A NOVEL DESIGN AND ANALYSIS OF MIMO ANTENNA FOR RADAR-SATCOMM APPLICATIONS

M.Pachiyaannan
Department of Electronics and Communication Engineering
Assistant Professor, Nehru Institute of Engineering and Technology, Coimbatore, Tamilnadu, India

G.K.D.Prasanna Venkatesan
Department of Electronics and Communication Engineering
Professor, SNS College of Engineering and Technology, Coimbatore, Tamilnadu, India

Abstract

A dual antenna,tri-band, dual feed, compact design a multidimensional pattern MIMO antenna on a same substrate for Radar-Satellite application is presented in this paper. The MIMO antenna comprises dual pattern quad arm shape (K-Antenna) and Monopole antenna (X-Antenna) with integrated reactive loading effect patch elements with separation distance on the same FR4 epoxy substrate material. The X-Antenna operating at 11GHz frequency for radar Application and K-Antenna operating at 19.6GHz, 22.8GHz and 26.4GHz frequency for Satellite applications. The results of MIMO Antenna has been simulated Ansoft High Frequency Structure Simulator software has been used to analyze the performances of antennas in term of return loss ,gain and radiation pattern.The simulated result also shows that the electromagnetic interferences between dual pattern antenna has been mimimized. The radiation pattern is nearly omni directional with moderate gain in both these operating bands. The MIMO antenna provides high degree of beam forming and its providing integrated Radar and Satellite application and also future Rover system and LTE MIMO systems.

Index Terms *- K-Antenna ,MIMO antenna, Monopole antenna, LTE MIMO System, Quad arm shape patch antenna, X –Antenna, Radar ,Rover, Satellite.*

Introduction

In recent years the radar is a vital component for safety at sea and near the shore. Radars are used to detect aircraft, missiles, artillery and mortar projectiles, ships, land vehicles, and satellites. The radar and satellite signals are challenging to share the communication. To linking of these devices is extremely significant because to knowing the object at sea level. The compact and low profile antenna is very essential to share radar and satellite application. The rapid development of the wireless communication devices the compact antennas is on rise. Due to low fabrication cost and compactness of the patch antennas many researchers are working in this these antennas are light weight and easy to install. Current wireless communication systems require higher bit rate transmission to support various services. A multi-input multi-output (MIMO) system is regarded as a promising solution, to the problem of data rate transmission since it can increase the channel capacity without sacrificing spectrum efficiency or consuming additional transmitted power [1]. The basic aim of MIMO antenna design is to minimize the correlation between the multiple signals as in [2],to achieve compactness in MIMO systems, the use of pattern diversity as in [3-10]. In the present design, the orthogonal polarization concept is applied to the proposed multi slot patch antenna yielding better results in terms of return loss and mutual coupling.

The limitations of microstrip antennas are narrow frequency band and disability to operate at high power levels of waveguide, coaxial line or even stripline. Therefore, the challenge in MIMO antenna design is to increase the bandwidth and gain [2]. Different radar systems such as synthetic aperture radar (SAR), shuttle imaging radar, remote sensing radars, and other wireless communication systems operate in L, C and X bands. Microstrip antenna is the first option for this high frequency band such as X-band due to its low cost, light weight, and robustness [2]. By inserting a microstrip-line section at one of the radiating edges of a rectangular patch, dual-frequency operation of microstrip antennas has been reported [6]. In such a design, the inserted microstrip-line section provides an integrated reactive loading to the microstrip antenna. By varying the dimensions of the inserted microstrip-line section, which can affect the resonance condition of the microstrip antenna, two resonant modes near the fundamental mode of the original unloaded microstrip antenna can be excited, making dual-frequency operation possible. Recently, it has also been reported that, by applying this inserted-loading technique and modifying the inserted microstrip-line section to be an inserted microstrip structure of cascaded transmission-line sections [5], the two resonant modes can be designed to be excited at frequencies very close to each other to form a wide operating bandwidth. This enhancement in the impedance bandwidth greatly relieves the narrow-bandwidth disadvantage of microstrip antennas. A typical geometry of such a design applied to a probe-fed rectangular microstrip antenna is shown in [5], in which an integrated reactive loading is inserted at one of the patch radiating edges for bandwidth enhancement.

