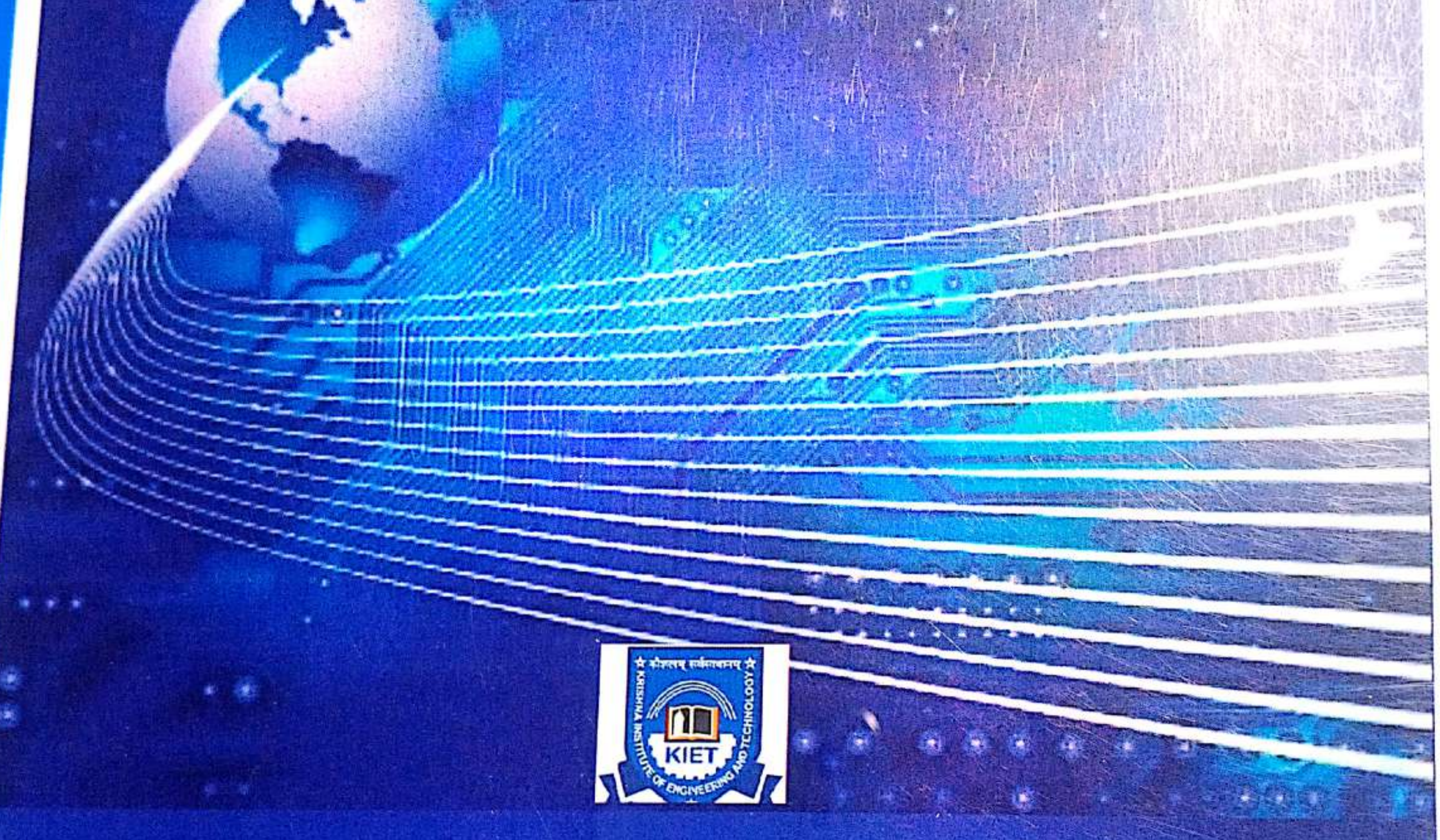
KIET IJCE

KIET International Journal of Communications & Electronics

VOLUME 3, SECOND ISSUE, JULY-DECEMBER 2015
ISSN:2320-8996



Editorial

Although the microstrip antenna has been extensively studied in the past few decades as one of the standard planar antennas, it still has a huge potential for further developments. This issue gives an idea for a Novel UWB modified Hexagonal microstrip antenna with curved partial ground plane (HMSA-CG). This is done for performance improvement of the patch antenna in terms of Gain and Group delay.

In conjuction with above work, a directional high gain cavity back shell monopole antenna for X and Ku band application with improve antenna radiation characteristic and gain despite of reduction in bandwidth is published. It is compact, high gain directive antenna is necessary in microwave imaging and radar application.

Wheelchairs are used by the people who are especially abled due to physiological or physical illness, injury or any disability. Recent development promises a wide scope in developing smart wheelchairs. An accelerometer based hand Motion Controlled Smart Wheelchair which is controlled using hand movements. The system is divided into two main units: Mems Sensor and wheelchair control. The Mems sensor, which is connected to hand on the wheelchair, is an 3-axis accelerometer can read analog data of motion and ultrasonic sensor converts analog data into digital values and gives it to the 8051 microcontroller.

A review theory of non-uniform waveguide effectively examines the various methods adopted for analyzing the propagation processes of waves of various natures. These techniques are used in the solution of practical situations in various fields, such as plasma heating in nuclear fusion, materials processing and radar and satellite communication systems.

The area of wireless sensor networks (WSNs) is one of the emerging and fast growing fields in the scientific world. A wireless sensor network (WSN) consisting of a large number of tiny sensors can be an effective tool for collecting data in diverse kinds of environments.Clustering is introduced to WSNs because it has proven to be an effective approach to provide better data aggregation and scalability for large WSNs. Clustering also proves to be energy efficient as is operated on limited power.

A compact low-pass filter using microstrip stepped-impendance provides a very sharp cutoff frequency response with low insertion loss. This fulfills the demand of newer microwave and millimeter-wave systems to meet the various issues such as cost, performance and size in the field of telecommunication. The use of microstrip provides the advantages of simplicity and ease of fabrication.

Preface

Dear Researchers,

We take this opportunity to welcome you all to the Volume No 3, Issue No. 2 of International Journal of Communications & Electronics (KIET - IJCE). This journal provides a forum for in depth and substantial discussions on the theory, design and implementation of the Emerging technologies in Communications, Networking, Microwave and Electronics techniques, thus providing solutions and strategies for business resilience.

It gives us an immense pleasure to have an amalgam of researchers from the fields of Communication Engineering, Electronics, and related technologies. The purpose of the Journal is to provide a platform to foster interdisciplinary communication among the delegates and to support the sharing process of diverse fields in various concepts and principles related to these domains.

Our appreciation also goes to entire team whose dedication and timeless efforts have gone for number of days for the second issue of the Journal.

Editors
KIET IJCE

Message

I am delighted to note that the Department of Electronics and Communication Engineering, KIET Group of Institutions, Ghaziabad is introducing Volume No 3, Issue No. 2 of International Journal of Communications and Electronics (KIET - IJCE).

I appreciate the efforts on the part of the Editorial Committee in bringing out an issue on Communications, Networking, Microwave and Electronics techniques.

I understand that the papers contributed for publication in the Volume No 3, Issue No. 2 are on almost all the current aspects of Communication Systems, Electronics systems, Microwave Engineering, Signal Processing & Applications, Networking Technologies and several others.

I have great pleasure in congratulating the Editors of this issue of KIET - IJCE for their untiring efforts in bringing out this third Volume No 3, Issue No. 2 of KIET-IJCE which will be a valued treasure for all who are pursuing research in Communications, Networking, Microwave and Electronics Engineering areas.

Let me close with warmest regards.

Dr. J. Girish
Director
KIET Group of Institutions

Message

It gives me immense pleasure in writing this foreword for the Volume No 3, Issue No.2 of the KIET International Journal on Communications and Electronics (KIET - IJCE). This journal is targeted towards researchers, professionals, educators and students to share innovative ideas, issues, recent trends and future directions in the fields of Electronics and Communication Engineering.

The Volume No 3, Issue No. 2 of the journal KIET-IJCE includes papers on the theory, design and implementation of the emerging technologies in the field of Communications, Networking, Microwave and Electronics techniques. Furthermore, it will enable the researchers in various domains to foster the exchange of concepts, protypes, research ideas and the results of research work which could contribute to the academic arena and also befit business and industrial community.

Dr. Sanjay Sharma
Editor – in - chief
KIET - IJCE

THIRD VOLUME
SECOND ISSUE
(JULY-DECEMBER 2015)

KIET IJCE KIET International Journal of Communications &Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

Directional Cavity Back Shell Monopole Antenna for X and Ku bands Application

Ferdows B.Zarrabi[1], Zahra Mansouri[2], Rahele Ahmadian[3], Maryam Rahimi[4]
[1,2]Department of Electrical engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran
[3,4]Department of Electrical engineering, Imam Khomeini international University, Qazvin, Iran

***Abstract*— compact , high gain directive antenna is necessary in microwave imaging and radar application so in this article a directional high gain cavity back shell monopole antenna for X and Ku band application is presented. The prototype antenna is containing monopole structure radiator and semi spherical cavity back for the goals of high gain and directive pattern. The effect of cavity back structure is investigated on four different models of monopole structure such as Discone antenna and slant structure for improving of the cross polarization. All these structures are modified for 8-12 or 10-12 GHz with VSWR less than 2 (more than 40%). At last a shielded antenna is presented to improve antenna radiation characteristic and gain despite of reduction in bandwidth it help to increase the gain of antenna more than 1.3 dBi at 9 GHz . The total sizes of antennas are 30mm×30mm×20mm, so it is compact than Horn antenna.**

***Keywords*— monopole, polarization, cavity back, X-band, shell , shield , Ku band**

I. INTRODUCTION

Because of wide bandwidth and economics advantages of UWB systems, they have been used in communication systems, medical imaging, radio communication and biomedical system such as brain struck and breast cancer detection system [1-3]. FCC (Federal Communication Commission) determined some laws and limitation for UWB systems such as frequency band of 3.1- 10.6 GHz for wireless communication or Spectral density of -41.3 dBm per MHz for UWB frequency band [4-5].Monopole antennas are known as a conventional UWB antenna with more than 120% bandwidth. Discone is celebrated type of monopole antenna with Omni directional pattern [6-7]. In last decade, difference model of monopole antenna have been presented for UWB application with some similar characteristics such wide bandwidth, linear polarization and Omni directional pattern with low gain. [2] Circular Disc Monopole (CDM) antenna is famous because of easy design calculation and fabrication for UWB application. Also in some studies have been tried to stabilize the radiation pattern of CDM antenna by changing in ground structure [8-9]. Another type is taper rectangular monopole antenna that has been studied for notch application with slot design and corner ground. It is used for directional application [10-11]. Dipole antenna with new balun and Radome is used for designing antenna with directional pattern in 7.4-10.5GHz. For achieving high gain, cavity back has been used in here to improve antenna gain and directivity [12]. Folded UWB Antenna is modified for Wireless Body Area Network (WBAN) and Specific Absorption Rate (SAR) for body tissue [13].Metal shields and cavity backs are known as conventional way for designing directional antenna or reduce F/B ratio in antenna and improve antenna efficiency [14-15] Metallic Stacked Fabry–Perot Cavity Antennas with FSS and other kind of metamaterial have been considered because of their quality for limiting or improving the wave propagation in some side of antenna. They are used to improve gain and reduce the F/B ratio [16-17]. Antennas with shield are noticed in many experimental research for reduce size or making high directivity antenna for GPR radar or other navigation and detection system with narrow band characteristic [18-20].

II. ANTENNA DESIGN

Mono pole antenna are known for them UWB characteristic and easy fabrication but these antenna has some weakness such as Omni-directional radiation pattern and low gain despite of weakness , these antennas has good impedance matching and low profile. In other hand shell and cavity back techniques is common way for achieve directive pattern so in here a combination of monopole antenna and shell is used for design UWB antenna at X-band with compact size and directive high gain pattern. Fig 1 shows four different models for prototype antenna. Obviously, antenna divided to two essential parts of radiator and spherical cavity by copper shell. The radiator is a monopole structure and it is connected to SMA 50 Ω feed line. The radius of ground is 15mm and total size of antenna is 30mm×30mm×20mm and these size are more compact than conventional pyramidal horn antenna . For this frequency range the horn antenna dimensions are 45 mm × 35 mm × 100 mm .So the prototype antenna has low profile and low weight than horn antenna . The first antenna is contained a V shape radiator with 5mm height. Discone height for second model is around 11.2 mm. In third and fourth model we used slant

KIET IJCE KIET International Journal of Communications &Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

radiator and the total height in both structures are 5mm. In all designed antenna the feed gap is 0.3m.

