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Improvement Performance In Designing Of 5G Communication Based Millimeter Wave Antenna

Ali Hashim Saeed[1]*, Audie Sabrie Abdul Razzak[2], Abbas Abdulameer Hameed[3]

[123] Computer Techniques, Engineering Department, Islamic University, Babel, Iraq

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*Correspondence: Ali Hashim Saeed
Email: alihashem@iunajaf.edu.iq

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Abstract: *A critical aspect of the scientific process is the reporting Of new results in scientific journals in order to disseminate .That information to the larger community of scientists .Communication of your results contributes to the pool of Knowledge within your discipline (and others)and very Often provides information that helps others interpret .Their own experimental results .In this research paper .We discuss how to improve the performance evaluation and design in form of some review for the mathematical .Model and general shape dimensions of antenna .Consequently, high and width band wave with a good .Efficiency of transmitting .In antenna theory ,improving antenna gain is important to attain isotropic antenna ,antenna gain can be improved by the controlled behavior of frequencies ,beam forming and choosing the right antenna fabric. So that all depends on what mentioned above .hence ,the 5G networks ,antenna structuring and designing is an integral part of the communication system.*

Keywords: *Antenna Array, Beam Forming, Gain, Propagation Loss, 5G*

Introduction

With the extensive use of wireless communication devices according to statistic reports. about 1.5 billion smart phones have been sold. During recent years (Juneja, 2021). Because of the limited bandwidth resources, Which is also a motivating factor toward adoption of new techno-Logy trends. Since data rate is of the essential performance para-meters in antenna they in which a better performing transmitter, channel and receiver work in coordination in a communication system. Hence the improving elements leads to the development of next generation of antenna services as shown in fig 2. The upcoming 5G techno-logy not only provides greater reliability, high data rates up to 20Gbps and reduced power consumption to meet the massive increase. In connected devices but also promises to increase the visions of Emerging technologies such as virtual reality and smart cities (Guarigla, 2001). Consequently, the development of next generation means much Better channel capacity and higher data rates by using a millimeter. Spectrum to characterize the performance of antenna to meet (Kikan, 2023). Certain parameters that should be kept in mind while designing. Antenna. Antenna parameters can be classified into two categories, Firstly the antenna parameters according to the field point of view Which include the radiation pattern, beam width, directivity, gain, Bandwidth and the polarization and the remaining antenna performance parameters are according to the circuit point of view which Include input impedance, radiation resistance and reflection coefficient return loss, VSWR and bandwidth (Sharma, 2021). Hence, to achieve an optimized antenna ,antenna designing parameters are the key factor in improving antenna performance and that is why the antenna substrate is kept in observation, and to verify abroad band planar sierpinski fractal antenna in order to achieve multiband applications and according to its defined dimensions results in optimal return losses, radiation patterns and gain of the proposed antenna (Ahmad, 2022a).

Methodology

As mentioned before ,the substrate thickness is the impor-tant factor to be considered in designing process of an antenna. here we have chosen a low- loss Teflon- based material from CTS studio suite library for the study of the impact of the substrate thickness on antenna performance (Wang, 2022). This substrate a dielectric constant € =2, and loss tangent tan=0.0007. An edge-fed micro- strip patch antenna was used in the study as shown in figure (1). The antenna dimensions were slightly adjusted for each substrate thickness so that the Antenna resonates at 28 GHz. As shown it can be seen in the figure (1) that as the substrate (Bruhn, 2023). Thickness increases from 0.127 to 0.787 mm ,the real part Of the input impedance increases from 207 to 322 at 28GHz. This increase in the real part of the antenna impedance can. Be recognized to an increase in the antenna radiation effici- ency. so the real part of the antenna input impedance can be written as :

$$R_a = R_r + R_{loss}$$

Where ,Ra is the total real part of the antenna input impedance .Rr ,is the radiation resistance which represents the Part of the input power of the antenna that is transferred Into radiated electromagnetic waves. R loss ,is the part of the antenna input resistance(i.e conductor losses, dielectric losses ,surface waves , etc ---).