In the reference [10 - 15] Ku-band, K-band and Ka-band systems differ in many respects including transponder bandwidth, beam size, transponder connectivity, topology and associated payload complexity and cost. Both Ku,K and Ka-band systems are used for multiple applications, including Mobile Satellite Services (MSS), Fixed Satellite Services (FSS), and Broadcast Satellite Services (BSS). Although Ku-band systems are deployed extensively throughout the orbital arc today, the number of Ka-band systems is increasing at a rapid pace.

In the reference [9] A dual polarized microstrip patch antenna has been proposed for Ku-band applications with dimensions of 15mm×15mm, and such an antenna has achieved a 950MHz bandwidth with a maximum gain of 7.6 dB, as noted in [9].In [10], a multiband patch antenna was designed for Ku- and K-band applications with dimensions of 8mm × 10mm, a bandwidth of 760MHz, and a peak gain of 4.5 dB. In the reference [11], a Ku-band patch antenna using notches and slit was proposed, whose dimensions are 7.6mm × 10mm, with a substrate thickness of 0.8mm; Teflon is used as the dielectric substrate material, and the antenna obtained a maximum bandwidth of 600MHz.

In [12], a dual-band compact microstrip antenna was proposed for Ku-band applications using three pairs of thin slits from the sides of a rectangular patch, whose dimensions are 9.5mm × 10mm; Rogers RT/ Duroid 5880 is used as the dielectric substrate material, with a substrate thickness of 0.254mm; the antenna obtained a maximum bandwidth of 90MHz. In [16 - 20], a dual-frequency triangular slotted microstrip patch antenna was proposed for Ku-band applications, where the patch dimensions are 8.5mm × 7.96mm × 1.905mm, the substrate thickness is 1.905mm and the Rogers RT/ Duroid 6010 is used as the dielectric substrate material and the maximum bandwidth is 576MHz. In all of the previous proposed antenna designs, narrow bandwidth was achieved for Ku-band applications. A printed double-T monopole antenna was proposed in [20 - 25].

In the Reference [8] a 20mm×20mm microstrip patch antenna was designed on a 1.575mm thick Duroid 5870 substrate for use in Ku- and K-band applications. A downlink frequency of 15.56GHz and an uplink frequency of 20.41GHz, with return losses of −32.56 dB and −31.13 dB, respectively, a peak gain of 3.90 dB, and 98.5% average efficiency were achieved.

In this paper designed the MIMO antennas with the slots capable of working in the mm-wave. The slots inside the patches have integrated with reactive loading to filter the S,C band frequency and increase the bandwidth of X band at 11Ghz As a result, this paper is proposed the possibility of prototyping by design and analysis of MIMO antennas for maritime Radar system using a typical FR-4 epoxy substrate.

Scope and Structure of the Paper

With reference of above background and motivation and Based on our occurrence we have attempted to design Multi dimensional MIMO antenna oriented, the K-antenna and X-Antenna which should satisfy the K band (18 GHz-26 GHz),Ku(26 GHz-40 GHz) band and X band(12 GHz-18 GHz) frequency.

K –antenna should satisfy following specifications

1. Display a bandwidth at 800 MHz in the vicinity of 19.2-20GHz at 19.6GHz, thus VSWR is 1.325 i.e VSWR<2.
2. Display a bandwidth at 800 MHz in the vicinity of 22.4-23.2GHz at 22.8GHz, thus VSWR is 0.798 i.e VSWR<1.
3. Display a bandwidth at 800 MHz at the lower end of the 26-26.8GHz at 26.4GHz range, thus VSWR is 1.542 i.e VSWR<2.

Likewise X-Antenna should satisfy following specifications

1. Display a bandwidth at 800 MHz in the vicinity of 10.6-11.4GHz at 11GHz, thus VSWR is 1.131 i.e VSWR<2.

Both the above antenna achieve total radiation efficiency over both bands are above >95%. The paper describes the design of Quad arm shape (K-Antenna) Patch and Monopole (X-antenna) patch that have been linearly polarized and coaxial feeding techniques with rectangular slots. The mutual coupling between dual pattern antenna is very less and its providing very less interference. The effect of the size of the ground plane on both frequency bands was also investigated. Section 2 discusses antenna design and structure issues. Section 3 discusses the results and discussion. Section 4 concludes the paper [26 – 30].