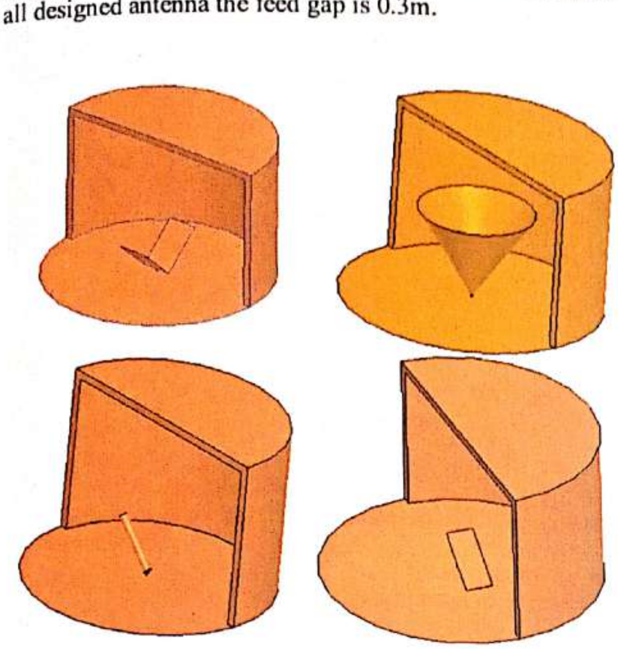
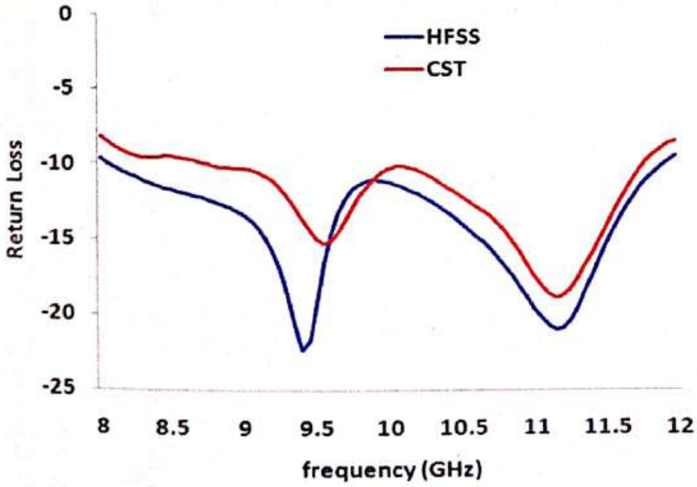


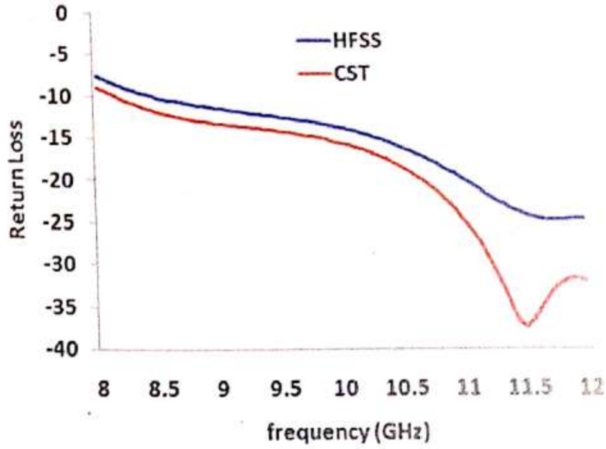
Fig.1 The prototype antenna

III. Simulation result

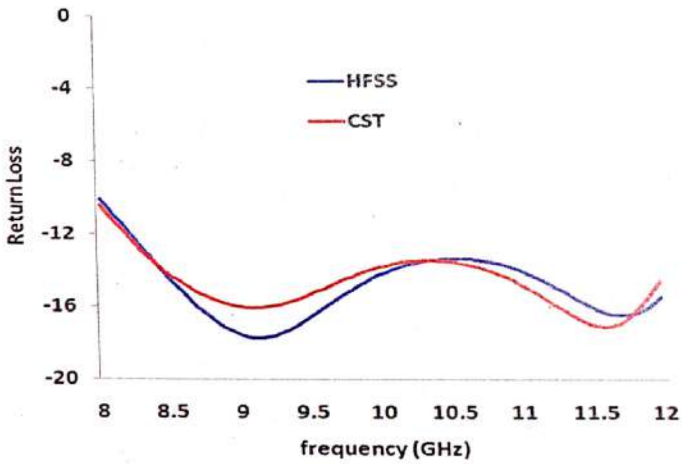
In this paper has been shown the simulation of all prototype antennas with HFSS 11 and CST microwave studio 2009 by different full wave method and the results have been compared together .The antenna parameters have been studied for X-band and Ku-band at 8-12 GHz . Fig.2 a, b, c, d shows the return loss comparison in HFSS and CST for first to fourth antenna, respectively. As presented in Fig 2, all antennas have wide impedance bandwidth in the range of 8-12 GHz which is important for radar application and satellite Ku-band communication for TV satellite communication. The antennas return loss are less than -10 dB at working frequency range.



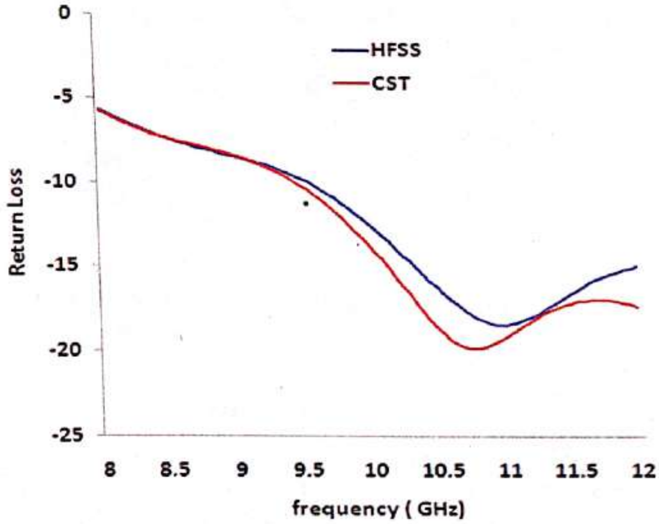
(a)



(b)

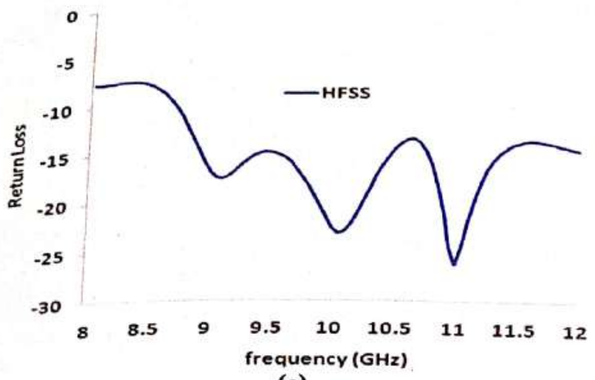


(c)



(d)

KIET IJCE KIET International Journal of Communications &Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

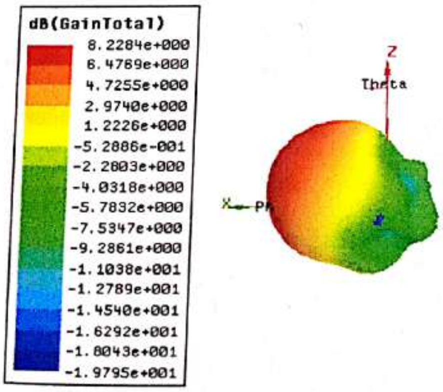


(e)

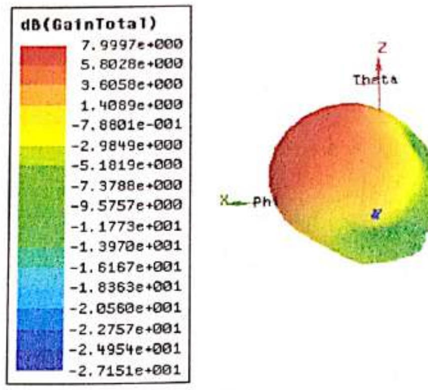
Fig.2 Antennas return loss in HFSS and CST a)V-shape radiator b)Discone radiator c)Slant wire structure d)slant Plane structure e) Pyramidal horn antenna

By comparison return loss of prototype antenna with conventional horn antenna ,despite of large scale of horn antenna , the horn antenna has limited bandwidth and matching design process is too dramatic . But in novel prototype antenna impedance match easy controllable by monopole structure. Fig 2.e shows the horn antenna return loss for this frequency range in HFSS simulator .

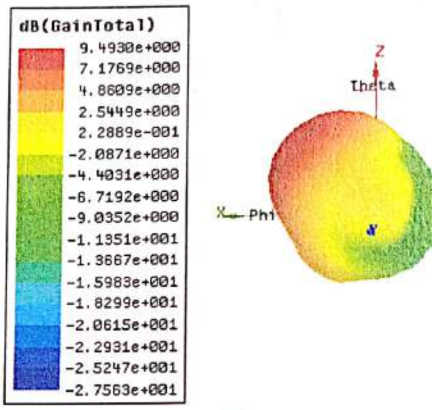
Fig 3 shows the pattern at 9, 10 and 11 GHz for first antenna (V-shape radiator). The antenna presented a directional characteristic at all frequencies and typically the gain for this structure is around 8-10dBi and antenna F/B ratio is more than 18 db .Antenna gain is around 8.22dBi for 9 GHs as shows in Fig 3.a and it is around 8 and 9.5dBi respectively for 10 and 11 GHz. All the prototype antennas have vertical polarization but slant structure in radiator is applied to improve the cross polarization. The pattern of horn antenna 10 GHz is presented in Fig. 3.d . With comparison between pattern , Obviously horn has more gain and better F/B ratio to prototype antenna so here shield is suggested to improve the prototype antenna radiation attribute ..



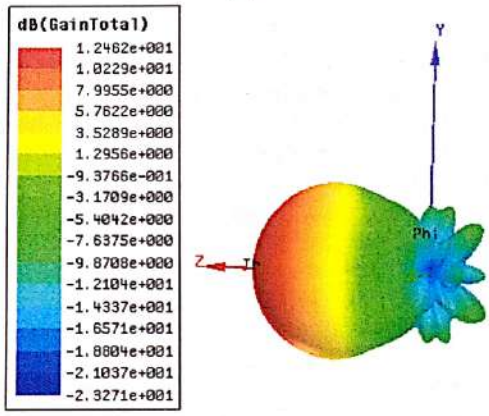
(a)



(b)



(c)



(d)

Fig. 3. Antennas gain for first model a) 9GHz b) 10 GHz c) 11 GHz d) horn antenna 9 GHz

IV. Metamaterial Shield

Metamaterial frequency selective surface (FSS) are known as periodic structure that usually are used in antenna for increase the gain . So in here a shield is added in front of antenna by using thin wire . Apparently, the shield fens will effect on antenna bandwidth and gain. Fig 4 shows prototype antenna with shield fens and the return loss is presented at Fig 5. As shows in Fig 5 the antenna bandwidth is reduced. The bandwidth is 8-9.5 GHz for return loss less than -10dB.

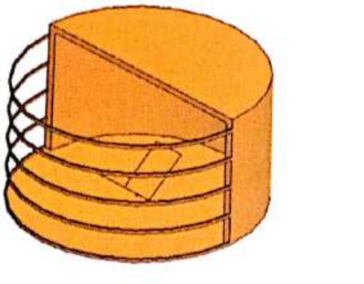


Fig. 4. Antenna with shield

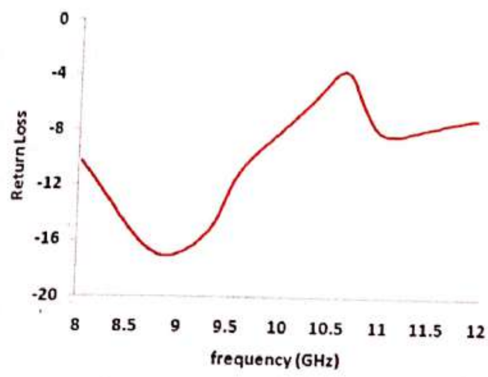


Fig. 5. Return loss of antenna with shield

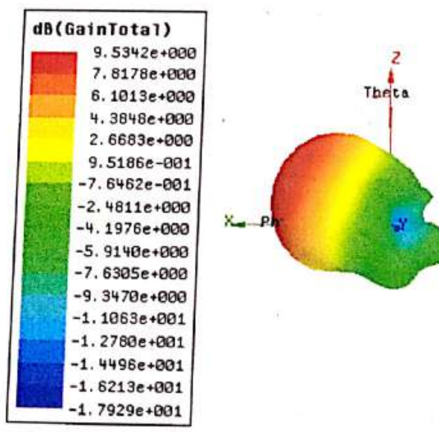


Fig. 6. The pattern of antenna with shield

Fig 6 shows the 3D pattern of antenna for antenna with shield at 9 GHz .The gain in antenna with shield is increased to 9.53dBi, so it shows more than 1.3dBi increment in comparison to conventional model. Fig 7 shows the comparison of cross polarization for Discone structure and slant form .The cross polarization has been increased to 3.17dBi at 10 GHz.

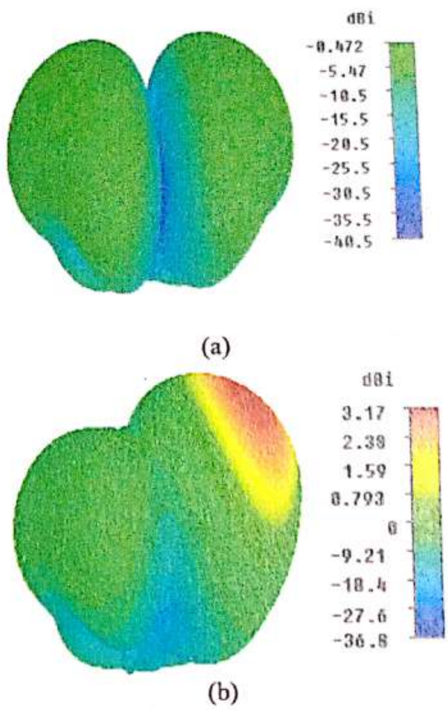


Fig. 7. The cross polarization for 10 GHz a) for Discone model b) for slant structure

V. Conclusion

In this paper, a novel compact antenna with UWB and high gain for X and Ku Bands application is presented. Here shows that with combination of monopole antenna with cavity back shell , we able to achieve high gain and directive radiation pattern . The prototype antenna has low profile and low weight than horn antenna and its shows more impedance matching and lower gain . So by using FSS shield we are tried to improve the antenna gain more than 1.3 dBi at 9 GHz. In other hand we shows difference model of radiator for our monopole antenna and cross polarization have been checked for slant and Discone model . So for high X-Pol application with easy change in monopole structure we able to achieve antenna with high cross polarization .

