ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Vol 7, Issue 10, October 2020

Gain in Bandwidth of a Microstrip Antenna With Negative Inductor

[1] Ila Kumari
[1] Ph. D. in Physics from Lalit Narayan Mithila University, Darbhanga, Bihar, India

Abstract: This review paper focuses on detection of glaucoma by learning and understanding different image processing techniques used till now. Glaucoma is disease related with human eyes. It is difficult to identify glaucoma until it reaches severe vision loss, because it shows zero symptoms at the early stage. Due to this factor this disease became the second leading cause of blindness after cataract in world wide. A comprehensive dilated eye exam can reveal the risk factors of glaucoma such as high eye pressure, thickness of cornea and abnormality in optic nerve. But, the challenging factor is functional changes in fundus of the eye cannot be easily tracked and hence the only way is identifying the structural changes of eye with the help of image processing technologies. This study would be helpful and applicable to both ophthalmologists in practice and researchers in the same field to enhance the diagnosis. This paper conclude that, combining most relevant features which are notable for structural changes of eye with Retinal Nerve Fiber Layer (RNFL) thickness alone can be more effective and provide promising accuracy in glaucoma detection.

Keywords: Glaucoma, RNFL (Retinal Nerve Fiber Layer), Fundus images, Feature Extraction, Image Processing.

INTRODUCTION

Now a days, microwave integrated circuits (MICS) have received great deal of interest for many application systems. They are easy to produce and more reliable with improved performance at low cost. The radiation pattern of a rectangular patch antenna can be controlled by inductive loading. For these reasons, integrated antennas are to be used as RF (Right Front) at antenna terminals.

The purpose of this study is to investigate the effects on radiation performances of loading a microstrip element with active inductive load.

2 Evaluation

2.1 Microstrip Patch Antenna

MPA (Microstrip Patch Antenna) consists of metallic patch on one side and dielectric substrate on another side. The length of the patch (L) is equal to one half of the dielectric wavelength which corresponds to the resonant frequency. The dielectric substrate material determines the size and bandwidth of an antenna. Larger the dielectric constant smaller is the size of antenna but it reduces the bandwidth and efficiency of the antenna while decreasing the dielectric constant increases the bandwidth and thereby increasing the size of the antenna. But there is limit on increasing the value of dielectric constant. The width W of the Microstrip antenna determines the input impedance and radiation pattern. Larger width indicates an increase in bandwidth. As shown in Figure 1. "h" is the height of substrate. Here rectangular patch antenna is used. There are various methods for improving the bandwidth and gain MPA like changing the shape of patch, using multilayer structures, different feeding techniques, array method, using different dielectric substrates etc.

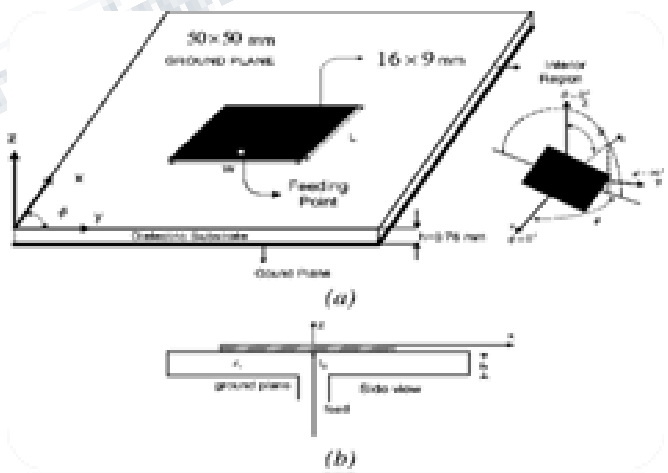

Figure 1: Antenna Configuration (a) top view and (b) side view.

ISSN (Online) 2394-2320

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Vol 7, Issue 10, October 2020

2.2 Microstrip Patch Antenna & parallel LCR circuit

Microstrip antennas exhibit a parallel LCR circuit. For this, the input impedance of an antenna can be expressed as :

$Z = Rmax/1+jQ$ ………. (1)

Where , Rmax is the resonant resistance

Q = Quality factor

$v = f/fr – fv/f$ ……….. (2)

Where fr = resonant frequency.

For lower and upper band edge frequencies f1 and f2 = S

And relative bandwidth (BW) can be written as:

$BW = f2 – f1/fr$ . . . . (3)

The quality factor can be expressed as:

$Q = 1/BW \sqrt{}$ (S. Rnorm - 1). (S – Rnorm)/S ……. (4)

It can be shown from eqn. (4) that decreasing the quality factor is also effective way to enhance the antennas impedance bandwidth.