Antenna Modelling and Design

The structure of the Multidimensional pattern antenna is Presented in Fig.1.It is composed by two part, K-Antenna is presented left side of the rectangle patch and X-Antenna is presented right side of the rectangular patch. These two antenna placed on a same substrate material with difference G1=4mm.The novel antenna is developed by integrating different length of rectangular slot and kept opposite face to avoid the electromagnetic interference. This antenna is printed on an FR4 substrate with relative permittivity 4.4 and thickness of t=1.4mm. The two identical antenna elements have the different structure and different dimensions. The antenna has two layers, the top layer and the bottom layer. On the bottom layer there are the grounds with length L and width W .On the top layer is the microstrip line-loaded monopole [31 – 35]. The antenna is fed by a coaxial feeding with 0.5mm diameter match 50Ω.The monopole is rectangular with width W3 and length L3.

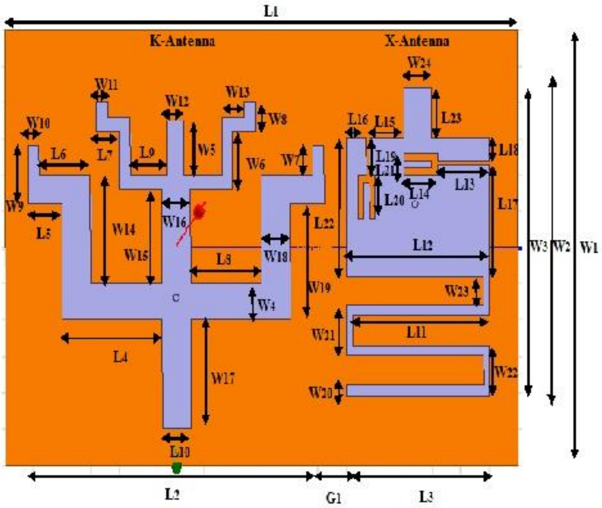

Fig. 1: Geometry of the proposed MIMO antenna.

The Optimal Dimensions of the Designed Antenna are as follows:
W1=60mm,W2=45mm,W3=42mm,W4=5mm.W5=7.5mm,W6=8mm,W7=4mm,W8=4mm,W9=8mm, W10=2mm,W11=2mm,W12=3mm,W13=4mm,W14=15mm,W15=13mm,W16=5mm,W17=15mm,W18=5mm,W19=16mm,W20=1.5mm,W21=7mm,W22=7mm,W23=4mm,W24=5mm,L1=90mm,L2=52mm,L4=17.5mm,L3=25mm,L5=6mm,L6=9mm,L7=4mm,L8=12.5mm,L9=6.5mm,L10=5mm,L11=24mm,L12=25mm,L13=9mm,L14=6mm,L15=6mm,L16=4mm,L17=15.5mm,L18=3mm,L19=5mm,L20=6mm,L21=3mm,L22=19mm and gab between two antennas G1 = 4mm.The Height of the feed gap between the main patch and ground plane t=1mm is also important parameter and its define the impedance bandwidth since t is the thickness of the substrate. By adjusting t, the electromagnetic coupling between the ground plane and patch can be controlled [36 – 40].

The proposed antenna exhibits tri-band characteristics. The radar operating frequency X-band at 11GHz having return loss than -20db and K-band operating frequency 19.6GHz and 22.8GHz having return loss than -20db and Ka-band operating frequency at 26.4 GHz having return loss than -20db frequency bands.

The Coaxial feed or probe feed is a very common technique used for feeding Microstrip patch antennas. As seen from Fig 1. In this paper Coaxial feeding techniques were used. The inner conductor of the coaxial connector extends through the dielectric and is soldered to the radiating patch, while the outer conductor is connected to the ground plane. In this Proposed antenna when compared to the loss tangent and permittivity of substrate material the FR4 epoxy is having very less permittivity value i.e 4.4 and loss tangent value is 0.020.

The parameters of the proposed antenna are optimized to get a VSWR that is less than 2 and to get stable radiation characteristics throughout the frequency band 11GHz to upper than 27GHz [41 – 45].In addition to the traditional antenna parameters, such as gain, radiation pattern, and reflection coefficients, new parameters and aspects have to be included in the design for MIMO systems. Mutual coupling between antenna elements is a key factor to achieve high antenna performance in the MIMO antenna configuration. For a low mutual coupling, antennas must be far away from each other. But the space for the internal antenna is not enough to obtain low correlation and mutual coupling. In this paper we present a structure for the MIMO antenna elements, in which the identical two antenna elements are orthogonally placed. Then the two antenna elements have orthogonal polarization which can reduce the mutual coupling between the two antennas [46 – 50].

