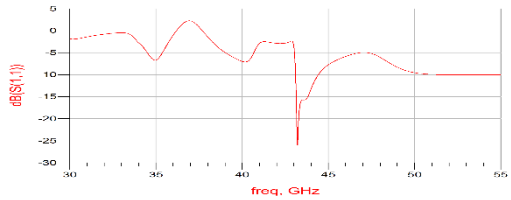


Figure 2.8 The return loss of the eight elements non-uniform patch antenna array (Corporate-Series Feed)

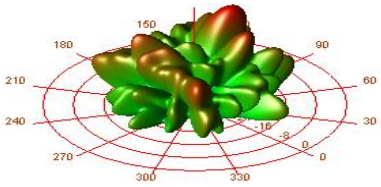


Figure 2.9 3D Radiation pattern of the eight elements non-uniform shaped patch antenna array (Corporate-Series Feed)

Table 2.3 Antenna parameters of The Eight Elements Non-Uniform Shaped Patch Antenna Array (Corporate-Series Feed)

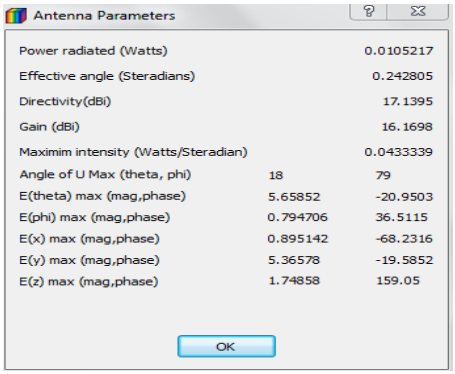


Figure 2.10 Eight elements non-uniform shaped patch antenna array (Series Feed)

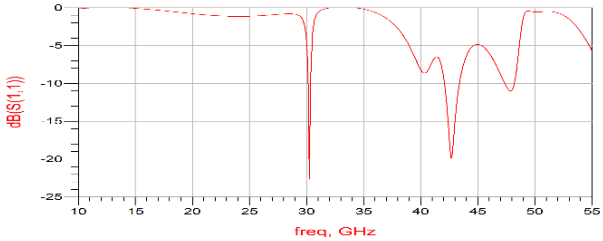


Figure 2.11 The return loss of the eight elements non-uniform shaped patch antenna array (Series Feed)

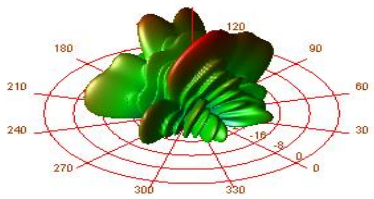


Figure 2.12 3D Radiation pattern of the eight elements non-uniform shaped patch antenna array (Series Feed)

TABLE 2.4 Antenna Parameters of The Eight Elements Non-Uniform Shaped Patch Antenna Array (Series Feed)

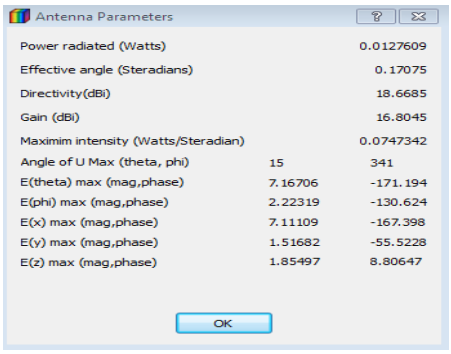


TABLE 2.5 Comparison of Performance Parameters of Non-Uniform Shaped Patch Antenna Arrays

Patch Antenna Type		(S11 < -10dB) BW GHz	Return Loss (dB)	Gain dB	Directivity dB	Remark
2 Elements (Corporate Feed)		9.47	-24.41	9.91	10.58	Multi Bandwidth
4 Elements (Corporate-Series Feed)		6.96	-30.57	12.1	12.95	Dual Bandwidth
8 Elements	Corporate-Series Feed	1.39	-26.04	16.17	17.14	
	Series Feed	1.55	-22.6	16.8	18.66	Multi Bandwidth

Conclusion

As seen from the simulation result the non uniform shaped patched antenna reflected various changes in the antenna parameters.From above summary table 2.5, we can observe clearly the relation between the number of the array and the gain is proportional whereas the increasing the number of elements, the gain will increase also the directivity will increase. On the other hand, the bandwidth decrease if the number of the elements increased. Also it has to be taken in consideration the frequency shifting because of the elements number. For that, the antenna gain and directivity shows high for eight elements array with little bit improvement for eight elements series feed as indicated in the above table. The major applications for

such extremely high frequency range for this kind of antenna is Astronomy and Remote Sensing application.

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