References

[1] J. Zhang , X. L. Sun, S. W. Cheung, T. I. Yuk, and Z. B. Ni. "CPW-coupled-fed elliptical monopole antenna for UWB applications." In Radio and Wireless Symposium (RWS), 2012 IEEE, pp. 295-298. IEEE, 2012

[2] Z. N.Chen, , M. J. Ammann, X. Qing, X. H. Wu, T. SP See, and A. Cat. "Planar antennas." Microwave Magazine, IEEE 7, no. 6: 63-73. 2006

[3] Abu Bakar, D. Ireland, A. M. Abbosh, and Y. Wang, "Experimental assessment of microwave diagnostic tool for ultra-wideband breast cancer detection," Progress In Electromagnetics Research M, Vol. 23, 109-121, 2012.
[4] D. Ghosh, , A. De, M. C. Taylor, T. K. Sarkar, M. C. Wicks, and E. L. Mokole. "Transmission and reception by ultra-wideband (UWB) antennas." Antennas and Propagation Magazine, IEEE 48, no. 5: 67-99, 2006.
[5] J.Powell, and A. Chandrakasan. "Differential and single ended elliptical antennas for 3.1-10.6 GHz ultra wideband communication." In Antennas and Propagation Society International Symposium, 2004. IEEE, vol. 3, pp. 2935-2938. IEEE, 2004.
[6] F.Keshmiri, , R. Chandra, and C. Craeye. "Design of a UWB antenna with stabilized radiation pattern." In Antennas and Propagation Society International Symposium, 2008. AP-S 2008. IEEE, pp. 1-4. IEEE, 2008.
[7] M.Dionigi, M. Mongiardo, and C. Tomassoni. "Investigation on the phase center of ultra wideband Discone antennas." In German Microwave Conference, 2010, pp. 59-62. IEEE, 2010.
[8] S. A.Hamzah, S. H. Dahlan, R. M. Talib, S. M. Shah, and A. Ubin. "Vertical UWB CDM antenna with integrated band notched filtering." In Applied Electromagnetics, 2007. APACE 2007. Asia-Pacific Conference on, pp. 1-4. IEEE, 2007.
[9] S. Ghosh, "Band-notched modified circular ring monopole antenna for ultrawideband applications." Antennas and Wireless Propagation Letters, IEEE 9: 276-279. 2010
[10] E.Antonino-Daviu, M. Fabres, M. Ferrando-Bataller, and V. M. Rodrigo Penarrocha. "Modal analysis and design of band-notched UWB planar monopole antennas." Antennas and Propagation, IEEE Transactions on 58, no. 5: 1457-1467. 2010
[11] M.A. Peyrot-Solis, G. M. Galvan-Tejada, and H. Jardon-Aguilar, "Proposal and development of two directional UWB monopole antennas," Progress In Electromagnetics Research C, Vol. 21, 129-141, 2011.
[12] M.Guo, and S.-S. Zhong. "Broadband wide beam width printed dipole antenna." In Antenna Technology (iWAT), 2012 IEEE International Workshop on, pp. 72-75. IEEE, 2012.
[13] C. H.Kang, S.J.Wu, and J..H. Tarng. "A novel folded UWB antenna for wireless body area network." Antennas and Propagation, IEEE Transactions on 60, no. 2: 1139-1142. 2012
[14] R. A.Alhalabi, , Y.C. Chiou, and G. M. Rebeiz. "Self-Shielded High-Efficiency Yagi-Uda Antennas for 60 GHz Communications." Antennas and Propagation, IEEE Transactions on 59, no. 3 : 742-750. 2011
[15] S.Yun, D. Kim, S. Nam "Bandwidth and efficiency enhancement of cavity backed slot antenna using a substrate removal," IEEE Antennas and Wireless Propagation Letters, Vol. 11, 1458-1461, 2012
[16] M.Padilla, , and J. Vardaxoglou. "Analysis of a metamaterial based leaky wave antenna with laterally shielded planar technology.": 287-287. 2007
[17] S. A. Muhammad, , R. Sauleau, and H. Legay. "Small-size shielded metallic stacked Fabry–Perot cavity antennas with large bandwidth for space applications." Antennas and Propagation, IEEE Transactions on 60, no. 2: 792-802. 2012
[18] W.Hong, and K. Sarabandi. "Platform embedded slot antenna backed by shielded parallel plate resonator." Antennas and Propagation, IEEE Transactions on 58, no. 9: 2850-2857. 2010
[19] C. H. E. N. Guo, and R. C. Liu. "Design of a shielded antenna system for ground penetrating radar applications." In Antennas and Propagation Society International Symposium, 2009. APSURSI'09. IEEE, pp. 1-4. IEEE, 2009.
[20] P. Y. Chen, and A. Alu. "Dual-Mode Miniaturized Elliptical Patch Antenna With μ-Negative Metamaterials." Antennas and Wireless Propagation Letters, IEEE 9: 351-354. 2010

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

Accelerometer Based Hand Motion Controlled Smart Wheelchair

Sandeep Kumar[1], P. Raja[2]
[1]OPJS University, Churu (RJ)
[2]BRCM College of Engineering and Technology. (HR)
[1] er.sandeepsahratia@gmail.com, [2] rajsella.visys@gmail.com

Abstract: **Wheelchairs are designed for disabled people, those are physically and mentally challenged Children's, youngsters and old people can use Wheelchairs. When a person is unable to walk or even when a person is disabled, malformed or paralyzed from the hips down or the legs, a wheelchair is generally used for their movement. This wheelchair was basically designed for walking especially for people with any of the above physical deformities. They can feel ease and more comfortable after using this wheelchair and it is indeed very helpful for them as they can move about freely. Recent developments are promises a wide scope of development in the field of smart wheelchairs. In this article presents a gesture based wheelchair which controls the wheelchair using hand movements. The system is divided into two main units, first one is MEMS Sensors unit and second one is wheelchair control unit.**

The MEMS sensors are connected to hand on wheel chair, which is 3-axis accelerometer can read the analog data of motion and ultrasonic sensor converts analog data into digital values and it gives in to the 8051 microcontroller.

Keyword- **Accelerometer, ADC, MUX, Microcontroller, LCD, GSM Modem, Mobile.**

I. INTRODUCTION

In today's time, an estimated there is 7,091,500,000 people [A] in the world (as of January 13, 2013). Approximately 1,000,000,000 people live in the 34 'developed countries'. The remaining 6,091,500,000 live in the 156 'developing countries'. There are approximately 340,500 births each day in the world. Approximately 153,000 people die each day in the world. Therefore the world population increases by 187,500 every day.

In the 34 developed countries it is estimated that 1% or 10,000,000 people require a wheelchair. In the 156 developing countries it is estimated that at least 2% or 121,800,000 people require a wheelchair. Overall, of the 7,091,500,000 people in the world, approximately 131,800,000 or 1.85% require a wheelchair means at least 100 million children, teens and adults worldwide need a wheelchair but cannot afford one. Some international organizations believe that the number could be as high as 6% of the population of developing countries. The number in Angola is 20% of population of 12 million people. Other "landmine" countries such as Afghanistan, Vietnam, Cambodia, Bosnia, Eritrea, Ethiopia, Sierra Leone and Mozambique have extremely high physical disability rates.

Traditional wheelchairs have some limitations in context to flexibility, bulkiness and limited functions. Our approach allows the users to use human gestures of movement like hands and synchronize them with the movement of the wheelchair so that they can use it with comfort. Some existing wheelchairs are fitted with pc for the gesture recognition. But making use of the pc along with the chair makes it bulkier and increases complexity. This complexity is reduced by making use of the accelerometer, the size of which is very compact and can be placed on the fingertip of the patients.

Other existing systems, which make use of the similar kind of sensors are wired, which again increases the complexity of the system. They also limit the long range communication. This complexity is removed by using GSM module.

A. Block Diagram

The system comprises of different main parts:

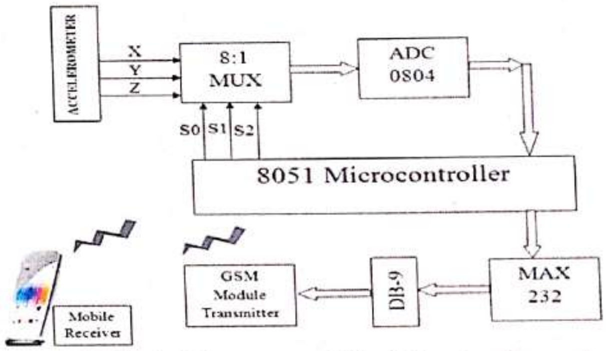


Figure 1: Block Diagramme of Tx & Rx Accelerometer

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

The different part of the wheelchair is Accelerometer, GSM Module and Mobile receiver. In Accelerometer reads the values of wheelchair motion and gives input to the ADC and ADC convert analog input into digital output is transmitted to the microcontroller and then transmitted by GSM Module to Mobile receiver. In Fig. 1 shows the block diagram of the Accelerometer. To control the movement of wheelchair by providing proper data to dc motor controller, this is connected to the wheelchair and it controlling the direction of dc motors.

II. GENERAL DESCRIPTION

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 *g*. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

The user can selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package (LFCSP_LQ).

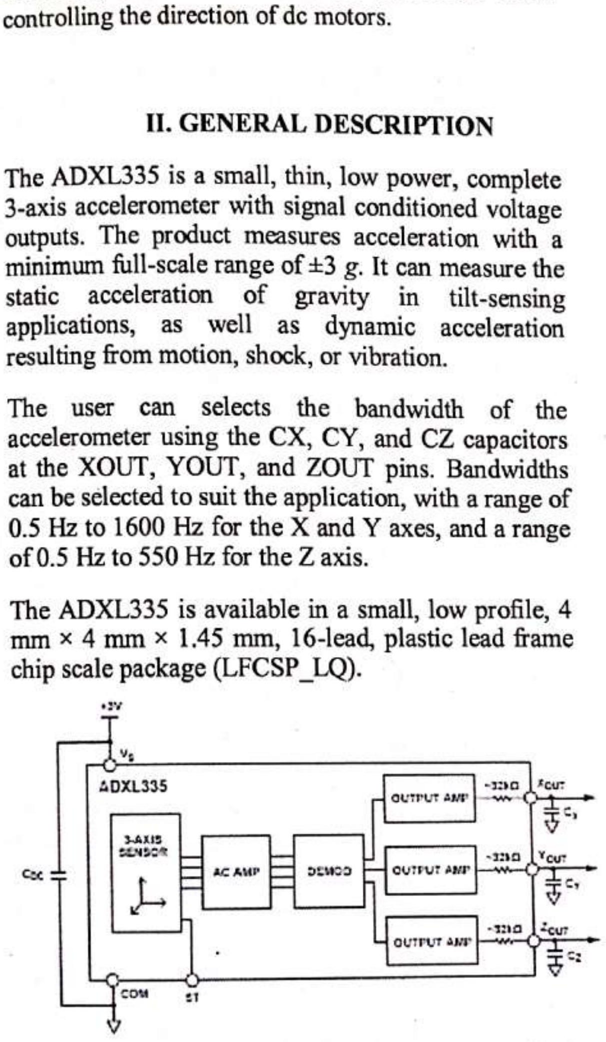


Figure 2: General Block Diagramme of Accelerometer

III. METHODOLOGY

The ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement range of ±3 *g* minimum. It restrains a polysilicon surface-micro machined sensor and signal conditioning circuitry to implement open-loop acceleration measurement architecture. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

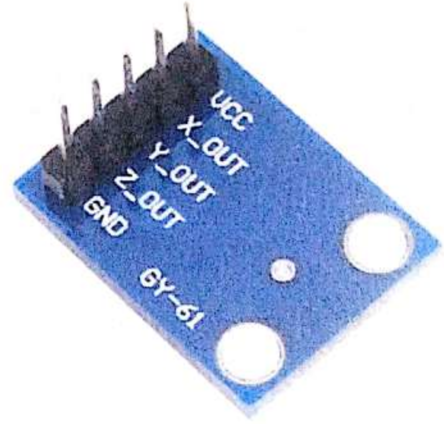


Figure 3: ADXL335 Accelerometer

The sensor is a polysilicon surface micro machined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces. Deflection of the structure is measured using a differential capacitor that consists of independent fixed plates and plates attached to the moving mass.

The fixed plates are driven by 180° out-of-phase square waves. Acceleration deflects the moving mass and unbalances the differential capacitor resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration.

The demodulator output is amplified and brought off-chip through a 32 kΩ resistor. The user then sets the signal bandwidth of the device by adding a capacitor. This filtering improves measurement resolution and helps prevent aliasing.

MECHANICAL SENSOR

The ADXL335 uses a single structure for sensing the X, Y, and Z axes. As a result, the three axes' sense directions are highly orthogonal and have little cross-axis sensitivity. Mechanical misalignment of the sensor die to the package is the chief source of cross-axis sensitivity. Mechanical misalignment can, of course, be calibrated out at the system level.

FEATURES

1. 3-axis sensing

2. Small, low profile package
3. 4 mm × 4 mm × 1.45 mm LFCSP
4. Low power : 350 μA (typical)
5. Single-supply operation: 1.8 V to 3.6 V
6. 10,000 *g* shock survival
7. Excellent temperature stability
8. BW adjustment with a single capacitor per axis
9. RoHS/WEEE lead-free compliant

APPLICATIONS

1. Cost sensitive, low power, motion- and tilt-sensing applications
2. Mobile devices
3. Gaming systems
4. Disk drive protection
5. Image stabilization
6. Sports and health devices

PERFORMANCE

Rather than using additional temperature compensation circuitry, innovative design techniques ensure that high performance is built in to the ADXL335. As a result, there is no quantization error or non monotonic behavior, and temperature hysteresis is very low (typically less than 3 mg over the −25°C to +70°C temperature range).

IV. WORKING

The proposed model is a wheelchair prototype built around eight bit microcontroller platforms. The microcontroller takes the input from acceleration sensor installed on the wheelchair covering all the directions and provides corresponding outputs that helps user to take decision and make judgments for the safe movement and control of the wheelchair. For movement control an analog joystick is to be installed on the wheelchair left arm-rest of wheelchair that will be responsible for the forward, backward and left-right movements of the wheelchair. The output of joystick is in nature of analog. So that signal will be converted to digital form by using an analog-to-digital converter before being feed as an input to the microcontroller for further processing. The microcontroller will get inputs continuously from the joystick and corresponding outputs will be controlling the wheelchair motors for movement of directions. The system will send alert signal to the concerned persons through SMS/call in case of an accident occur. The system will accept analog input from a 3-axis accelerometer; ADC will convert it into digital signal; microcontroller will process this digital signal to make decisions and finally the output values will be used to send alert through GSM modem accordingly. The whole electronic circuitry and the motors will be power assisted by a battery bank with a capacity of 4 ampere should be able to continuously supply a current of 1 ampere for exactly 1 hour.

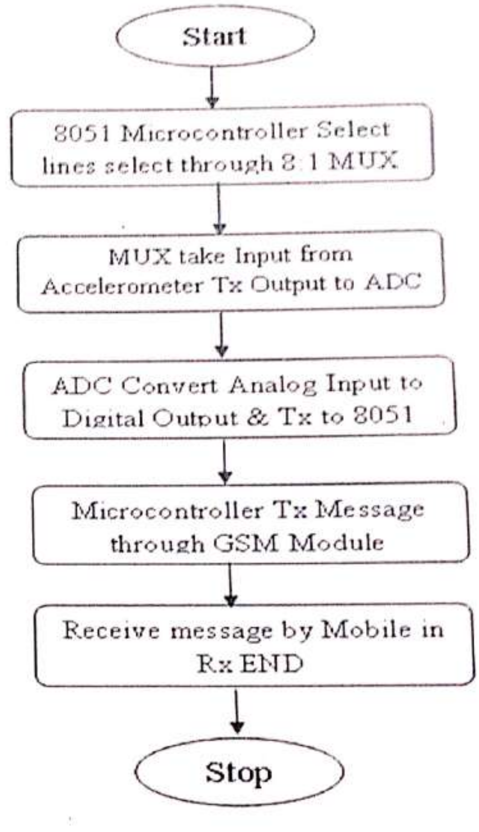


Figure: Flow Chart Accelerometer working

VI. CONCLUSION

In the race of man v/s machine, hand gesture controlled s/m comes as an example of companionship of man and machine. Taking the technology to the next level from speech recognitions and wired connections is the technology of wireless hand gesture controlled s/m,. Using a simple master I2C chip we can connect up to 128 chairs using a single remote. The applications of the same can be plenty. This s/m gives the user independence and a psychological advantage of being independent. To avoid physical deficiency to the user come the accelerometer to the rescue as with the slight twist of the finger the user gets the ability and freedom to turn the wheelchair into the desired direction. Of course some training is required to use the accelerometer wheelchair as its quite sensitive but in the end there could not be a better use of technology for an individual who is deprived of the same physical strength.