Paremetric Study and Numeric Result

The different characteristics of the proposed antenna are investigated and optimized by commercially available finite element based software HFSS. The proposed antenna resonates at four frequencies 11 GHz, 19.6GHz, 22.8GHz and 26.4 GHz. The K band of first resonant frequency has a bandwidth at 800MHz from 19.2-20GHz.The K band of second resonant frequency has a bandwidth at 800MHz from 22.4-23.2GHz. The other two Resonant Frequencies create a same bandwidth ranging from 26-26.8GHz and X band of resonant frequency has a bandwidth at 800MHz from 10.6-11.4GHz. These four resonant frequencies maintain the same bandwidth at entire band to utilize the adequate data transmission [51 – 54]. The return loss of the K antenna at the three Resonant Frequencies is shown in Fig. 2.The return loss values are -22.3 dB, -26.7 dB and 21.05 dB for the frequencies 19.6 GHz, 22.8 GHz and 26.4 GHz respectively and the return loss of the X antenna at the resonant frequencies is shown in Fig. 4.The return loss value is -23.7 dB at frequency of 11 GHz.

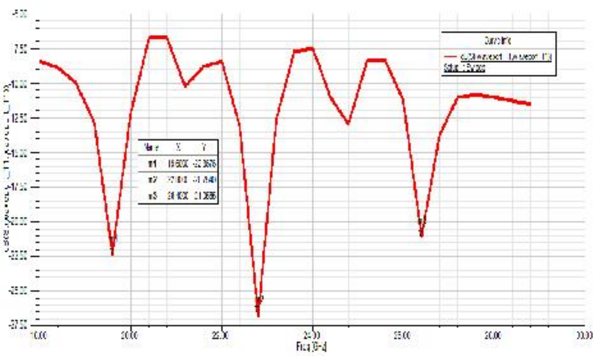

Fig. 2: Return loss of S11 curve VS Frequency of MIMO antenna

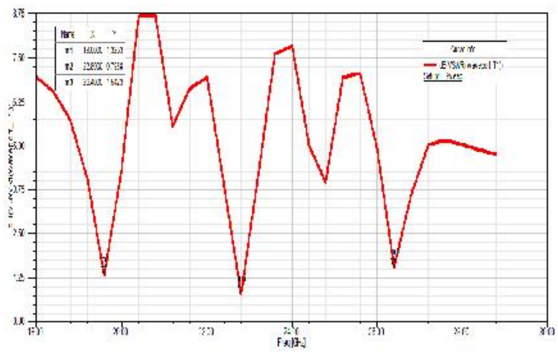

Fig. 3: VSWR of S11 curve VS Frequency of proposed antenna

The Voltage Standing Wave Ratio (VSWR) describes the amount of power reflected by an antenna. In Practical, the VSWR should be between 1 and 2 for less reflection losses.The simulated VSWR of the K antenna is shown in Fig.3. The standard VSWR values are 1.3,0.79 and 1.54 for the respective frequencies 19.6 GHz, 22.8 GHz and 26.4 GHz for the operational bands of the microstrip patch antenna. The value of VSWR achieved is less than 1.5 in the desired operating bands likewise X antenna, the value of VSWR is 1.13 at 11GHz frequency which has achieved less than 1.5 for the desired band is shown in Fig.5.

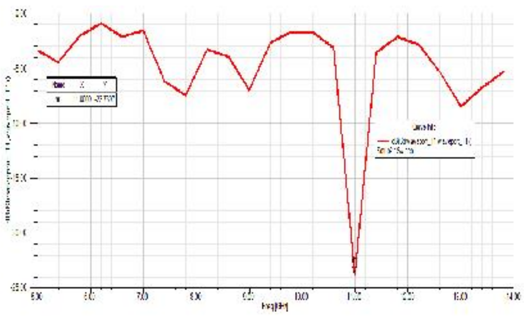

Fig. 4: Return loss of S12 curve VS Frequency of MIMO antenna

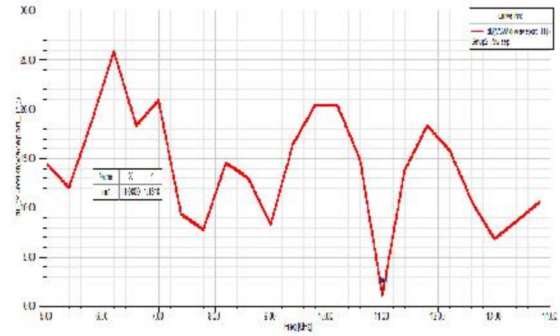

Fig. 5: VSWR of S12 curve VS Frequency of proposed antenna

Results and Discussion

The simulated radiation pattern of proposed K antenna at resonant frequency of 19.6 GHz, 22.8 GHz and 26.4 GHz is shown in Fig.6 the gain of the proposed K antenna is achieved gain 2.34dB.The radiation efficiency of the proposed antenna is above 95% efficiency was observed over the entire operating band of K-band and Ka-band which has suitable for satellite applications.