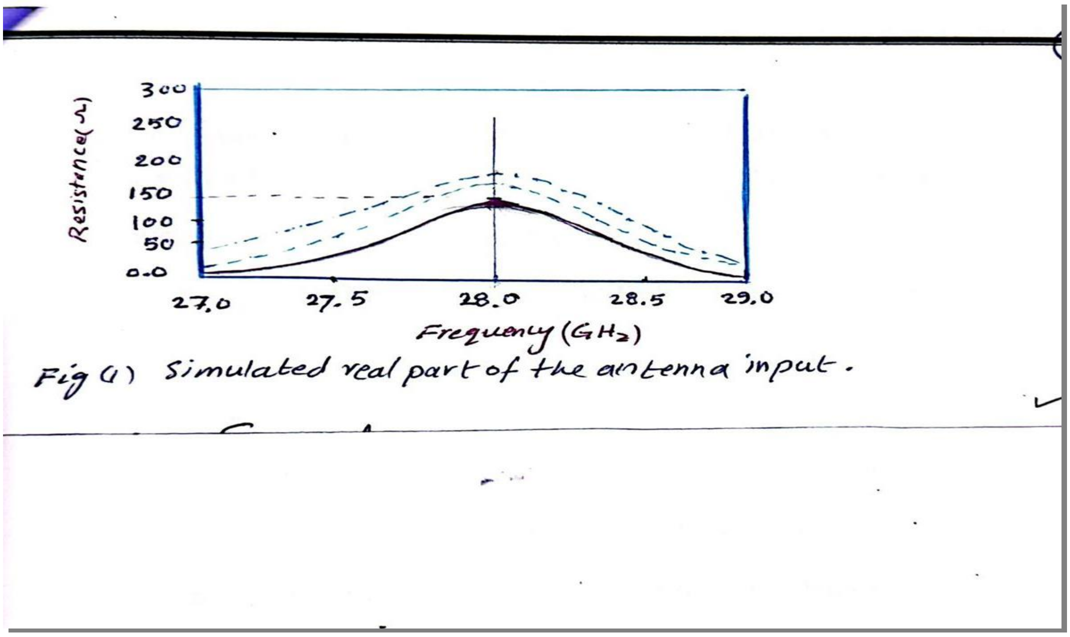


Fig (1) Simulated real part of the antenna input.

Designing Fractal antenna :

First of all, we have to know what is fractal antenna the entropies of Shannon, ?A fractal antenna is an antenna that uses a fractal ,self –Similar design to maximize the length, that which our interested in this aspect as an important factor as design-ing is concerned of antenna (Mittra, 2022). Such antenna is also referred to as multilevel and space filling curves. And the key aspect lies in its repetition of a motif over two or more scale sizes known as " iteration". That is why, the fractal antenna very compact and multiband, and is used for application in cellu-iar telephone and microwave communication (Vasudevan, 2024). So in order to determine the effective length Leff of the Patch using the following formula which shown its depen-dence on "C" i.e free space light velocity, effective dielectric constant € eff ,and resonant frequency Fr, then determine the actual length "L" of the patch using the following equation:

Leff = C/2Fr * € eff.

And actual length will be as :

L = Leff - 2 L .

This is the main formula for designing The antenna.

Where

L : is the incremental length generated by the fring

Fields ,which given as below :

L =0.412 h (€ eff+0.3) (h/w+0.264)/(€ eff-0.258)(h/w+0.8)

And

L eff= r+1/2 + r-1/2 2+12 h/w.

where

w, is the width of the strip.

h ,is the substrate thickness .

€ eff , is the effective dielectric constant or effective relative permativity.

Also for efficient radiator ,we have to calculate the width
W as below :
W=C/2Fr * 2/ r+1.
Finally, using these relations ,the antenna can be Simulated using simulation tools such as CST .or high-Frequency structure simulator (HFSS),and its performance Parameters can be adjusted in order to obtain optimum
Operational characteristics.

Here we show the designed parameter for multiple Arrays :

Table 1.

Design No.	Frequency band	No. of Antenna in an array	Reflection coef. dB	R
2	Mm band 45GHz	4*1	-37	2.2
3	Mm band 45GHz	3*1	-18	2.2
4	Mm band 45GHz	16*1	-6	2.2

Table 2.