Eqn. (4) reduces to BW(Rnorm=1) = 1/Q. S – $1/\sqrt{S}$ ……. (5)

2.3 The Admittance

A parallel RLC circuit of a narrow band frequency can be written as:

$Yant (fr + \Delta f) = Gant – jBant$

$\approx 1+ 4Q2 (\Delta f/fr)2$

$Rnorm – 2jRnormQ(\Delta f/fr)$ ………. . (6)

Where the frequency shift from resonance is:

$\Delta fmax = f – fr$

And, $\Delta fmax /fr = 1/2Q\sqrt{2Rnorm - 1}$ ……. . (7)

For parallel type resonance, the bandwidth is –

$BW = 2Gant/w0 (dB/dw)w0$ . . . . (8)

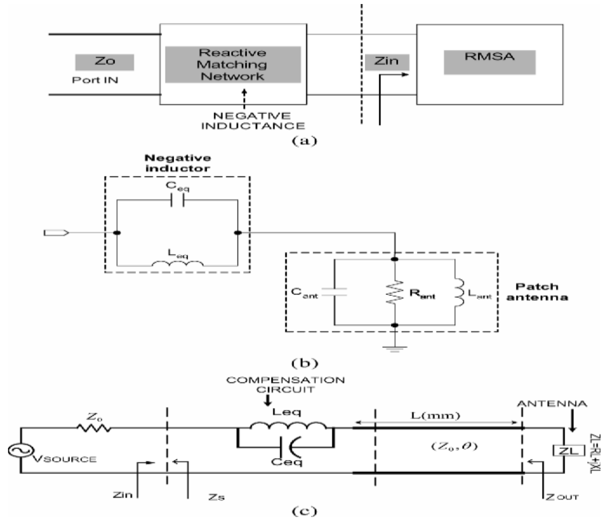

Figure 2. (a) Matching block diagram, (b) equivalent circuit of the MPA with negative inductance, (c) equivalent circuit model both matched to source and the antenna.

The calculated return loss level is increased by using reactive matching network. This compensation network could transform the frequency dependent complex antenna impedance Z0 over a large bandwidth which is the requirement here. Thus, it is important to select suitable components for optimizing the matching levels which will maximize the bandwidth. This resonant load can be realized by a cascade of negative inductor or capacitor segments connected to an appropriate point of the patch antenna.

3 PROPOSED ACTIVE COMPENSATED ANTENNA:

The 50 input impedance of the antenna is obtained. TLYA – 5CH200 which has permittivity of 3.20 and thickness of 0.78 mm has been used as a substrate material.

The patch dimensions of width w = 16 mm and length L= 9 mm have been selected with ground plane dimensions of 50×50 mm used. The designed antenna operates at 10.5GHz with -21.5 dB at resonant frequency.

Then the equivalent inductance and capacitance can be written as:

$Leq = - Cgs/gm$

$Ceq = Cgs$

The negative inductance compensation circuit having two

ISSN (Online) 2394-2320

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Vol 7, Issue 10, October 2020

same type of FET has been simulated.

TABLE 1 Electronics Units

Unit Name	Unit Symbol	Quantity
Ampere (amp)	A	Electric current (I)
Volt	V	Voltage (V, E) Electromotive force (E) Potential difference (Δφ)
Ohm	Ω	Resistance (R)
Watt	W	Electric power (P)
Decibel-milliwatt	dBm	Electric power (P)
Decibel-Watt	dBW	Electric power (P)
Volt-Ampere-Reactive	var	Reactive power (Q)
Volt-Ampere	VA	Apparent power (S)
Farad	F	Capacitance (C)
Henry	H	Inductance (L)
siemens / mho	S	Conductance (G) Admittance (Y)
Coulomb	C	Electric charge (Q)

4 CONCLUSION

Use of negative inductor to overcome the limitations of Microstrip patch antenna is an interesting research area. The researchers from various disciplines are being attracted towards this because of its unique properties. In this paper, introduction to negative inductance, various types, and methods to overcome the limitations of microstrip patch antenna have been discussed. From comparative analysis we observe that use of negative inductance in MPA can improve the bandwidth from 13.1% to 25.2% with a minimum dip point of -36. 33 dB. have resulted in surprising improvements in various parameters like gain, bandwidth, radiation etc.