ACKNOWLEDGMENT

This research was supported/partially supported by OPJS University, Churu. I am thankful to my colleagues P.Raja who provided expertise that greatly assisted the research, although they may not agree with all of the interpretations provided in this paper. I am also grateful to Dr. Sajjan Singh for assistance with this technique and who moderated this paper and in that line improved the manuscript significantly.I have to express out appreciation to the P.Raja for sharing their pearls of wisdom with us during the course of this research.

REFERENCES

[1] Daisuke Chugo, Kenji Shiotani, Yuki Sakaida, Sho Yokota, Hiroshi Hashimoto ***"An Automatic Depressurization Assistance based on an Unconscious Body Motion of a Seated Patient on a Wheelchair "*** RIKEN-TRI Collaboration Center for Human-Interactive Robot Research (RTC) RIKEN (The Institute of Physical and Chemical Research) Nagoya, Aichi,Japan

[2] Dilok Puanhvuan, y odchanan W ongsawat ***"Semi-Automatic P300-Based Brain-Controlled Wheelchair "*** Proceedings of 2012 1CME International Conference on Complex Medical Engineering July I - 4, Kobe, Japan.

[3] Augie Widyotriatmo, Saqi Khudi Rauzanfiqr, Suprijanto ***"A Modified PID Algorithm for Dynamic Control of an Automatic Wheelchair"*** 2012 IEEE Conference on Control, Systems and Industrial Informatics (ICCSII) Bandung, Indonesia, September 23-26,2012.

[4] Chun-Rong Huang, Member, IEEE, Pau-Choo (Julia) Chung, Fellow, IEEE, Kuo-Wei Lin, and Sheng-Chieh Tseng ***"Wheelchair Detection Using Cascaded Decision Tree"*** IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE, VOL. 14, NO. 2, MARCH 2010.

[5] Octavian Postolache, Joaquim Mendes ***"Unobstrusive Heart Rate and Respiratory Rate Monitor Embedded on a Wheelchair"*** MeMeA 2009 - International Workshop on Medical Measurements and Applications Cetraro, Italy May 29-30, 2009.

[6] Anthony Remazeilles, Christophe Leroux, G´erard Chalubert, Laurent Delahoche, Bruno Marhic, Isabelle Laffont and Nicolas Biard ***"Automatic Grasping Task with a Catadioptric Sensor for Disabled People"*** 2008 10th Intl. Conf. on Control, Automation, Robotics and Vision Hanoi, Vietnam, 17–20 December 2008.

[7] Mohamed Fezari, Abd-Erahman Khati ***"New speech processor and Ultrasonic Sensors Based Embedded system to Improve the Control of a Motorised Wheelchair"*** Laboratory of Automatic and Signals Annaba University of Annaba, Faculty of Engineering,Algeria.

[8] Chandan Banerjee, Harish Gupta, Kumar Sushobhan ***"Low Cost Speech and Vision Based Wheel Chair For Physically Challenged"*** Electronics & Communication Engineering, Vellore Institute of Technology University, Vellore, India.

[9] Datasheet of ADXL335

[10] www.DEL-CORAZON.org

Review on Theory of Non Uniform waveguides

Reema Budhiraja[1], **Manish kumar**[2], **R C Jain**[3]

JIIT,Sector-62,Noida

[1]reema.budhiraja@jiit.ac.in, [2]manish.kumar@jiit.ac.in, [3]rc.jain@jiit.ac.in

Abstract— **Uniform waveguides are widely used in telecommunications systems both for ground and space applications. The theory of uniform waveguides is well-known but not all waveguides of a telecommunication system are uniform and so-called non-uniform waveguides are also encountered. This paper reviews various kinds of non uniformity observed in waveguides and different methods adopted by researchers for analysing these non-uniform waveguides have been discussed.**

Keywords— **Non-Uniform, Waveguides, Taper, Coupling Coefficient, Orthogonal**

I. Introduction

Non-uniform element is a gradual waveguide taper with a length which is longer than either of the dimensions of the waveguide cross section. The parameters of these waveguides are slowly changing functions of one of the coordinates. A bent waveguide with a radius of curvature larger than the cross section dimensions or a long tapering between two waveguides with different cross sections or a long waveguide twist comes under the category of non-uniform waveguides. These devices operate in a broad frequency band. Since the cross sections of these waveguides is essentially larger than the wavelength, so lot of various modes can propagate in gradual waveguide transitions. These waveguides are designed in such a way that the main part of the incident power is carried away by one specific wave while simultaneously the amplitudes of the other modes are maintained very small.

Any complicated waveguide non-uniformity can be considered as the superposition of several basic kinds of non-uniformity like: a bend, a variation of the filling medium, a variation of the wall impedance and a variation of the waveguide cross-section. A waveguide bent by a finite angle can be considered as the limit of a waveguide consisting of a lot of small tilts. Similarly, the properties of a continuously varying filling medium can be represented by the limit of a waveguide filled with a multilayered medium, and a variable cross section waveguide is the limit of a lot of small cross-section steps. Now different methods adopted by the researchers for analysing these non-uniform waveguides have been discussed.

II. METHOD OF FIELD CONTINUITY ADJUSTMENT

The method of field continuity adjustment is based on field expansion in to a sum of waves forming the electromagnetic field of the uniform and non-uniform waveguide and on the continuity requirements for the fields at the boundary which leads to linear algebraic coupled wave equations for the coefficients of these expansions. The application of this method is limited to simple non-uniform waveguide structures. In the works of Lewin (1955a and b), Piefke (1957) and Solymar (1959b) the reflection Coefficients of the wave were obtained by this method for rectangular waveguide broadening [1]. An equivalent method was employed by Mar' in to determine the coupling and reflection coefficients when a rectangular waveguide is broadened in the E-plane. Solymar (1958, 1959d) applied this method to circular waveguides for the determination of the coupling coefficient between the TE_{01} and TE_{02} modes [2] [3][4]. Also, Tanaka (1957) did the same for the calculation of the coupling and reflection coefficients in the general case of arbitrary wave incidence [5]. Jouget (1947a) also solved the problem of the interconnection of two rectangular waveguides, one being straight and the other being bent, by the method of field continuity adjustment. But this method is limited to simple non uniform waveguide structures.

III.CONFORMAL MAPPING

Conformal mapping was used by Krasnushkin (1945) for the analysis of planar waveguides [6]. By means of this method the complicated boundary of the non-uniform waveguide is transformed at the limit in to two straight parallel lines. After which the wave equation describing the field in the waveguide becomes more complicated and adopts a form equivalent to an inhomogeneous medium placed between two parallel lines. The parameters of this inhomogenity are related to the conformal mapping function .Rozhdestvenskiy and Chetayev(1951) used conformal mapping to solve the problem of matching transitions with dielectric filling [7]. Conformal mapping was also applied by Weinstein (1957) where the problem of a slow varying non-uniformity in a planar waveguide was solved by variational methods. Now conformal mapping can be used for the case of circular straight waveguides but it can not be employed for more complex problems like the simultaneous broadening of a rectangular waveguide in two planes, so for these cases special methods were used.

IV. MATCHED CO-ORDINATE SYSTEM

In this method a coordinate system was introduced where Maxwell's equations incorporate additional terms proportional to the curvature, in contrast to the Cartesian orthogonal system. These terms represent supplementary currents generated by the propagating wave. This method was used by Jouget (1947b) for circular waveguide, bent along a circumference with a large radius r.The publication by Lewin (1955b) also relates to this method, where the wave numbers of the eigen waves for twisted and curved rectangular waveguides are determined. Viktor ova and Sveshnikov (1958) also applied this method for a waveguide bent along a double curvature line and simultaneously having a slow variation of its cross section [8]. Pokrovskii, Ulinich and Savvinyk(1958) proposed a productive idea for the calculation of straight waveguides with variable cross section , based on the introduction of a special system of coordinates in their paper about planar waveguides [9]. Later on Discontinuous horn transitions between two waveguides, that means waveguides with their generatrices described by analytical functions having discontinuities in the first derivative, and problems relating to cut-off cross section waveguides were investigated using this method.

V. CROSS SECTION METHOD

In this method the electromagnetic field in a nonuniform waveguide is represented by means of a superposition of the mode fields corresponding to more simple waveguides. The coefficients of this superposition satisfy ordinary differential coupled wave equations and from the solution of these coupled wave equations the amplitudes of the waves scattered by the non uniform waveguide can be determined. Stevenson (1951a) discussed straight waveguides with variable cross section in which the electromagnetic field was expressed through six functions, each of which was expanded in terms of eigenfuctions of TE and TM modes corresponding to the constant cross-section uniform waveguide [10]. Now to obtain the coefficients of these expansions, second order differential coupled wave equations were derived. But the mathematical apparatus obtained from this procedure is very large and complicated and the only attempt to apply it to practical problems for the determination of the field scattered on a nonuniform waveguide section was done by Leonard and yen (1957) [11].In this work they calculated the reflection coefficients for several waves at the connection of a straight circular waveguide with a cone and moreover the reflections from the broadening of a rectangular waveguide. The formulae obtained for the rectangular waveguide are still valid, but for the case of circular waveguides they are wrong

The cross section method is proposed again by Schelkunoff (1955) and it is illustrated by several examples of broadening planar waveguides and also by waveguides bent along a circumference arc [12]. The work published by Heyn (1955) also presents the expansion of the wave fields of a constant cross-section bent waveguide through straight waveguide fields. In both papers, first order differential equations were established for the determination of the expansion coefficients, but these equations remain unsolved and the expressions for the scattered wave amplitudes were not presented.

Unger then in (1958a) applies the mathematical apparatus proposed by Schelkunoff to the practical problem of the incidence of a TE01 wave into a symmetrical transition between two circular waveguides [13]. The amplitudes of the waves propagating in both directions are used as variables instead of the coefficients of the field Fourier expansion as it was done in Schelkunoff (1955) and Heyn (1955) and therefore the expressions for the amplitudes of the TE_{0n} waves scattered forwards have been obtained.

Reiter (1959) independently from Schelkunoff but employing approximately the same method, studied variable cross section straight waveguides [14]. His results were applied later to the calculation of practical cases in Solymar (1959a) in a more comfortable form. The paper of Lyubarski and Povzner (1957) were also viewed as another version of the cross section method [15].

Variable cross–section straight waveguides were also considered in the papers of Gutman (1957, 1958, 1959a, 1959b). Their originality, compared with Schelkunoff (1955b) and Reiter(1959) and to the further works based on these publications , consists in the introduction of a special system of coordinates as well as in another method to deduce the differential equations. The paper published by Emelin(1958) generalizes this method to the case of simultaneously varying shape of the cross section and the direction of the axis [16].

VI. CONCLUSION

Electronic devices generating high power millimeter waves produce electromagnetic fields with a very complex structure.

It is necessary to launch this power with minimal losses and with a specific field structure. This makes the use of nonuniform waveguides compulsive. Depending upon the type of nonuniformity, appropriate method is applied for its analysis.

REFERENCES

[1] Lewin ,L.(1955b): "Propagation in curved and twisted waveguides of rectangular cross-section", Proc. IEE,102B.p.75
[2] Solymar,L.(1958): 'Design of a conical taper in circular waveguide system supporting H01 mode'.Proc. IRE,46,(3),pp.618-619
[3] Solymar,L.(1959b): 'Mode conversion in pyramidal tapered waveguides' , IRE Trans.Microw,theory Tech., MTT-7, pp.379-383
[4] Solymar,L.(1959d): 'Monotonic multisection tapers for overmoded circular waveguides',Proc.IEE,106B,suppl.(13),pp.121-128
[5] Tanaka, K. (1957): 'Mode conversion through the tapered section of circular waveguide system'. Proceedings of international conference on ultra high frequency circuits and antennas,Paris,October
[6] Krasnushkin,P.E.(1945): 'The waves in curved tubes'(Scientific Reports of Moscow State University).75-Phys.,book2,partII,p.9
[7] Rozhdestvenskiy,B.L.,And Chetayev,D.N.(1951): ' On the problem of reflection diminishing in a varying cross-section waveguide', Dokl. AN USSR,79,(3)
[8] Viktorova,S.L.,and Sveshnikov,A.G.(1958): 'Conversion of H01 mode in a space bent waveguide of circular cross-section',(Scientific reports of the highest school),Physical mathematical sciences,(2),p.133
[9] Pokrovskii,V.L.,Ulinich,F.R.,and Savvinykh,S.K.(1959b): 'The theory of tapered waveguides'.Radio Eng.Electron.,4,(2),pp.10-23
[10] Stevenson,A.(1951a):'General Theory of electromagnetic horns' ,J.Appl.phys.,22,pp.1447-1454
[11] Leonard,D., and YEN,L.(1957): 'Junction of smooth flared waveguides',J.Appl.Phys.,28,p.1441
[12] Schelkunoff,S.A.(1955): 'Conversion of Maxwell's equations into generalized telegraphist's equations'. Bell Syst.tech.j.,34,pp.995-1043
[13] Unger,H.G.(1958b): 'Circular waveguide taper of improved design',Bell Syst.tech.J.,37,pp.899-912
[14] Reiter,G.(1959): 'Generalized telegraphist's equation for waveguides of varying cross-section',Proc.IEE,106B,suppl.(13),pp.54-57
[15] Lyudbarski, G.YA., and POVZNER, A.YA. (1957): 'On the theory of wave propagation in variable cross section waveguides',Sov.phys.-tech.phys.,4,(2),pp.146-154
[16] Emelin,B.F.(Yemelin)(1958): 'Waveguide equations for an irregular waveguide',Radio eng.Electron.,3,(5),pp.40-57

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

A Novel UWBModified Hexagonal Microstrip Antenna With Improved Gain

Sayed Arif Ali[1], DeepakJhanwar[2], Dhirendra Mathur[3]
[1, 2] Electronics and Communication Engineering Department
Government Engineering College, Ajmer, India
[1]find_arif@rediffmail.com
[2]deepakjhanwar2001@gmail.com
[3]Centre of Nanotechnology
Rajasthan Technical University , Kota, India
[3]dhirendramathur@gmail.com

***Abstract*—In this papera Novel UWB modified Hexagonal microstrip antenna with curved partial ground plane (HMSA-CG) is proposed. The hexagonal patch is a flower like structure. This paper investigates performance improvement of the patch antenna in terms of Gain and Group delay. Simulation results are obtained using Ansoft HFSS. Design issimulated on Rogers RT Duroid 6002 substrate.The Modified Hexagonal MSA shows improved average gain characteristics of3.6 dB(maximum gain varies from 1.9 dB to 5.4 dB in UWB), almost flat Group delay and impedance bandwidth from 3-11.3 GHz. Radiation pattern observed is Omnidirectional.**

***Keywords*—UWB(Ultra Wide Band); Gain;Group Delay;Hexagonal Microstrip Patch Antenna with Curved Ground Plane (HMSA-CG).**

I .INTRODUCTION

In 2002, for the use of indoor and hand-held systems, the Federal Communication Commission (FCC) released ultra-wide band (UWB) from 3.1-10.6 GHz. Enormous research is going on UWB antennas in both academia and industry for applications in wireless transmission systems. Very low power pulses, below the transmission noise threshold are emitted by an UWB system[1].