(mm)	(MHz)	Fractional bandwidth	% Efficiency at 28 GHz
0.127	424	1.51	81
0.254	745	2.7	91
0.381	961	2.4	92

From the information of above tables ,it might be hard to achieve such high gain using single small antenna, However, several small antennas can be grouped together in an antenna array to achieve such high gain directive Pattern that can be electronically scanned in a certain direction. See the Figures 2, 3, 4, 5 for more understanding (Apoorva, 2021).

Result and Dicscussion

5G gain the recommendation in terms of high data rates, i.e (20) Gbps down link and (10) Gps up link as well as the support for IOT rules .That is only when we have efficiently designed antenna according to supported millimeter wave spectrum.

No.	Parameters	Fractal antenna
1	size(mm)	30*30
2	frequencies (GHz)	5.10 - 10.03 - 10.37

3	Resonant freq. (GHz)	3.4, 4.49 , 5.13 [multiband iteration]
4	Error (% avg.)	33
5	Reflection coefficient (dB)	-11.76, -14.68 , -16.58, -11.46 , -24.90
6	Gain (d B)	2.80, 8.97, 3.66, 4.32 , 2.37
7	directivity (d B i)	6.81,10.61, 7.59, 9.22 ,8.49
8	VSWR	1 to 2
9	Simulated bandwidth(MHz)	30, 40, 40, 20, 110
10	Measured bandwidth (MHz)	100 ,50 ,190

Now we have to show an example in order to explain the steps which we have taken to start of designing our 5G micro-strip antenna, using the (CST studio suite) program application, and with the help of given data as shown in the table (3). So that we can define the parameters of the micro- strip 5G antenna and its operational frequencies, depending on the equations mentioned in this paper, and with adjusting process of antenna dimensions of a given parameters, then using them in our modeling programing [micro-strip patch antenna calculation program] . with this program we can select the following data :

1. Dielectric constant to be 2.2
2. Dielectric height to be 0.787
3. operational frequencies to be from 20 to 40 GHz
4. Width to be 4.332 mm
5. Length to be 3.063 mm

Then using these data in the program in order to calculate and getting results. Then we will see the drawing of 3- dimensions shape of the proposal design antenna after steps to be done.

Conclusion

This is brief description of our designed antenna which result of getting several responses represented by different curves attached with this paper (Ahmad, 2022b). Which shows frequencies vs magnitudes, operational frequency near a bout 26 to 28 GHz which antenna starts resonating in such a way it will show one or more iterations of same shape curve frequency ,that means we will have a multiband, i.e our interested to get wide band frequencies for more operational frequency (Benisha, 2019).

Table 3.

	Micro –strip patch antenna calculator design data :
1.	Length of ground plane (L) :6 mm
2.	Width of ground plane(W) : 6mm
3.	Hight of ground plane (g) : 0.0175mm
4.	Length of substrate (w) : 6mm
5.	Width of substrate (L) : 6mm
6.	Height of substrate (h) : 0.787 mm
7.	Length of patch (lp) : 3.063 mm