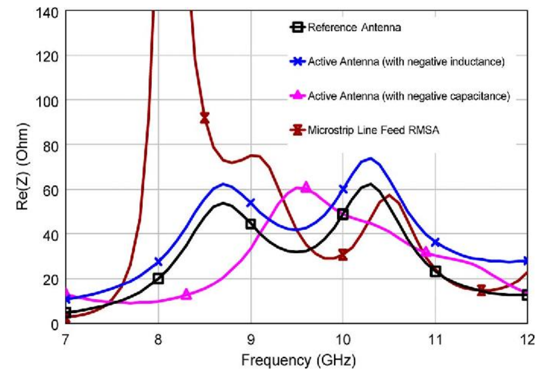

Figure 3. Variation of antenna impedences.

References

[1] Mekala Harinath Reddy, R. M. Joany; M. Jayasaichandra Reddy, M. Sugadev, E. Logashanmugam, ”Bandwidth enhancement of microstrip patch antenna using parasitic patch”, IEEE 2017.

[2] Pragya Shilpi, Dharmendra Upadhyay, Harish Parthasarathy, “Design of Dualband Antenna with Improved Gain and Bandwidth using Defected Ground Structure”, 3rd International Conference on Signal Processing and Integrated Networks (SPIN) IEEE 2016.

[3] Tahsin Ferdous, Ara Nayna, Emranul Haque, Feroz Ahmed, “Design of a X band defected ground circular patch antenna with diamond shaped slot and ring in patch for UWB applications”, International Conference on Signal Processing, Communication, Power and Embedded System (SCOPES) IEEE 2016.

[4] Jogesh Chandra Dash, Guru Prasad Mishra, Biswa Binayak Mangaraj, “Design of dual band patch antenna with bandwidth enhancement using complementary defected ground structure”, IEEE 2016.

[5] Parvathy P. Chandran, Sanoj Viswasom, “Gain and Bandwidth Optimization of a Novel Microstrip Patch Antenna”, Fourth International Conference on Advances in Computing and Communications IEEE 2014.

[6] Achmad Munir, Guntur Petrus, Hardi Nusantara, “Multiple slots technique for bandwidth enhancement of microstrip rectangular patch antenna”, International Conference on QiR IEEE 2013.

[7] Dr. Prasanna Zade, Dr. Vivek Kapur, Devashree S. Marotkar, “Design of Microstrip Patch Antenna with Asymetric Sai Shape DGS for Bandwidth Enhancement”, Applied Electromagnetic Conference IEEE 2015.

[8] D.M.Pozar,’’A microstrip antenna aperture

ISSN (Online) 2394-2320

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Vol 7, Issue 10, October 2020

coupled to a microstrip line,’’Electron.Lett.Vol.21 pp.49-50,Jan 1985.

[9] K.L.Wong and W.H.Hsu,’’increasing a broadband rectangular path antenna with pair of widw slits,’’IEEE Trans.Antennas propogation,vol 49,pp.368-369,2001

[10] Ajay Thatere, P. L. Zade, Dwejendra Arya, “Bandwidth enhancement of microstrip patch antenna using ‘U’ slot with modified ground plane”, International Conference on Microwave, Optical and Communication Engineering (ICMOCE) IEEE 2015.

[11] Iman Ben Issa, Mohamed Essaaidi, “Simultaneous gain and bandwidth enhancement of a circularly polarized microstrip patch antenna using a coupled square-shape split ring resonators metamaterial superstrate”, IEEE 2011.

[12] Uday Kumar, Dileep Kumar Upadhyay, Babu Lal Shahu, “Improvement of performance parameters of rectangular patch antenna using metamaterial”, IEEE International Conference On Recent Trends In Electronics Information Communication Technology, May 20-21, 2016

[13] N. Ripin, S. N. C. Yusoff, A. A. Sulaiman, N. E. A. Rashid, M. F. Hussin, “Enhancement of bandwidth through I-shaped Defected Ground Structure”, IEEE International RF and Microwave Conference (RFM) 2013.

[14] Kirti Inamdar, Y. P. Kosta, S. Patnaik, “Criss-Cross Metamaterial-Substrate Microstrip Antenna with Enhanced Gain and Bandwidth”, Radio electronics and Communications Systems, 2015.

[15] Girish Kumar, K. P. Ray, Broadband Microstrip Antenna, Artech House.

[16] B. -I. Wu, W. Wang, J. Pacheco, X. Chen, T. Grzegorczyk, J. A. Kong, “A study of using Metamaterials as antenna substrate to Enhance Gain”, Progress in Electromagnetics Research 2005.