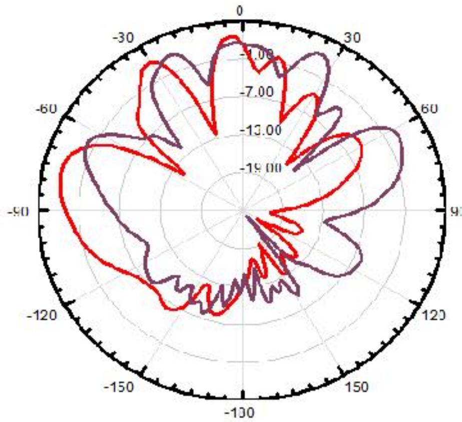

Fig. 6: Radiation pattern of total gain of proposed antenna

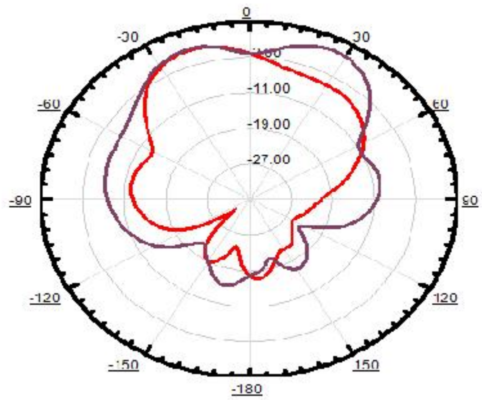

Fig. 7: Radiation pattern of total gain of proposed antenna

The simulated radiation pattern of proposed X antenna at resonant frequency of 11 GHz is shown in Fig.7.the gain of the proposed X antenna is achieved gain 2.34dB.The radiation efficiency of the proposed antenna is above 95% efficiency was observed over the entire operating band of X-band which has suitable for radar applications. Finally this dual pattern antenna has achieved near omni directional radiation pattern which has cover large area.

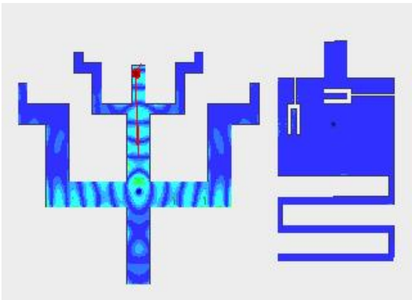

Fig. 8: E-Field Vector current distribution of proposed antenna

Fig.8. depicts the current distribution on the patch at resonance frequency 11GHz, 19.6 GHz, 22.8 GHz and 26.4 GHz. The direction of current is indicated by arrow sign. It is clearly observed from the current distribution display that the electric current strongly flows at the edge of the

triangular slot, especially near the feeding probes of the patch and it can say that the slots dominate the antenna performance. Due to the multilength slot, the current flow is controlled which leads the lessening of cross polarization level. At different part of the patch, the current distribution is almost regular.

Conclusion

The proposed design of dual pattern, dual feed and tri band characteristics on a same FR4 Substrate Microstrip antennas for radar and satellite applications have been Investigated. Low profile coaxial fed rectangular patch antenna with multi slot has studied. Different parameters like VSWR values are 1.3,0.79 and 1.54 for the respective frequencies 19.6 GHz, 22.8 GHz and 26.4 GHz for the proposed K antenna and the value of VSWR achieved is less than 1.5 in the desired operating bands likewise X antenna, the value of VSWR is 1.13 at 11GHz frequency. HFSS Simulator used from validation of proposed antenna. The measured parameters satisfy the attractive radiation patterns, low cross polarization, coupling between two antenna, current distribution and efficiency with improved bandwidth and higher gain make the proposed antenna required limits hence making the proposed antenna suitable for radar and satellite applications and also to provide future Rover system and LTE MIMO systems