8.	Width of patch (wp) : 4.236 mm
9.	Width of feed line (wf) : 0.3 mm
10.	Length of feed line (lf) : 1.468 mm

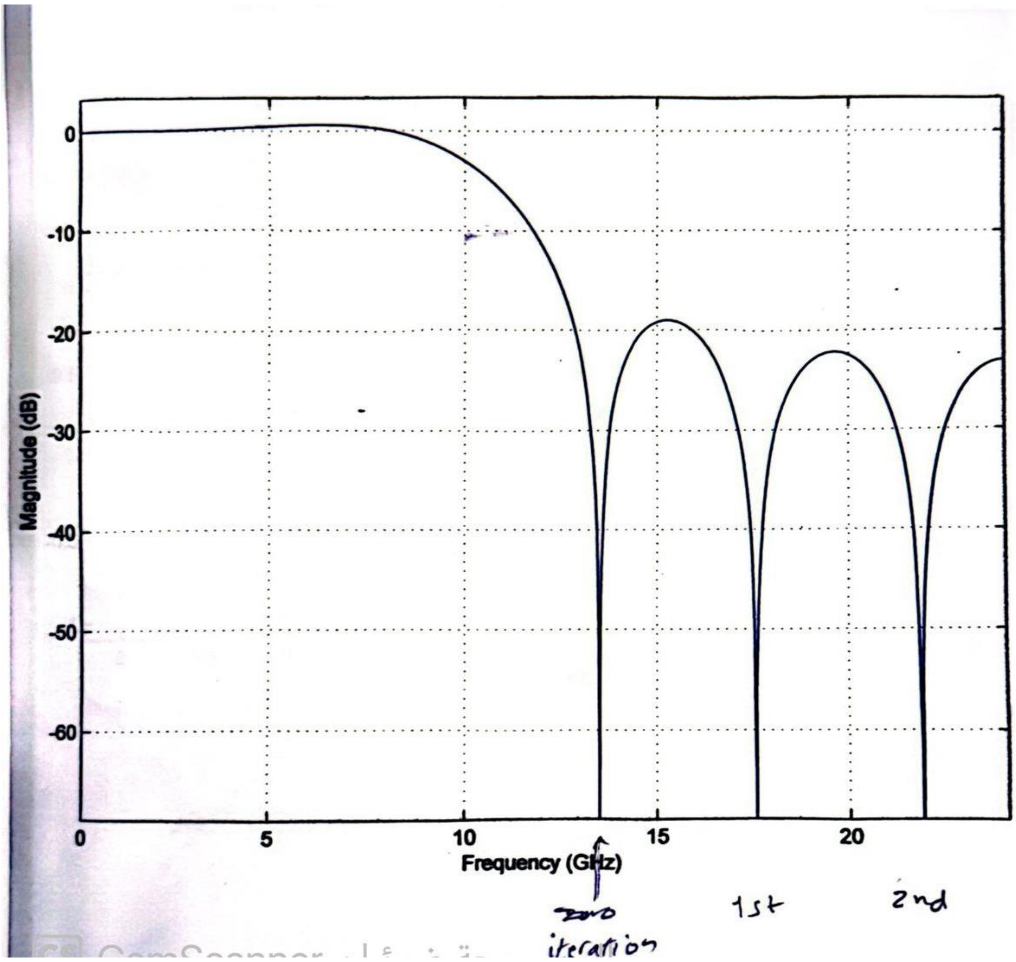


Figure 2. shows the periods of iterations of bands frequencies with its amplitudes spectrum