The UWB antenna should be compact, planar and low cost. Integration of antenna with electronic PCB circuits should also be feasible[2].

Not only return loss, radiation patterns and gain, for short-range high- speed low power UWB communication, it is important to evaluate waveform distortions also[3].

In 2008 HadiBadjian and Chakrabarty reported a UWB patch antenna design on FR-4 substrate operating in frequency band of 1.78 – 6.59 GHz. This antenna consists of a rectangular patch with one step and partial ground plane [4]. In same year, Lim, Nagalingamand Tan presented a compact design of microstrip UWB antenna operating between 4.1 GHz to 10 GHz. The antenna parameters are demonstrated in frequencyand time domain as well[5]. A planar Ultra-wideband Monopole Antenna with WLAN notch is designed by Wang, Li and Quan [6]. In this, radiating element is a hexagon and UWB is achieved by implementing partially modified ground plane. Rejection characteristics is obtained by etching an arc slot.

In 2010, Azim, Mobashsher, Tariqul Islamand Norbahiah designed a square shaped planar antenna having partial ground plane with a slot, operating in 2.95 to 15.44 GHz [7]. Ping, Chakrabarty and Amir Khanhave designed an Impulse-Ultra Wideband (I-UWB) slotted rectangular patch antenna with partial ground plane operating in 3.34 GHz to 20 GHz [8]. A pentagon shaped CPW feed monopole antenna on foam substratewas proposed by Robert A. Moody and Satish K. Sharmain [9]. They studied the effect of rectangular slots in both the ground plane and the planar monopole on gain and radiation pattern of the antenna.

In 2011, an UWB printed slot antenna was presented by M. Kumar, A. Basu, and S. K. Koul[3].The antenna covers band of 3.1 to 10.6 GHz on a piece of dielectric substrate of size 30.4mm × 35.4 mmwith improved performance in time and frequency domain. Mandal and Dashave reported a UWB printed regular hexagonal monopole antenna fed by a microstrip line [10].In this design an inverted U-shape slot is etched in patch which createda notch band at the wireless local

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

shown. It is easily observed that the radiation pattern is Omni directional.

B. Discussion & Comparison

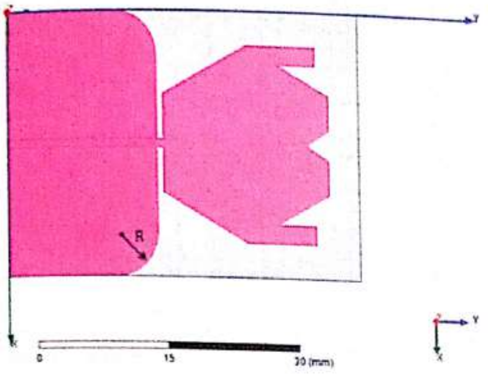


Fig. 3. Top view of HMSA-CG

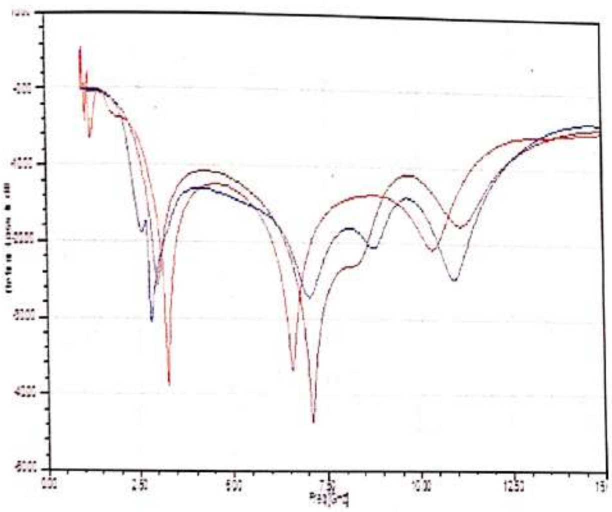


Fig. 4.Comparison of Return Loss of HMSA-PG (red), HMSA-FS (blue) and HMSA-CG (brown)

Table I shows the comparison of the two proposed antennas. Both antennas are UWB in nature and omni-directional but the average gain and group delay is better in HMSA-CG. At upper region of UWB, gain improved due to curved ground. Average gain is calculated for UWB range i.e. 3.1-10.6 GHz. Although gain obtained is low but a low gain is of little concern in UWBsystems, where power may actually be intentionally reduced to noise levels. More important is flat Gain and group delay [3] and we have achieved this goal to some extent in this paper.

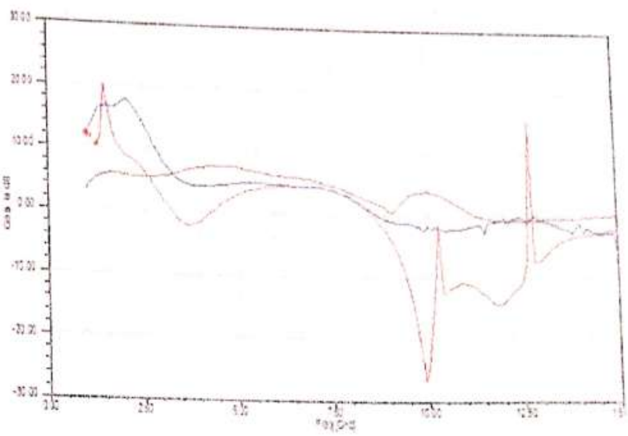


Fig.5.Gain Vs Frequency Curve of HMSA-PG (Red), HMSA-FS (Blue) and HMSA-CG (brown)

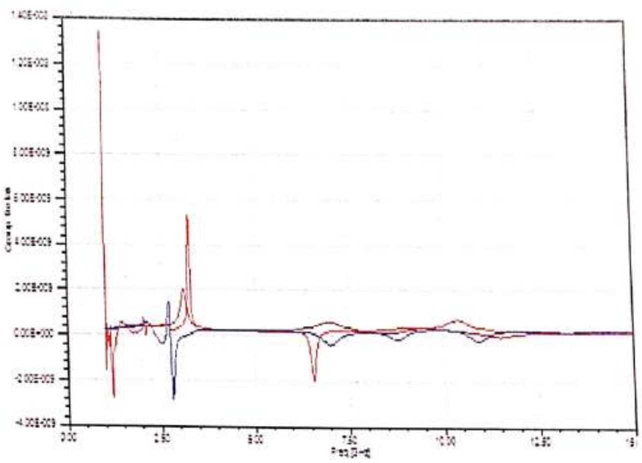


Fig.6.Group Delay of HMSA-PG (Red), HMSA-FS (Blue) and HMSA-CG (brown)

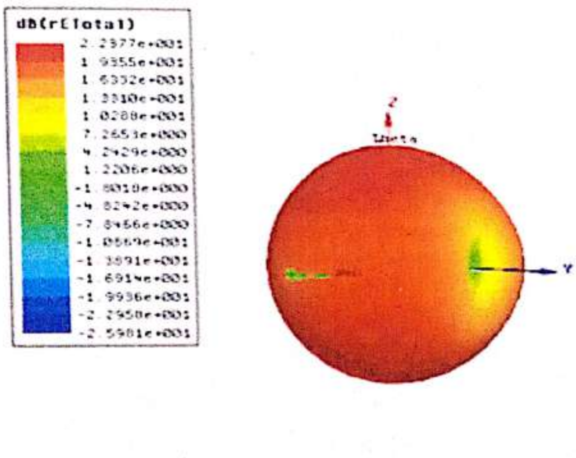


Fig. 7: 3D Radiation pattern of HMSA-CG

Table I: Comparative Analysis

Antenna Parameters	Comparison of Antennas	
	HMSA-CG	*Modified HMSA-FS[11]*
Bandwidth	3- 11.3 GHz (8.3 GHz)	2.28-12.28 GHz (10 GHz)
Average Gain	3.6 dB	3.3 dB
Group Delay	Almost constant	Almost constant

IV. CONCLUSION

The modified hexagonal microstrip antenna with curved partial ground has been proposed for UWB communication systems. It has been demonstrated bysimulated results that the gain and group delay of this antenna isbetter and stable than the previousdesigned HMSA-FS. Further a stop band at approximately 5 GHz to 6 GHz frequency range can be implemented to avoid interference from WLAN or HYPERLAN bands.

REFERENCES

[1] FCC, First Report and Order 02-48 February 2002.

[2] G. Brzezina, Q. Ye, L. Roy, "Development of a practical ultra-wideband antenna with planar circuit integration possibilities",in IEEE Antenna and Propogation Soc. Int. Symp. 2005, 3-8 July 2005, pp. 504-507.

[3] M. Kumar, A. Basu, S. K. Koul, "UWB printed slot antenna with improve performance in time and frequency domain",in Progress in Electromagnetics Research C, Vol. 18, pp. 197-210, 2011.

[4] Mohammad HadiBadjian, Chandan Kumar Chakrabarty, "Circuit modelling of an UWB patch antenna", IEEE International RF and Microwave conference Proceeding, December 2-4, 2008, Kuala Lumpur, Malaysia.

[5] K.-S. Lim, M. Nagalingam, C.-P. Tan, "Design and construction of microstrip UWB antenna with time domain", Progress In Electromagnetics Research M, Vol. 3, 153–164, 2008.

[6] Dong Li, ShaohuiQuan, Zhengpeng Wang, "Design of a planar Ultra-wideband monopole antenna with WLAN band-notched characteristic", APMC 2008, 16-20 Dec. 2008 , pp. 1-4.

[7] RezaulAzim, Ahmed ToabaMobashsher, Mohammad TariqulIslam, Norbahiah Misran "Compact planar antenna for UWB applications" in ICMMT 2010 Proceedings.

[8] Lee Chia Ping, Chandan Kumar Chakrabarty, Rozanah Amir Khan, "Enhanced bandwidth of impulse-ultra wideband (I-UWB) slotted rectangular patch antenna with partial ground plane", IJECCT 2010, Vol. 1 (1).

[9] Robert A. Moody and Satish K. Sharma, "Investigations on coplanar waveguide fed pentagon shape planar monopole UWB antenna on foam substrate providing invariant radiation patterns" Antennas and Propagation Society International Symposium 2010, 11-17 July 2010, pp. 1-4.

[10] Mandal T., Das S., "UWB printed hexagonal monopole antennas with WLAN band rejection", IEEE Conference, December 18-22, 2011, Kolkata, India. Page(s):1-4, Print ISBN: 978-1-4577-1456-6.

[11] S. Arif Ali, D. Mathur, "A Novel UWB modified Hexagonal Microstrip Antenna", ICIET Conference Proceeding, September 26-27, 2014, ACEIT, Kukas, Jaipur, India. Page(s):27-29, Print ISBN: 978-81-925882-3-0.

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

Review on Energy Efficient Using Clustering Algorithm for Wireless Sensor Networks

Sudhir B. Lande[1], Sushil Z. Kawale[2]
Kavikulguru Institute of Technology & Science, Ramtek, India
[1]landeecd@yahoo.co.in , [2]sushilkawalepauni@gmail.com

***Abstract*–The area of wireless sensor networks (WSNs) is one of the emerging and fast growing fields in the scientific world. This has brought about developing low cost, low-power and multi-function sensor nodes. However, the major fact that sensor nodes run out of energy quickly has been an issue and many energy efficient routing protocols have been proposed to solve this problem and preserve the long life of the network. WSN consisting of a large number of sensor nodes is effective for gathering data in a variety of environments. Since the sensors operate on battery of limited power, it is a challenging task to design an efficient routing scheme which can minimize the delay while offering high energy efficiency and long network lifetime. Achieving both energy efficiency and scalability at the same time is a challenging task in wireless sensor networks. This is very crucial to ensure that the system operates at minimum energy with increasing scalability and network life-time.**

***Keywords:*–Wireless sensor networks (WSNs), energy efficiency, network lifetime, scalability, clustering algorithm, hierarchy.**

I. INTRODUCTION

In these days, wireless sensor network emerging as a promising and interesting area. Homogeneous and Heterogeneous nodes are used in wireless sensor network where a wireless medium is used by the nodes to communicate with each other. A hundred to thousands of nodes can be deployed in the sensing region to sense the environment. These nodes work cooperatively and send information to the sink. Figure 1 shows the basic architecture of WSN. Wireless sensor network can be categorized into two types first Unstructured WSN- The nodes are densely deployed and also the nodes can be deployed in ad-hoc manner in the sensing area or region. Second is Structured WSN – Sensor node developments of some or all nodes are preplanned. The nodes placement is also planned. So, the maintenance of structured WSN is much easy as compare to Unstructured WSN [1].

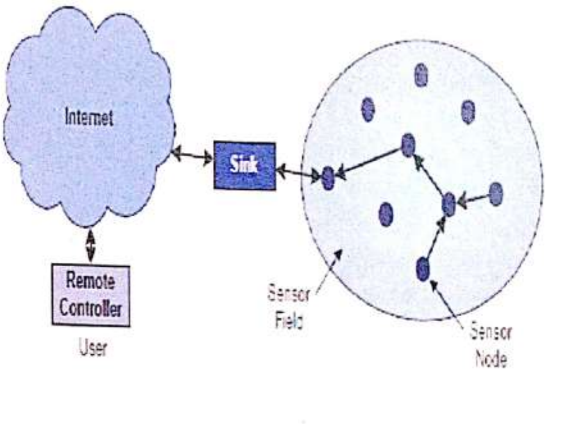


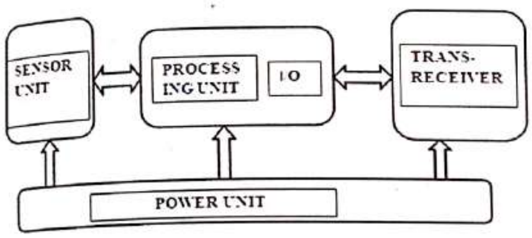
Figure1. Basic architecture of wireless sensor networks [2]

Sensor nodes work cooperatively to monitor environment conditions such as temperature, sound, vehicular movement, pressure and pollutants. The sensor nodes are deployed in the sensing area through wireless links which provide opportunities for many civilian and military applications, for example intrusion detection, battlefield monitoring and availability of equipments, environment observation and home intelligence.