References

1. Prasanna Venkatesan.G.K.D., "Network onchip with CDMA technique" has published for the Journal of Scientific and Industrial Research (JSIR). Vol.73, pp.209-213, April 2014, ISSN:0022-4456.
2. Prasanna Venkatesan.G.K.D., "CDMA Technique with Inter process Communication" has published for Research Journal of Applied Sciences, Engineering and Technology (RJSET).Vol.7 (8), pp.1691-1696, February 2014. ISSN: 2040-7459.
3. Prasanna Venkatesan.G.K.D.,"A Novel mechanism for interconnection between peripherals in SOC'S using CDMA technique" has published for international journal of scientific and research publications (IJSRP) .volume 2, issue 8, August 2012, ISSN2250-3153.
4. Prasanna Venkatesan.G.K.D., "CDMA Coding techniques for interconnect between IP Cores", IOSR Journal of engineering (IOSREN), Vol.2, pp.84-90, September 2012. ISSN:2250-3021.
5. Shashidhar Kasthala, GKD Prasanna Venkatesan, A Amudha, "MIMO PLC Channel Modelling on Indian Residential Networks" International Journal of Applied Engineering Research, 0973-4562/July 2017/ Vol. 12, N0. 14
6. J Kirubakaran, GKD Prasanna Venkatesan, "Performance Analysis Of Mimo Based Astm-Ofdm System For Indoor Communication", Int J Adv Engg Tech/Vol. VII/Issue II/April-June 2016
7. M. Pachiyaannan, G. K. D. Prasanna Venkatesan, "LTE 4600 MIMO Antenna: Design and Optimization", Asian Journal of Research in Social Sciences and Humanities Vol. 7, No. 3, March 2017, pp. 802-811.
8. Prasanna Venkatesan G.K.D."Low-power 1-bit full-adder cell using Enhanced pass transistor logic and power gating ", International Journal of Advanced Technology in Engineering and ScienceVolume No.02, Issue No. 06, June 2014.

9. S.Jayakumar, P.V. Ananthapadmanabhan, K. Perumal, T. K. Thiyagarajan, S.C, Mishra, G. Suresh, L.T. Su, A.I.Y. Tok, J.Guo Materials Chemistry and Physics. 140 (2013) 176 - 182.
10. S.Jayakumar, P.V. Ananthapadmanabhan, K. Perumal, T. K. Thiyagarajan, S.C, Mishra, L.T. Su, A.I.Y. Tok, Materials Science and Engineering B. 176 (2011) 894 - 899.
11. S.Jayakumar, P.V. Ananthapadmanabhan, K. Perumal, T. K. Thiyagarajan, S.C, Mishra, L.T. Su, A.I.Y. Tok, "Synthesis of Nano-ZrO 2 by Reactive Plasma processing", AIP Conference Proceedings, 1349(1), (2011), 257 – 258.
12. G.K.D. Prasanna Venkatesan, J.Poongkothai, S. Jayakumar, "Effect of Synthesis Techniques on Size, Shape and Crystallinity of Zro2 Nano Particles", Shanlax International Journal of Arts, Science and Humanities, 5(1), (2017), 34-39.
13. G.K.D. Prasanna Venkatesan, J.Poongkothai, S. Jayakumar, "Synthesis of Spherical Agglomerated Nano ZNO Particles by Modified Precipitation Method", Shanlax International Journal of Arts, Science and Humanities, 5(1), (2017), 63-65.
14. G.K.D. Prasanna Venkatesan, J.Poongkothai, S. Jayakumar, "Thermal Plasma Spherodization Of Silica From Quartzite Powder", Shanlax International Journal of Arts, Science and Humanities, 5(1), (2017), 66-70.
15. PrasannaVenkatesan G.K.D." A Novel Approach To Papr Reduction With Reduced Complexity Based On OICF Algorithm ", has published in International Journal of Advanced Technology in Engineering ,Volume No.02, Issue No. 06, June 2014 .
16. Prasanna Venkatesan G.K.D " Analysis Of Power Efficiency In Clustering Based Routing For Heterogeneous MANETS", has published in International Journal For Technological Research In Engineering ,Volume 1, Issue 9, May-2014.
17. Prasanna Venkatesan G.K.D. "Glitchless Digitally Contrlled Delay Lines For Power Optimization", has published in International Journal For Technological Research In Engineering Volume 1, Issue 9, May-2014.
18. Dr.G.K.D.Prasanna Venkatesan J.Kirubakaran," Performance analysis of MIMO systems using CDMA for 4G Wireless Communication", International Journal of Applied Engineering Research, Vol 10, 2015
19. S Jegadeesan, GKD Prasanna Venkatesan, "Smart cow health monitoring, farm environmental monitoring and control system using wireless sensor networks", Int. J. Adv. Eng. Tech./Vol VII/Issue I/Jan–March 2016
20. Prasanna Venkatesan G.K.D."Fpga Based Optimal Charging In a Solar Powered Robot", has published in IOSR Journal of VLSI and Signal Processing (IOSR-JVSP)Volume 4, Issue 3, Ver. II (May-Jun. 2014), PP 29-33.
21. Prasannavenkatesan G.K.D." An Energy Efficient Data Collection for Mobile User With Cluster Points" has published in IOSR Journal of VLSI and Signal Processing (IOSR-JVSP) Volume 4, Issue 3, Ver. II (May-Jun. 2014), PP 44-47.
22. Prasanna Venkatesan G.K.D. "An Efficient Cluster head Selection Strategy for Multicasting and Geocasting" has published in International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 5, May 2014.