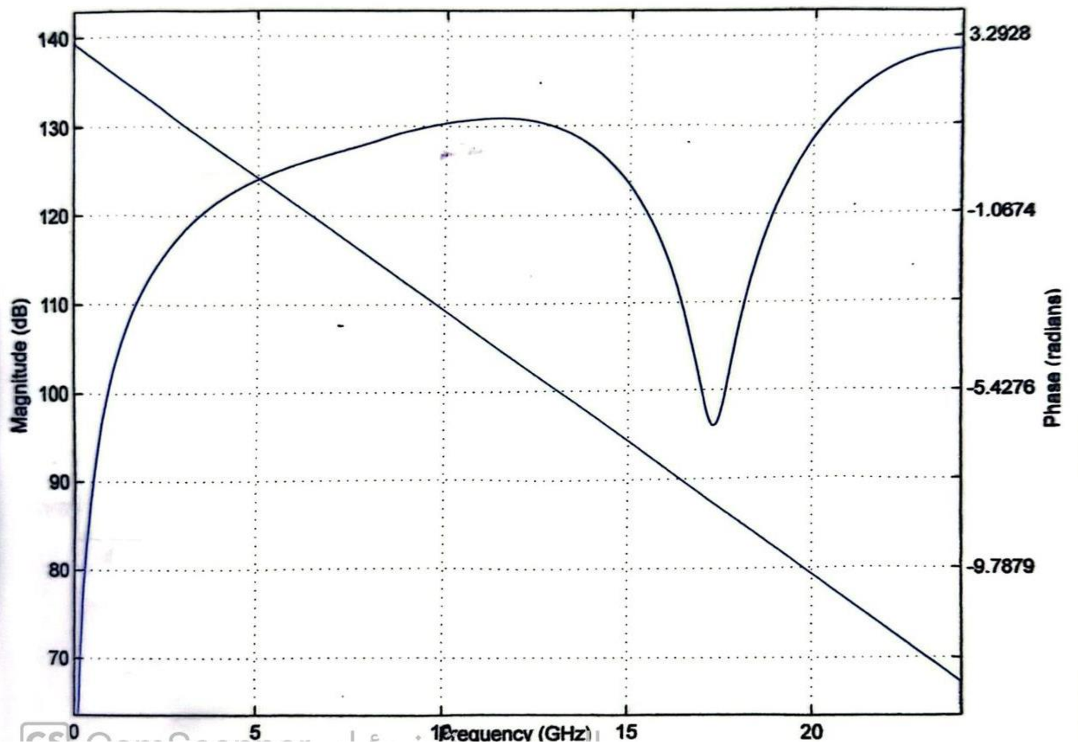
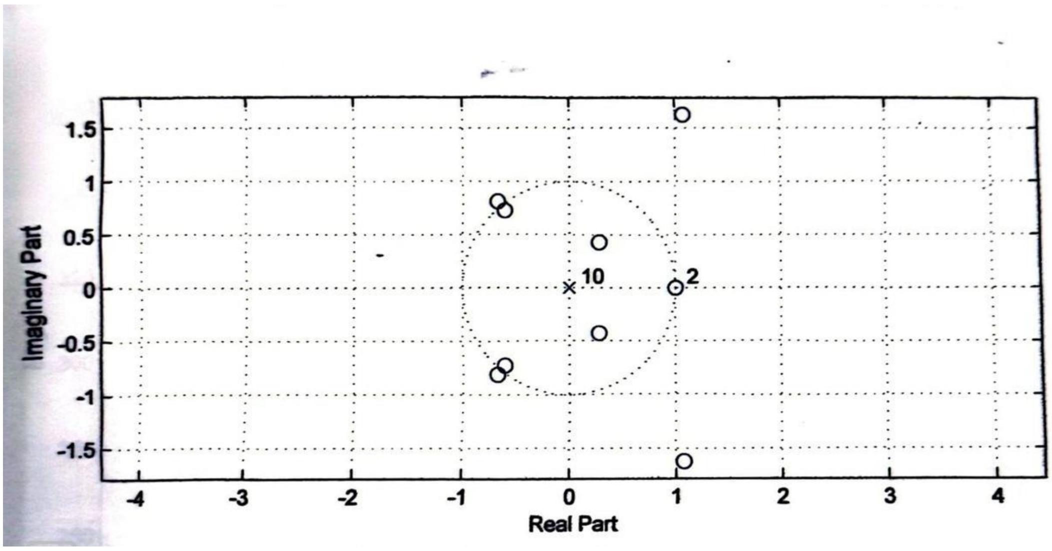