Basically a sensor node is made by four components a sensing unit, a processing unit, a communication unit, a power unit. Figure 2 shows the sensor node. A sensing unit is made up of one or many sensors and analog to digital convertor. Where the sensor nodes sense the physical phenomenon and generate the analog signal. Than the ADC convert these analog signal in digital signals which are sensed by the sensors. After the conversion of the signals they are fed into processing unit. The processing unit has limited memory (storage) and processor (microprocessor) provides full control

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

to sensor nodes. A communication unit use radio for data transmission bandwidth nodes. The most important component or unit of a sensor node is power unit which supply power to the nodes. There can be more components or units can be added to the sensor node, depending on different applications.



Figure

Figure2. wireless sensor node

In some specific application where we need the location information, there we use global positioning system (GPS) in

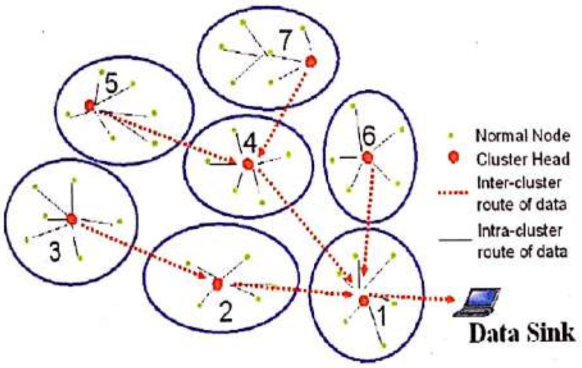


Figure 3. Clustering process in WSN[2]

II. ENERGY EFFICIENCY IN ROUTING

More research works have already been done in routing in WSN, since energy efficiency is more important for wireless sensor networks than any other networks. In wireless communication, data transmission consumes more power than data processing. The battery power of the node will be reduced whenever they transmit more number of data proportionately. In order to reduce the data size we can prefer techniques like data fusion or aggregation. Data fusion is that in which the sensed data are fused at certain point for transmitting data at reduced size. There are two types of aggregation in which the first type of data aggregation will data gathered from different sources will be fused and sent in reduced size. But the problem is, it lacks in precision and accuracy of data from various sensor nodes. In the second method both the data

nodes. Some specific applications need to move the sensor nodes, than the motor can be used as a component or unit in a node. These units should be small so that power consumption will be less. The sensor nodes are grouped called clustering. When the sink is far away from the sensing region then the local aggregation is much better than direct communication. Thus clustering works efficiently in those conditions or environments which aggregates the nodes into clusters. There is only a one cluster head for a cluster. Cluster heads can be chosen by sink or members of the clusters. Cluster heads serve as relays for transmitting the data to the sink. The cluster head of the cluster have the same transmission capacity as the sensor nodes. Data aggregation at cluster head reduces the number of data transmission to the sink and improves energy efficiency and lifetime of the network. Figure 3 shows basic clustering process in wsn.

under the single header are combined together and forwarded to the base station. Here header packets consolidates and pass it to the base station without any modification to the original data from the sensors. Thus accuracy can be improved.[3]

In order to prolong the lifetime of the WSN, designing efficient routing protocols is critical. It has been established that most of the energy consumption in a WSN comes from data reception and transmission. A good routing protocol therefore can reduce the number and size of unnecessary transmissions that take place, thus helping alleviate the energy crisis in WSNs. Hierarchical routing algorithms are techniques with special advantages related to scalability and efficient communication. The main aim of hierarchical routing is to optimize energy consumption of sensor nodes by arranging the nodes into clusters. Data aggregation and fusion is performed within the cluster in order to decrease the number of transmitted messages.

III. ENERGY EFFICIENT HIERARCHICAL ROUTING

Among the issues in WSN the consumption of energy is one of the most important issues. Regarding energy efficiency Hierarchical routing protocols are found to be the best. By the use of a clustering technique they minimize the consumption of energy greatly in collecting and disseminating data. Hierarchical routing protocols minimize energy consumption by dividing nodes into clusters. In each cluster, a node with more processing power is selected as a cluster head, which aggregates the data sent by the low-powered sensor nodes.[4]

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

The primary motive of hierarchical routing is to maintain the consumption of energy by sensor nodes as an efficient one through multi-hop communication that too in a particular cluster, by doing fusion and data aggregation to decrease the number of transmitted messages to the sink. Formation of cluster is mainly based on the sensors energy reserve and proximity to the cluster head.[5]

The set of aspects that are used to differentiate all lustering based protocols are discussed below

A. Clustering Method

The three approaches are used for clustering process are centralized, distributed and hybrid. In centralized clustering, the clusters and cluster heads are made by an authority (centralized authority). In distributed clustering, all the nodes in the clusters can took the decision of becoming cluster head for the current round. Hybrid clustering is the mixture of both of above.

B. Cluster Properties

In clustering process, following properties are used in the structure of the cluster.

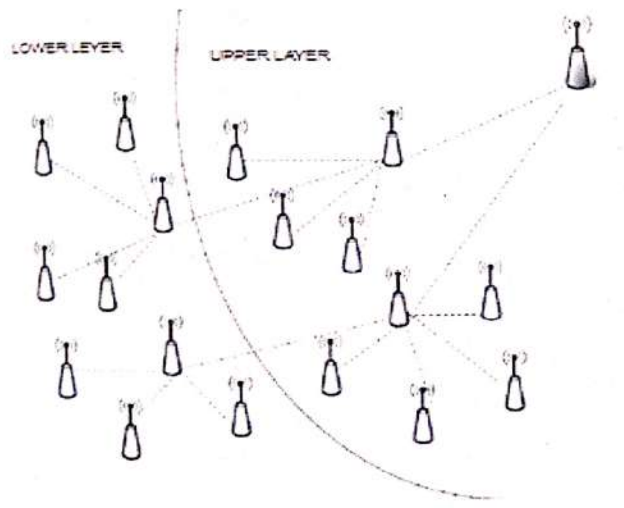


Figure 4. Hierachical routing scheme[2]

1) Cluster Count: Cluster heads can be pre assigned for fixed clusters or cluster heads can be elected by its cluster members for variable number of clusters. Cluster count can be defined as number of clusters formed in a round. Small size cluster distribution can be better to conserve energy in wireless sensor network.

2) Cluster Size: Cluster size is the maximum distance between the sensor (member) nodes and cluster head. Cluster size can be fixed for fixed clusters or it can be variable for each cluster. Large sized clusters are not good in term of energy consumption because it maximizes transmission distance.

3) Cluster density: Cluster density is proportion of number of cluster member in cluster and cluster area. In fixed clustering approach, there is density of cluster where as in dynamic clustering the cluster density is variable. So it is a big challenge to conserve energy of cluster heads in dense clusters.

4) Message count: The number of message transmissions is required for a cluster head selection is called as message count. The cluster heads are chosen using message transmission in many non probabilistic algorithms. If message transmission number is more for a cluster head than the energy consumption also increases.

5) Stability: During the clustering process if cluster counts are not varied than it is called fixed. But if the cluster counts varied during clustering process than that is called as adaptive. Fixed cluster count gives more stability to the WSN's.

6) Intra-cluster Topology: The communication between the cluster head and the sensor (member) nodes can be direct or multi-hop. This depends upon the sensor node's range of transmission. If the communication range of sensor node is very high than the node can direct communicate with cluster head (CH). But if the transmissions range of the node is low than the node can communicate with CH using multi-hop.

7) Inter-cluster head connectivity: The procedure indicates the communication between the CH and the base station (BS). CH has some range or capability to connect to the BS. But if CH have not that capability than clustering scheme has to ensure some intermediate provision of routing to base station.

C. Cluster-head Capabilities

The capabilities of cluster heads during clustering process play very important role. The capabilities of CH's can influence the clustering process in terms of stability and life time of sensor network. Following are some aspects for differentiating the clustering process.

1) Node Type: Some nodes are pre chosen as cluster heads at the time of sensor nodes deployment for that round only depends upon their energy and computation resources.

2) Mobility: Mobile CH can be used for balancing the cluster which gives the better network performance. Mobility

KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

of CH's in the network cane assigned on the basis of objectives defined in clustering scheme. If there is any need in the network than mobile cluster heads can be re-locatable easily.

3) Role: The role of CH's in the network is to collect the information from sensor nodes, aggregate that information and send to the base station.

D. Cluster-head Selection

Cluster heads can be pre assigned or chosen randomly from deployed sensor network. Following are the two ways to select the cluster head.

1) Probability Based CH Selection: In probability based clustering algorithm, each sensor node in the network uses pre assigned probability to determine the initial cluster heads. Probability can be the maximum energy of the sensor nodes.

2) Non Probability Based CH Selection: In non probability based clustering algorithm, the cluster heads selection is based on sensor nodes proximity, connectivity and degree.

IV. DIFFERENT CLUSTERING ALGORITHM IN WSN

A. LEACH

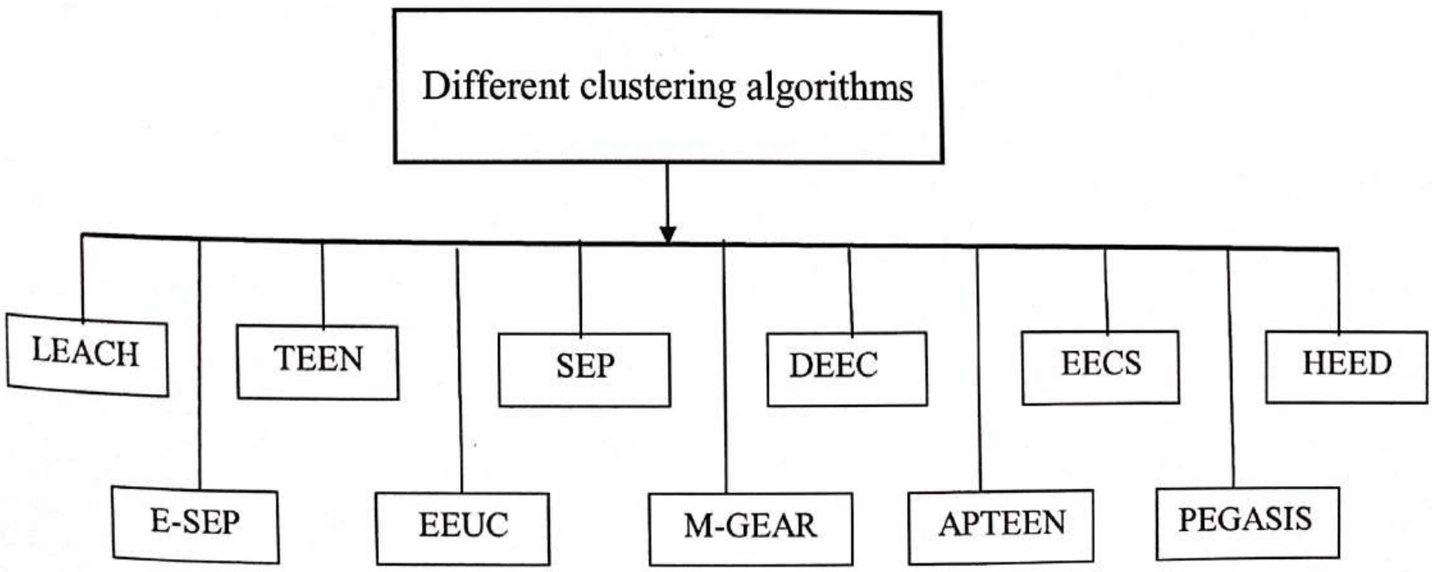
W. R. Heinzelman, A. P. Chandrakasan and H. Balakrishnan [9] proposed Low Energy Adaptive Clustering Hierarchy (LEACH) protocol in 2000. It is one of the most popular hierarchical routing algorithms for sensor networks. The idea is to form clusters of the sensor nodes based on the received strength of the signal and use local cluster heads as routers to the BS. This will save energy since the transmissions will only be done by such cluster heads rather than all sensor nodes. Optimal number of cluster heads is estimated to be 10 percent of the total number of nodes. All the data processing such as data fusion and aggregation are local to the cluster

Cluster heads change randomly over time in order to balance the energy dissipation of nodes. This decision is made by the node choosing a random number between 0 and 1. The node becomes a cluster head for the current round if the number is less than the following threshold

$$T(n) = \frac{p}{1-p*\left(\frac{1}{p}\right)},\ n \in G$$

$$= 0 \qquad ;\ \text{Otherwise} \qquad (1)$$

Where p is the desired percentage of cluster heads (e.g. 0.1), r is the current round and G is the set of nodes that have not been cluster heads in the last 1/p rounds. However the limitations of Leach protocol are that it uses single-hop routing within cluster and thus not applicable to networks deployed in large regions, dynamic clustering brings extra overhead, assumes all nodes can transmit with enough power to reach BS, if necessary (e.g., elected as CHs), Each node should support both TDMA and CDMA, failure of cluster head is a problem and cluster head selection is a difficult problem to optimize. However LEACH is only effective for homogeneous network as it sets same probability of becoming cluster head to all sensor nodes.



Consequently, a number of enhancements to the conventional LEACH routing protocol have been proposed and is summarized. In Centralized LEACH (LEACH-C) [10] location of the nodes is sent to the BS, which then selects CHs for each round. No. of CHs is fixed to a predetermined value. The BS utilizes global knowledge of the network to produce better clusters that require less energy for data transmission.Balanced-LEACH protocol (LEACH-B) [11] a adaptive strategy is designed whereby each node chooses its CH evaluating the energy dissipated in the complete path between itself and the final receiver, passing by the CH. It performs well when the final receiver is closer to the sensors. In Two-Level LEACH (TL-LEACH) [12] two level hierarchy of CHs are formed. The secondary CH collects data from the cluster members and relays the data to the base station through a primary CH that lies between it and the BS. Here better distribution of the energy load among the sensors in dense networks. In Multi-hop low energy adaptive clustering hierarchy (MH-LEACH) [13] the CHs away from the sink, sends data to the sink using the other CHs as relay stations. It improved throughput. In Advanced-solar aware- Low energy adaptive clustering hierarchy protocol (A-s LEACH) [14] all nodes are considered to be solar powered having battery power as backup, where CHs initially selected by BS, chooses the next CHs after a certain time called round. Here enhanced data aggregation by FIFO priority scheme and collision minimized non-persistent Carrier Sense Multiple Access (CSMA).