23. Prasanna Venkatesan G.K.D."A Base Station Switching Scheme for Green Cellular Networks" has published in International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 5, May 2014.
24. Shashidhar Kasthala, G.K.D.Prasanna Venkatesan, "Estimation of MIMO Power Line Communication Channel Capacity using Multi-Conductor Transmission Line Theory", 2nd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT) 21-23 July 2016
25. G.K.D.PrasannaVenkatesan G.K.D." Multiple Error Recovery in TMR System", has published in International Journal of Engineering Trends and Technology (IJETT) – Volume 11 Number 7 - May 2014.
26. Prasanna Venkatesan G.K.D "Design and Implementation of an On-Chip Permutation Network with Fault Addressing"has published in International Journal of Engineering Trends and Technology (IJETT) – Volume 11 Number 7 - May 2014.
27. PrasannaVenkatesan G.K.D. "An Efficient Location Based Anonymous Routing Protocol for ADHOC Networks", has published in IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 2, Issue 2, Apr-May, 2014.
28. Prasana Venkatesan G.K.D.,"A Hybrid Communication Infrastructure Power System Using Effective Sensor Network", has published in IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 2, Issue 2, Apr-May, 2014.
29. Shashidhar Kasthala, GKD Prasanna Venkatesan, A Amudha, "Design and Development of Protective Coupling Interface for Characterizing the Residential Broadband PLC Channel," Journal of Advanced Research in Dynamical and Control Systems, 1943-023X /May 2017/Vol. 9 SI.2
30. M.Pachiyaanan, Prasanna venkatesan G K D "Compact Size K-band UWB Antenna for Surface Movement Radar: Design and Analysis" has presented in IEEE International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT), Pages:695-698,IEEE Explore Digital Library. The IEEE part Number is CFP15D66-USB and ISBN Number is 978-1-4673-9222-8.
31. K Priyadharshini, RR Jegan, GKD Prasanna Venkatesan, "Automatic registration of images with simulated rotation and translation estimation using HAIRIS", International Conference on Current Trends in Engineering and Technology (ICCTET), 2013
32. S Ramya, GKD Prasanna Venkatesan, "Study of various transmission schemes of MIMO systems", International Journal of Emerging Trends in Engineering and Development, 2(3), 2013
33. K.Sampath Kumar, G.K.D.Prasanna Venkatesan, "Effective Method of Prevention of Cache Poisoning for Wild Card Secure DNS – A Novel Approach", IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol.3, No.2, April 2013
34. S Jayakumar, TK Thiyagarajan, PV Ananthapadmanabhan, SC Mishra, K Perumal, "Synthesis of spherical nanoparticles of zirconium oxide by reactive plasma", Proceedings of the third international conference on frontiers in nanoscience and technology: technical programme and abstract book, 45(5), 2011, 80
35. Y Chakravarthy, KP Sreekumar, S Jayakumar, TK Thiyagarajan, PV Ananthapadmanabhan, AK Das, LM Gantayet, K Krishnan, "Process development for synthesis and plasma spray

deposition of LaPO 4 and YPO 4 for nuclear applications", Proceedings of international conference on peaceful uses of atomic energy-2009, 41(4), 2009, 624 – 625