Figure 3. shows the phases with amplitudes



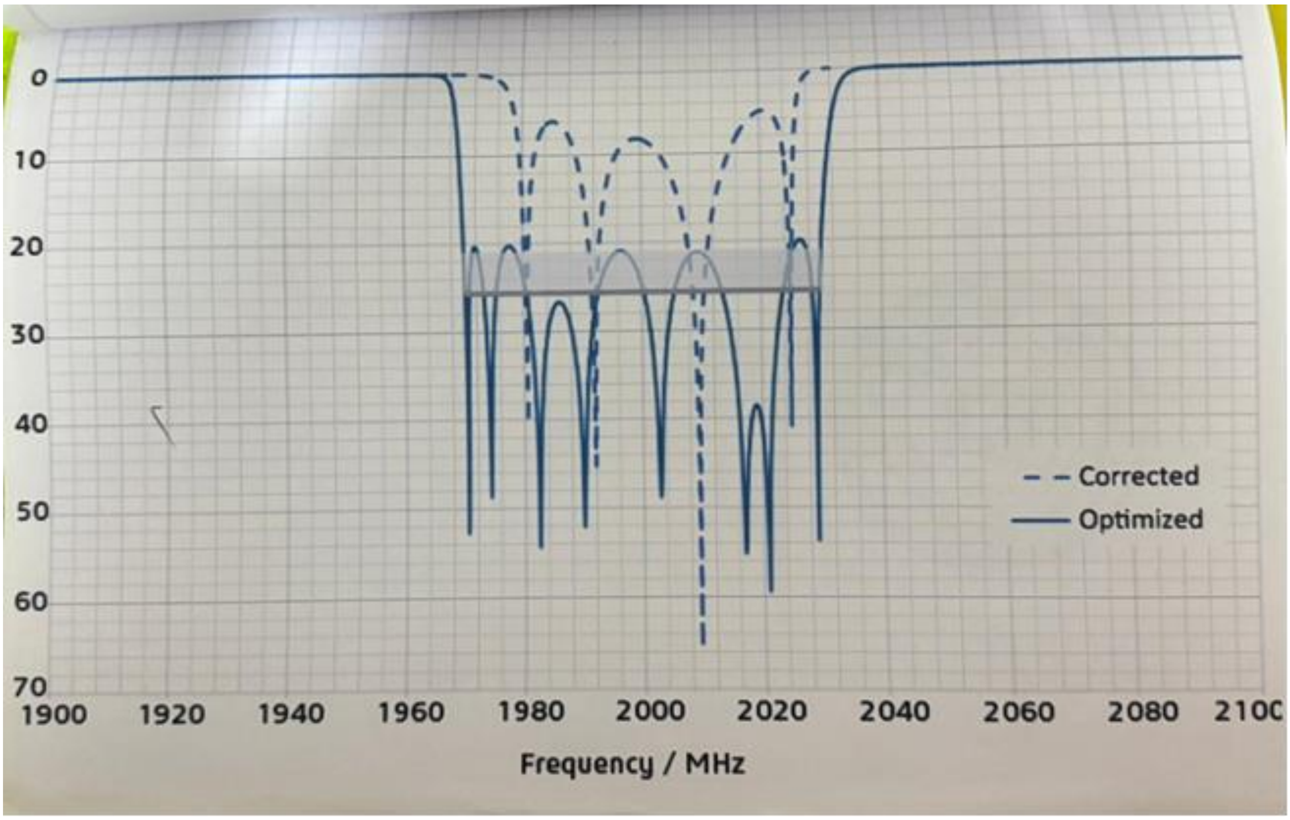


Figure 4. shows the improvements in Gain of the antenna

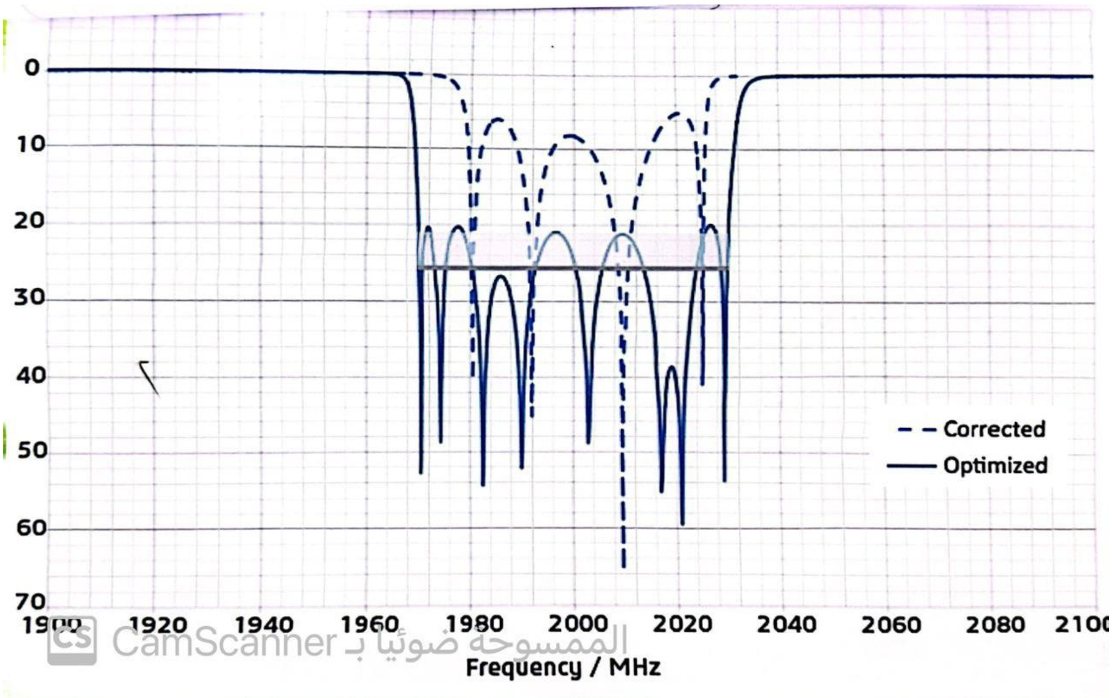


Figure 5. shows the optimization