B. PEGASIS

S. Lindsey and C. Raghavendra [15] introduced Power Efficient Gathering in Sensor Information Systems (PEGASIS) protocol in 2002. It is an improved version of LEACH protocol. Instead of forming clusters, it is based on forming chains of sensor nodes. One node is responsible for routing the aggregated data to the BS. Each node aggregates the collected data with its own data and then passes the aggregated data to the next ring. The difference from LEACH is to employ multi hop transmission and selecting only one node to transmit the data to the sink or base station. Since the overhead caused by dynamic cluster formation is eliminated, multi hop transmission and data aggregation is employed, PEGASIS outperforms the LEACH. However excessive delay is introduced for distant nodes, especially for large networks, where single leader can be a bottleneck.

C. TEEN

In 2001, A. Manjeshwar and D. P. Agarwal [16] proposed Threshold sensitive Energy Efficient sensor Network Protocol (TEEN) protocol. Closer nodes form clusters, with cluster heads to transmit the collected data to one upper layer. Forming the clusters, cluster heads broadcast two threshold values. First one is hard threshold; it is minimum possible value of an attribute to trigger a sensor node. Hard threshold allow the nodes to transmit the event, if the event occurs in the range of interest. Therefore a significant reduction of the transmission delay occurs. Unless a change of minimum soft threshold occurs, the nodes don't send a new packet of data. Employing soft threshold prevents from the redundant data transmission. Since the protocol is to be responsive to the sudden changes in the sensed attribute, it is suitable for time-critical applications.

D. APTEEN

A. Manjeshwar and D. P. Agarwal [17] proposed Adaptive Threshold sensitive Energy Efficient sensor Network Protocol (APTEEN) protocol in 2002. The protocol is an extension of TEEN aiming to capture both time-critical events and periodic data collections. The network architecture is same as TEEN. After forming clusters the cluster heads broadcast attributes, the threshold values along with the transmission schedule to all nodes. According to energy dissipation and network lifetime, TEEN gives better performance than LEACH and APTEEN, because of the decreased number of trans- missions. The main drawbacks of TEEN and APTEEN are overhead and complexity of forming clusters in multiple levels, implementing threshold-based functions and dealing with attribute based naming of queries.

E. SEP

In 2004, G. Smaragdakis, I. Matta and A. Bestavros proposed Stable Election Protocol (SEP) [18]. This protocol is an extension of LEACH. It is a heterogeneous aware protocol, based on weighted election probabilities of each node to become cluster head according to their respective energy. This approach ensures that the cluster head election is randomly selected and distribution is based upon the fraction of energy of each node, which assures a uniform use of the energy. In this protocol, two types of nodes (two tier in-clustering) and two level hierarchies were considered. CHs selecting probability for normal nodes is

$$p_{nrm} = \frac{p_{opt}}{(1+m.\alpha)} \quad (2)$$

and for advanced nodes

$$p_{nrm} = p_{opt} \cdot \frac{1+\alpha}{1+m.a} \quad (3)$$

Where p_{opt} is the optimal probability of each node to become CH. The idea is that the advance nodes have to become the CHs more often than normal nodes. SEP gives better result as the value of α and m will increase.SEP maintains the constraints of well-balanced energy consumption.

As initially, advanced nodes have to become the CHs more often than normal nodes. Thus, SEP yields longer stability region by utilizing the extra energy of more powerful nodes. But the main drawback of SEP method is that the election of the cluster heads among the two type of nodes is not dynamic, which results that the nodes that are far away from the powerful nodes will die first. SEP sets two probabilities based on only nodes initial energy. But the possibility in SEP is that after certain rounds an advanced node might become normal node due to more energy consumption. In such conditions, SEP selects low energy node as a maximum probability of being cluster heads SEP is only aware of nodes initial energy.

F. E-SEP

The extension of SEP, Femi A. Aderohunmu and Jeremiah D. Deng proposed E-SEP [19] in the year of 2009.E-SEP considers three types of nodes, normal nodes, intermediate nodes and advance nodes. Where, advance nodes are in a fraction of total nodes with an additional energy as in SEP and a fraction of nodes with some extra energy greater than normal nodes and less than advance nodes, called intermediate nodes, while rest of the nodes are normal nodes. As in SEP, the initial energy for normal nodes is E_o, and for advanced nodes is $(1+\alpha).E_o$. E-SEP added another set of initial energy nodes i.e. E_{int} as $(1+\mu)$. E_o, where $\mu=\alpha/2$. Like SEP, in E-SEP CHs are selected depending on probability of each type of node. However, energy dissipation is controlled to some extent due to three levels of heterogeneity. ESEP has same drawbacks as SEP. For selecting CHs it also set the probability based on nodes initial energy. E-SEP also does not consider residual energy of nodes.

Other extension of SEP protocols is ASEP-E [20], Z-SEP [21], T-SEP [22] and H-SEP [23]. In ASEP-E, four types of nodes have been considered for assigning the probability of each type of nodes.. Z-SEP is zone based clustering algorithm where the advance nodes only have the probability to become a cluster head.. T-SEP is threshold based SEP, uses three level of heterogeneity. As in T-SEP the CHs selection is done based on threshold value, it decreases the throughput due to threshold sensitivity. H-SEP is heterogeneous aware protocol to minimize transmission cost between CH and BS. In H-SEP selection of cluster heads cannot be done in a distributive way.

G. DEEC

In 2006, Q. Li, Z. Qingxin and W. Mingwen [24] proposed Distributed Energy Efficient Clustering Protocol (DEEC) protocol. This protocol is a cluster based scheme for multi level and two level energy heterogeneous wireless sensor networks. In this scheme, the cluster heads are selected using the probability based on the ratio between residual energy of each node and the average energy of the network. The epochs of being cluster- heads for nodes are different according to their initial and residual energy. The nodes with high initial and residual energy have more chances to become the cluster heads as compared to nodes having low energy. The main disadvantage of DEEC is advanced nodes are always penalized, particularly when their residual energy reduced and become in the range of the normal nodes. In this position, the advanced nodes die rapidly than the others.

H. EECS

In 2005, M. Ye, C. Li, G. Chen and J. Wu [25] proposed Energy Efficient Clustering Scheme (EECS) protocol. It is novel clustering scheme for periodical data gathering applications for wireless sensor networks. It elects cluster heads with more residual energy through local radio communication. In the cluster head election phase, a constant number of candidate nodes are elected and compete for cluster heads according to the node residual energy. The competition process is localized without iteration. Further in the cluster formation phase, a novel approach is introduced to balance the load among all cluster heads. But on the other hand, it increases the requirement of global knowledge about the distances between the cluster-heads and the base station.

I. HEED

In 2004,O Younis, S Fahmy proposed HEED: A hybrid, energy-Efficient, distributed clustering approach [26]. HEED is a multi-hop clustering algorithm for wireless sensor networks, with a focus on efficient clustering by proper selection of cluster-heads based on the physical distance between nodes. Cluster construction in HEED Reference2is performed based on two parameters- the node's residual energy, and intra-cluster communication cost. In HEED, elected CHs have relatively high average residual energy. Moreover HEED aims to provide evenly distributed CHs throughout the network. CHs send the aggregated data to the

BS in a multi-hop fashion rather than single-hop fashion of LEACH. Similar to LEACH, the performing of clustering in each round imposes significant overhead in the network. This overhead causes noticeable energy dissipation which results in decreasing the network lifetime. As per HEED implementation, these nodes are forced to become a CH and these forced CHs may be in range of other CHs or may not have any member associated with them. As a result, more CHs are generated than the expected number and this also accounts for unbalanced energy consumption in the network .

J. EEUC

In 2005, C. Li, M. Ye, G. Chen and J. Wu proposed An energy-Efficient unequal clustering mechanism for wireless sensor networks [27].EEUC is designed for periodic data gathering applications in WSN. According to this scheme the nodes in one region compete to become CH in such a way that the node's competition range decreases as its distance to the base station decreasing. Thus the nodes closer to the BS consume less energy for intra cluster routing and can utilize it for inter-cluster routing. Energy consumed by cluster heads per round in EEUC much lower than that of LEACH standard but similar to HEED protocol.

V. COMPARATIVE STUDY

In this section, we compare between routing protocols covered in this survey. Table 1 summarizes the classification of the hierarchical cluster-based routing protocols by stating its strength points and limitations. It is obvious that there are wide number of researches were conducted for homogeneous networks where all nodes consume energy at same level, while there are few researches were developed for some heterogeneous networks where some nodes are supported with more capabilities and are assigned with more responsibilities such as data gathering and forwarding. Hence the consumed energy level is not equal among all nodes. The main advantage of homogeneous over heterogeneous protocols is the formulation of approximately balanced clusters partition in network, while heterogeneous overcomes homogeneous protocols in terms of increasing reliability, lifetime, and decreasing network latency. Since real world applications may require different capability-supported sensors to develop network reliability and prolong network lifetime, researches should be oriented towards heterogeneous networks. In the homogeneous WSNs, most of proposed single-hop protocols are based on LEACH protocol and have sought to overcome the drawbacks that it suffers from, such as wasting energy during CH-selection phase, unbalanced clusters, and consuming a large amount of energy if the CHs are located far away of the sink. Many of protocols that have been suggested to improve LEACH protocol suffer from the same problems in addition to an extra overhead of forming clusters and then selecting CHs.

On the other hand, multi-hop routing protocols were suggested to improve LEACH protocol by reducing the energy consumption due to long-distance direct transmission. However, many of these specified protocols suffer from hotspots, delay, overhead, in addition to limited scalability. Single-hop heterogeneous protocols achieve more reliability and less delay compared to multi-hop heterogeneous protocols. This can be explored by the number of hops required to reach the sink.

Hence from above discussion we found that the hierarchical clustering based algorithm provide better results in its higher energy efficiency, network scalability, and lower data retransmission.

TABLE 1. COMPARISION OF SELECTED PROTOCOLS

Protocol Name	Cluster Stability	Delivery Delay	Scalability	Load Balancing	Advantages
LEACH	Medium	Very Small	Very low	Medium	Energy saving
TEEN	High	Small	Low	Good	Energy saving
SEP	Medium	Very small	Medium	Good	Network lifetime
DEEC	High	Very small	High	Good	Energy saving
HEED	High	Medium	Medium	Medium	Energy saving

APTEEN	Very low	Small	Low	Medium	Network lifetime
PEGASIS	Low	Very large	Very low	Medium	Energy saving, network lifetime

VI. PROBLEM STATETMENT

There is a situation of clustering where each node sends data to the CH and then the CH performs aggregation on the received raw data and then sends it to the BS. This approach consumes a substantial amount of energy which needs to be improved upon. Thus, the problem can be formulated as: How can we improve network-lifetime & energy efficiency in Wireless Sensor Network using the hierarchical routing technique ?

VII. CONCLUSION

Hierarchical cluster-based routing protocols are considered as one of the most efficient routing protocols in wireless sensor networks (WSN) due to its higher energy efficiency, network scalability, and lower data retransmission.

In this paper we have surveyed the past research works which mainly focuses on energy efficient clustering based routing protocols for wireless sensor networks and we have Systematically analyzed a few classical WSN clustering routing protocols in deep, and compared these different approaches based some primary metrics. Hence we finding better performance in it higher energy efficiency, better scalability and lower data retransmission using the hierarchical clustering algorithm. We have also discussed the fundamental concept of wireless sensor network, clustering, clustering type, clusters property and cluster- heads capabilities.

REFERENCES

[1] Hui Lin and Halit Üster "Exact and Heuristic Algorithms for Data-Gathering Cluster-Based Wireless Sensor Network Design Problem" IEEE/ACM transactions on networking, vol. 22, no. 3, june 2014 , 903-916

[2] V.Chandrasekaran,Dr.A.Shanmugam "A review on hierarchical cluster based routing in wireless sensor networks"JGRCS,Pages 1-15, February 2012

[3] Nagaraju Uppa, B.V.S.S. Subrahmanyam "An energy efficient technique to prolong Network life time of Ad-Hoc Sensor Network" IETE Technical Review, Pages 154-160

[4] Jenq-Shiou Leu, Member, IEEE, Tung-Hung Chiang, Min-Chieh Yu, and Kuan-Wu Su "Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network With Isolated Nodes", IEEE communications letters, vol. 19, no. 2, february 2015, 259-262

[5] Naveen Sharma and Anand Nayyar "A Comprehensive Review of Cluster Based Energy Efficient Routing Protocols for Wireless Sensor Networks" International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 3, Issue 1, January 2014 pages 441-453

[6] Stefanos A. Nikolidakis , Dionisis Kandris , Christos Douligeris "Energy Efficient Routing in Wireless Sensor Networks Through Balanced Clustering" *Algorithms* 2013, *6*, 29-42;

[7] Amin Rostamiland Mohammad Hossin Mottar " Wireless Sensor Network Clustering Using Particles Swarm Optimization For Reducing Energy Consumption" (IJMIT) Vol.6, No.4, November 2014 , 1-15

[8] Mihaela I. Chidean, Eduardo Morgado, Eduardo del Arco, Julio Ramiro-Bargue˜no and Antonio J. Caama˜n , "Scalable Data-Coupled Clustering for Large Scale WSN" page:209-216, april, 2014

[9] W. Heinzelman A. Chandrakasan and H. Balakrishnan. An application specific protocol architecture for wireless microsensor networks. Proc. 33rd Hawaii Int',l. Conf. Sys. Sci., pages 660-670, 2000

[10] S.D. Muruganthan D.C.F. Ma B. Rollyi and A. Fapojuwo. A centralized energy- efficient routing protocol for wireless sensor networks. IEEE Radio Communications, 43(3):8-13, 2005.

[11] A. Zanella A. Depedri and R. Verdone. An energy efficient protocol for wireless sensor networks. In Procidings AINS, pages 1-6, 2003.

[12] G. Morabito V. Loscr and S. Marano. A two-levels hierarchy for low-energy adaptive clustering hierarchy (tl-leach). IEEE 62nd Vehicular Technology Conf., pages 1809-1813, 2005.

[13] G. Wang H. Zhu H. Dai L. Wu and B. Xiong. The clustering algorithm of wireless sensor networks based on multi-hop between clusters. WRI World Congress on Computer Science and Information Engineering, 3:177-181, 2009.

[14] M.J. Islam M.M. Islam and M.N. Islam. A-sleach: An advanced solar aware leach protocol for energy e_cient routing in wireless sensor networks. Networking, Sixth International Conference,, 2007.

[15] S. Lindsey and C. Raghavendra. PEGASIS: Power-efficient gathering in sensor information systems". IEEE Aerospace Conference Proceedings, 3: 9-16, 2002.