36. Shashidhar Kasthala, GKD Prasanna Venkatesan, "A Review On Plc Modeling Techniques For Residential Networks", International Journal, 8(8), 2017
37. M Kumaresan, GKD Prasanna Venkatesan, "Cloud Scheduling Using Hybrid Heuristic Based HEFT and Enhanced GRASP Approach: A Study and Analysis", 8th International Conference on Computational Intelligence and Communication Networks (CICN), 2016
38. M Pachiyaannan, GKD Prasanna Venkatesan, "Dual-Band UWB Antenna for Radar Applications: Design and Analysis", 8th International Conference on Computational Intelligence and Communication Networks (CICN), 2016
39. Prasanna Venkatesan G.K.D.,"A Spectrum Decision Framework for Scheduling and Primary User Emulation Attack in Cognitive Radio Network", has published in International Journal of Science and Research,Volume 3 Issue 5, May 2014.
40. M. Pachiyannan, Prasanna venkatesan G.K.D., "Design a 4G MIMO Antenna over wireless sensor node transmission for LTE band" has published in Australian Journal of Basic and Applied Sciences (AJBAS) on May Issue 2015,9(11),Pages:235-252.
41. K Sampath Kumar, GKD Prasanna Venkatesan, "Certain Investigation in DNS Performance by Using Accelerator and Stub Network", 2016 8th International Conference on Computational Intelligence and Communication Networks (CICN).
42. M Pachiyaannan, GKD Venkatesan, " Optimal Design of 6.1 GHz UWB Antenna for off Body Communication", Asian Journal of Information Technology 15 (21), 4229-4235, 2016
43. Shashidhar Kasthala, GKD Prasanna Venktesan, "Evaluation of Channel modeling techniques for Indoor Power Line Communication," International Conference on Advanced Computing & Intelligent Engineering , Advances in Intelligent Systems and Computing (AISC), series of Springer, 2194-5357/ Dec 2016
44. S Jegadeesan, GKD Prasanna Venkatesan, "Distant biometry in cattle farm using wireless sensor networks", International Conference on Communication and Electronics Systems (ICCES), 2016
45. Shashidhar Kasthala, GKD Prasanna Venkatesan, A Amudha, "Design and Development of Protective Coupling Interface for Characterizing the Residential Broadband PLC Channel," Journal of Advanced Research in Dynamical and Control Systems, 1943-023X /May 2017/Vol. 9 SI.2
46. A Anitha, RK Arun Kumar, P Nanthini, GKD Prasanna Venkatesan, M Pachiyaannan, "Analysis And Design Of Cylindrical Shaped Conformal Uwb Antenna", International Journal of Advances in Engineering & Technology, 9(2), 177, 2016
47. M Kumaresan, GKD Venkatesan, "An Effective Scheduling Algorithm for Auditability Awareness using Cloud", Asian Journal of Research in Social Sciences and Humanities, 6(12), 154-165, 2016.
48. K.Sampath Kumar and G.K.D.PrasannaVenkatesan, "A Novel Approach to Enhance DNSCache Performance inWeb Browser using SPVAlgorithm" Indian Journal of Science and Technology, Vol 8(15), DOI: 10.17485/ijst/2015/v8i15/54635, July 2015
49. M Pachiyaannan, GKD Venkatesan, " Optimal Design of 6.1 GHz UWB Antenna for off Body Communication", Asian Journal of Information Technology 15 (21), 4229-4235, 2016

50. K.Sampath Kumar, G.K.D.Prasanna Venkatesan, "Effective Method of Prevention of Cache Poisoning for Wild Card Secure DNS – A Novel Approach", IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol.3, No.2, April 2013
51. M Kumaresan, GKD Prasanna Venkatesan, "Classification Of Images Distributed On Social Sharing Sites In View Of Ba-Svm", Int J AdvEngg Tech/Vol. VII/Issue II/April-June, 2016
52. Dr.G.K.D.Prasanna Venkatesan S.Jegadeesan, "Increasing the Life Time of the Network by Adjusting the Transmission Power of Nodes Based on Received Signal Strength in Wireless Sensor Networks", Research Journal of Applied Sciences, Engineering and Technology, 8(18), 9, 2014
53. Praveen Kumar.M Dr.G.K.D.Prasanna Venkatesan, "MIMO Based Transceiver System for Unmanned Ground Vehicle for Surveillance In War Field", 1(3),4,2010
54. P Deepa, T Manikandan, GKD Prasanna Venkatesan, "Design and Implementation of an On-Chip Permutation Network with Fault Addressing", International Journal Of Engineering Trends And Technology, 1(11), 359-361.