the function of Gain of the antenna

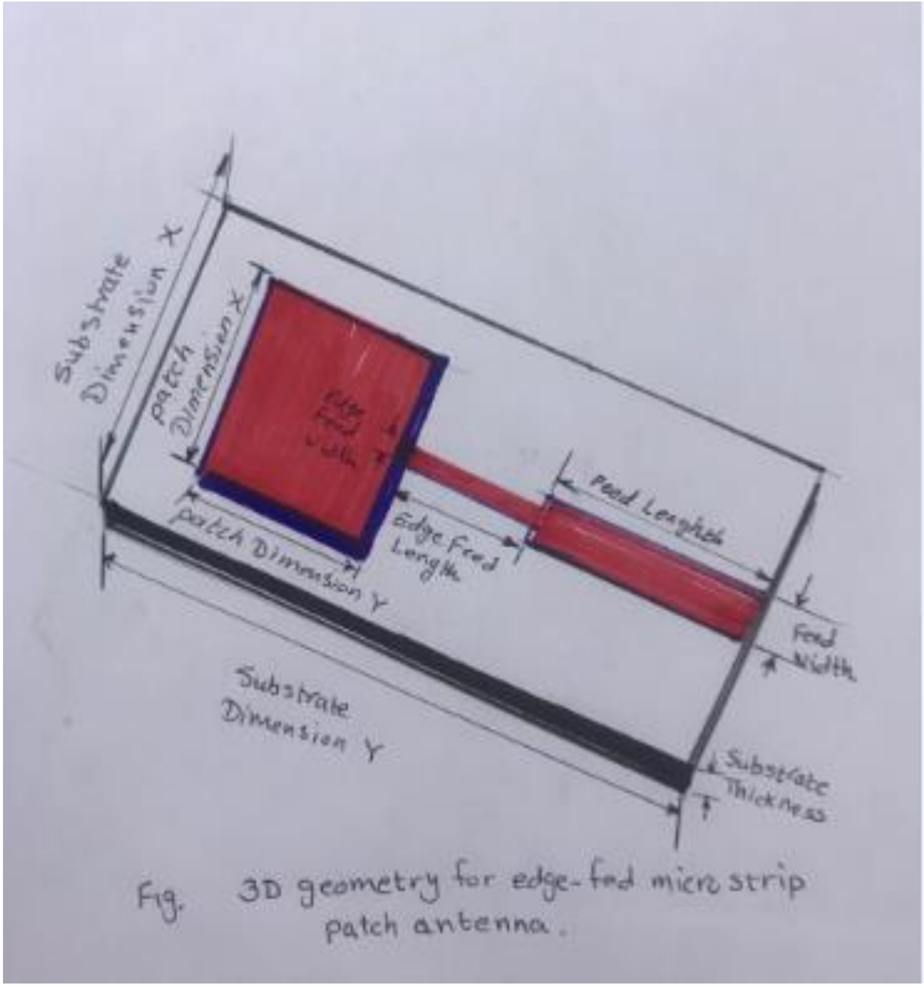


Figure 6. Describe 3D geometry for edge-fed micro–strip Patch antenna dimensions structure

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