[16] A. Manjeshwar and D.P. Agarwal. TEEN: a routing protocol for enhanced efficiency in wireless sensor networks. In 1st International Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing, pages 2009-2015, April 2000.

[17] A. Manjeshwar and D.P. Agarwal. APTEEN: A hybrid protocol for efficient routing and comprehensive information retrieval in wireless sensor networks. Parallel and Distributed Processing Symposium., Proceedings International, IPDPS, April 2001.

[18] G. Smaragdakis I. Matta and A. Bestavros. SEP: A stable election protocol for clustered heterogeneous wireless sensor networks. in Second International Workshop on Sensor and Actor Network Protocols and Applications (SANPA), 2004.

[19] F.A. Aderohunmu and J.D. Deng. An enhanced stable election protocol (sep-e) for clustered heterogeneous wsn. Department of Information Science, University of Otago, 2009.

[20] A. Kaur S. Singh and K. Singh. Advanced SEP-E protocol for extending the lifetime of the heterogeneous wireless sensor networks. International Journal of Networks and Systems, 2:27-33, 2013.

[21] S. Faisal N. Javaid A. Javaid M.A. Khan S.H. Bouk and Z.A. Khan. Zonal-stable election protocol for wireless sensor networks. Journal of Basic and Applied Scientific Research, 3:132-139, 2013.

[22] A. Kashaf N. Javaid Z.A. Khan and I.A. Khan. T-SEP: Threshold-sensitive stable election protocol for wsns. Frontiers of Information Technology (FIT) of IEEE, pages 164-168, 2012.

[23] A.A. Khan N. Javaid U. Qasim Z. Lu and Z.A. Khan. HSEP: Heterogeneity-aware hierarchical stable election protocol for wsns. Seventh International Conference on Broadband, Wireless Computing, Communication and Applications, August 2012.

[24] Q. Li Z. Qingxinand and W. Mingwen. Design of a distributed energy efficient clustering algorithm for heterogeneous wireless sensor networks. Computer Communications, 29(12):2230|-2237, August 2006.

[25] M. Ye C. Li G. Chen and J. Wu. EECS: an energy efficient cluster scheme in wireless sensor networks. In IEEE International Workshop on Strategies for Energy Efficiency in Ad Hoc and Sensor Networks (IEEE IWSEEASN-2005), Phoenix, Arizona., 2005.

[26] O. Younis and S. Fahmy. HEED: A hybrid, energy-efficient, distributed clustering approach for ad-hoc sensor networks. IEEE Trans. Mobile Computer., 3:366-379, 2004.

[27] C. Li M. Ye G. Chen and J. Wu. An energy-efficient unequal clustering mechanism for wireless sensor networks. In IEEE International Conference on Mobile Ad-hoc and Sensor Systems, pages 604-611, 2005.

[28] Q. Nadeem M.B. Rasheed N. Javaid Z.A. Khan Y. Maqsood and A. Din. M-GEAR: Gateway-based energy-aware multi-hop routing protocol for wsns. Broadband and Wireless Computing, Communication and Applications (BWCCA) of IEEE, pages 164-169, July 2013.

[29] S.K. Mitra and M.K. Naskar. Comparative study of radio models for data gathering in wireless sensor network. International Journal of Computer Applications (4):49-57, August 2011.

KIET IJCE KIET International Journal of Communications &Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

Design and analysis of Stepped impedence lowpass filter using microstrip line

Aditi Singh[1], *Pravesh Singh*[2]
ECE Department, KIET, Ghaziabad, Uttar Pradesh
[1]aditi8jan@gmail.com , [2]pravesh_singh01@yahoo.co.in

***Abstract*— In this paper a lowpass filter has been designed. The filter has designed by using the method known as stepped impedance. This paper fulfills the demand of newer microwave and millimeter-wave systems to meet the various issues such as cost, performance and size in the field of telecommunication. This paper presents a low insertion loss and the low cost design S-lowpass filter(LPF) with the use of microstrip layout having the center frequency at 2.5GHz with the permittivity of value 4.4 and the height/thickness of the substrate is 1.27mm for the order n=6. The use of microstrip provides the advantages of simplicity and ease of fabrication. The design and simulation are performed by using the 3D full wave electromagnetic simulator IE3D.**

***Keywords* – Lowpass filter, IE3D, Dielectric constant, microstrip filter, Impedance configuration.**

I .INTRODUCTION

In today's fast growing world, microwave communication systems are expanding rapidly to higher frequency such as S-band since it is quiet advantageous as compared to conventional wireless links in respect of size and the bandwidth. Hence microstrip technology play important role in manu RF or microwave applications. A lowpass filter is defined as a filter that can pass low frequency signals and attenuates/cuts the amplitude of signals with frequencies higher than the cut-off frequency. It can be used as hiss filter for audio purpose, as digital filter for4 smoothing data, acoustic barrier ans as an anti-aliasing filter for conditioning signals.

The actual amount of attenuation for each frequency varies depending on specific filter design. It is sometimes called as high-cut filter or treble cut filter in audio applications. A lowpass filter is the opposite of the high pass filter. A banpass fiis a combination of the lowpass and a highpass filter. The filters are one of the primaand necessary components of a microwave systems. We prefer microstrip line as it is advantageous because of various parameters, such as low cost, compact size, light weight, planar structure and easy integration eith other components on a single circuit board. Conventional structures of filters such as equal ripple and butterworth lowpass filters are some requirements of special fabrication methods. Thus microstrip technology is used for simplicity and ease of fabrication . yhe design and simulation are performed u3D full wave electromagnetic simulator IE3D. this filter is widely used today in radarsatellite and terrestrial communication applications.

II. DESIGN AND ANALYSIS OF MICROSTRIP FILTER

In order to design low pass filter basically two steps to be followed- In the first step, an appropriate low pass prorotyoe is selected. The choice of the type of the response, including pass band ripple and the number of reactive elements will depend on the specifications that are required. The element values of the low pass prototype filters which are usually normalized to make a source impedance g_0=1 and a cutoff frequency Ω_c=1.0, then transform to the L-C elements for the desired source impedance usually 50ohms for microstrip filters[1] is to find an appropriate microstrip realisation approximates the lumped element filter. The element values of the low pass prototype with chebyshev response at passband ripple factor L_{Ar}=0.1 db, characterize impedance source/load Z_0=50ohms, are taken from normalized values g_i, i.e., $g_1, g_{2,} g_{3,.........} g_n$. The filter is assumed to be fabricated on a substrate of dielectric constant ε_r and of thickness(or height) h mm for angular(normalized) cutoff frequency Ω_c, using the element transformation[2].

The filter designing steps are mentioned below-

1) Determine the number of sections from specification characteristics for microstrip parameters:-

Filter Specification-

Relative Dielectric constant, ε_r=4.4

Height of substrate h=1.27mm

Cutoff frequency, f_c=2.5 GHz

The loss tangent $\tan\delta$=0.02

The filter impedance, Z_0=50Ω

The highest line impedance $Z_H = Z_{OL}$ =100Ω

The lowest line impedance $Z_L = Z_{OC}$ =25Ω

Normalized cut off frequency, Ω_c=1 rad/sec

2)We have chosen the element values for the desired lowpass filter from table 3.2[1] for n=6. The values of the prototype elements to realize the specifications is given by the formula written below-

$$L_i=\frac{\Omega_c}{\omega_c}\frac{Z_0}{g_0}g_i \ , \quad C_i=\frac{\Omega_c}{\omega_c}\frac{g_0}{Z_0}g_i$$

The physical impedances of the high and low impedance lines are given below-

$$l_L=\frac{\lambda_{gL}}{2\pi}\sin^{-1}\left(\frac{\omega_c L_i}{Z_{oL}}\right)$$

$$l_C=\frac{\lambda_{gC}}{2\pi}\sin^{-1}(\omega_c C_i Z_{oc})$$

3)The formula used in order to calculate the width of the capacitor and inductor is given by[1],

For $\frac{w}{h} < 2$

$$\frac{w}{h}=\frac{8\exp(A)}{\exp(2A)-2}$$

Where,

$$A=\frac{Z_c}{60}\left[\frac{\varepsilon_r+1}{2}\right]^{0.5}+\left[\frac{\varepsilon_r+1}{\varepsilon_r-1}\right]\left[0.23+\frac{0.11}{\varepsilon_r}\right]$$

And

$$Z_c=\frac{\eta}{2\pi}\sqrt{\varepsilon_{re}}\ln\left(\frac{8h}{w}+0.25\frac{w}{h}\right);$$

Where η= 120π ohms is the wave impedance in free space.

4)The effective dielectric constant can be found by the following formula[1]

$$\varepsilon_{re}=\left(\frac{\varepsilon_r+1}{2}\right)+\left(\frac{\varepsilon_r-1}{2}\right)\left[\left(1+\frac{12h}{w}\right)^{-0.5}+(0.04)\left(1-\frac{w}{h}\right)^2\right]$$

5) The effective wavelength can be also found as[1],

$$\lambda_{ge}=\frac{300}{f(GHz)\sqrt{\varepsilon_{re}}}\ \text{mm}$$

TABLE-I

Dimensions for a stepped impedance lowpass filter(For n=6).

Dimesions	Values		
Microstrip line width(in mm)	W_c= 8.38	W_o= 2.43	W_L= 0.563
Characteristic impedance(in ohms)	Z_{OC}= 22	Z_O= 50	Z_{OL}=100
Effective Dielectric constant	$(\varepsilon_{re})_C$= 5.843	$(\varepsilon_{re})_O$= 3.387	$(\varepsilon_{re})_L$= 3.042

III. SIMULATION RESULT

The layout of a 6-pole , stepped impedance microstrip lowpass filter on substrate with ε_r=4.4, h=1.2mm at 2.5GHz frequency, has been shown below,

Fig.1: Layout of a 6-pole stepped impedance microstrip lowpass filter ona asubstrate with ε_r=4.4, h=1.2mm at 2.5GHz frequency.

KIET IJCE KIET International Journal of Communications &Electronics
Volume. No. 3, Issue No. 2, July-December 2015, ISSN: 2320 - 8996

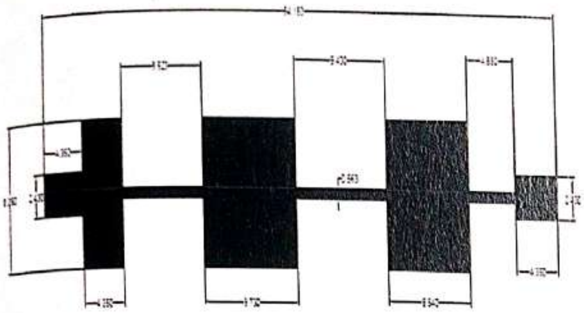


Fig.2, Layout of a 6-pole stepped impedance microstrip lowpass filter ona asubstrate with ε_r=4.4, h=1.2mm at 2.5GHz frequency with dimension.

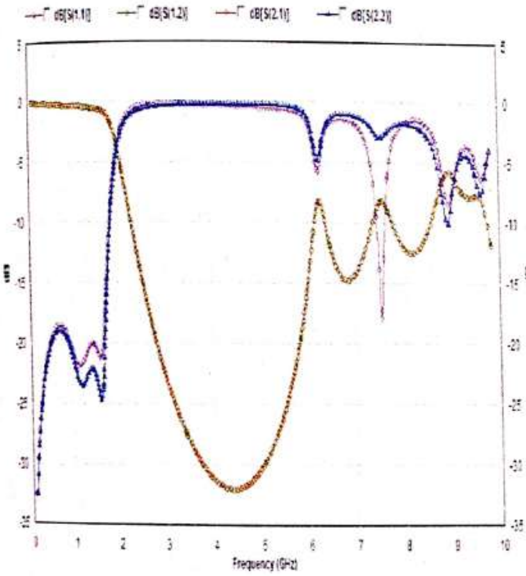


Fig.3, Full-wave EM Simulated Performance of the stepped impedance lowpass filter n=6 at 2.5GHz.

IV. RESULTS AND DISCUSSION

The simulated filter structure and response is shown in fig. 1 and fig. 3. The fabricated and measured response is shown in fig. 3. In the response graph gain (dB) is plotted on the Y-axis and frequency (GHz) on the X-axis. The simulated LPF achieved a 3dB bandwidth of about 24%.From the graph shown in fig. 4, it is clear that the simulated cut-off frequency is found to be 2.5GHz for stepped- impedance low pass filter and from figure 3, it is clear that the measured value is 2.210580GHz at-8.0288dB.Hence the low pass filter is capable of passing the frequency less than 2.2105880 GHz & rejects the frequency after 2.2105880GHz. So this filter can be used for S-band applications i.e. above 2GHz.The response of the low pass filter with alternating sections of high and low impedance line is also plotted in fig5 by developing program code in Matlab which shows the value of insertion loss(S21) of -4dB at cutoff frequency 2.5GHz.

V. APPLICATIONS

Microstrip lines circuits find extensively applications in radar systems, microwave communication links, satellite communication systems, wireless and mobile communication systems, medical equipment etc.

VI.CONCLUSION

A stepped impedance low pass microstrip filter has been simulated, designed, fabricated and tested by measurement with a vector network analyzer. The cutoff frequency achieved is lower than the design specification value(2.5GHz).

VII. ACKNOWLEDGEMENT

The authors would like to thank authorities of Krishna Institute of Engineering and Technology, Ghaziabad for all the support provided. The measurement facility provided by, Dr. Sanjay Sharma(H.O.D. of ECE deptt. KIET, Ghaziabad) is gratefully acknowledged.

References

[1] Jiashen G.Hong, M.J. Lancaster, "Microstrip filters for RF/Microwave Applications", John Wiley & Sons Inc., 2002.

[2]]D.M. Pozar,"Microwave Engineering", John Wiley,2000.

[3] Sudipta Das., Dr. S.K. Chowdhury," Design simulation anf fabrication of stepped impedance microstrip line low pass filter for S-band Application using IE3D and MATLAB." IJECT Vol.3, Issue 1, Jan-March 2012

[4] IE3D Software Developed by M/S Zeland Software Inc

[5] G. Mathaei, L.Young, E.M.T. Jones,"Microwave Filter impedance matching networks and coupling structures", Artech House, Norwood, MA, 1980.

[6] M. Makimoto, S.Yamoshita,"Microwave Resonators and Filters", IEEE Trans. Wireless communication Vol. 2, August 1986.

[7] Tae-Yeoul Yun, Kai Chang,"Transaction on Microwave Theory and Techniques", IEEE Trans, Vol. 49, No. 3, 2001.

[8] Constantine A. Balanis,"Antenna Theory: analysis and design, 3rd Edition, Wiley.