CGC International Journal of Contemporary Technology and Research
ISSN: 2582-0486 (online) Vol.-4, Issue-2; DOI: 10.46860/cgcijctr.2022.07.31.316

Smart Antennas for Various Applications

Preeti Bansal*, Nidhi Chahal
Department of Electronics and Communication
Chandigarh Engineering College, Landran, Mohali
Email Id: Preeti.ece@cgc.edu.in, Nidhi.ece@cgc.edu.in

Abstract: **The paper presents about smart antennas for advancement in wireless and mobile communication. Smart antennas also called adaptive array antennas with better signal processing & can be used to calculate beam forming vectors which helps in tracking & locating antenna beam of target. Smart antennas are helpful in health monitoring in covid-19 pandemic and provides better service quality. Smart antenna is one of the rising innovations which can satisfy the prerequisites. Smart antennas are being used for controlling, monitoring and analyzing real time systems for various applications In smart antennas spatial division of the signal is used as compared to spectrum division, it can be beneficial for improving the performance of wireless communication. This paper describes how switched beam & adaptive array antennas differ from basic antennas.**

Indexed Terms- **Adaptive antennas, smart antennas, wireless communication, and mobile communication. (*Keywords*)**

I. INTRODUCTION

With increasing demand of wireless & mobile communication, service providers are concerned for advancement in present technologies. Due to continuous & rapid advancement in communication system, there is requirement of better quality & service by user .This led to use of smart antennas which are better as compared to present antennas as they are cost effective, low power consumption.[14] [15]. SMART antenna shave attracted many researchers due to the remit so great channel capacity, strong anti-interference ability, convenient be an adjustment, and achieves point-to-point communication. Smart antennas are additive array systems with which antenna radiation beam can be modified by using some additional processing techniques [8]. Calibration of various systematic errors is crucial to a smart antenna's correct operation. Taking into account explosion accumulation in the quantity of advanced cell endorsers, specialist organizations are turning out to be progressively worried about the restricted limits of systems already into existence [12] [17]. The concern give rise to the dispersion of smart antennas systems all through significant metropolitan areas, cellular regions etc. Smart antennas can be considered because it contains array of elements which are connected to a digital processor. By using different type of configurations the capacity of a wireless link will be increased by combining gain diversity, gain of array, and conquering interference. Multiple path of propagation are generated by reflection and scattering. By using smart antennas in communication faster bitrate, SDMA, multi user can be achieved [13].

II. LITERATURE REVIEW

In this paper Smart Antenna System performance is done is evaluated in a current Wireless Communication for example to recognize the best areas for smart antennas in the radio system in the most practical arrangement, the raise requirement for a radio system arranging and enhancement apparatus [1]. As aresult, using10 dB range band width matching of the Smart antenna decreases with increase in$\in_r$. As substrate value is further increased, higher Q factor of antenna is achieved. With$\in_r$=1, the bandwidth of an antenna attains a highest band width matching. The Smart Antenna provides best performance in terms of its bandwidth and size. In this paper various parameters like gain, radiation pattern of smith chart for 3GHZ frequency band are calculated.

The smart antennas are used for the SOTM (Satellite on the move) application in this paper [2] Adaptive beam-steering smart antennas have been used which helps in reduction of cost. For good performance mm-wave smart antennas have been designed which are low in cost. Here, two examples wide beam scanning folded reflect array and a low cost dual polarized reconfigurable reflect array having phase control of single bit with PIN diodes have been used in designing.

In this paper [3], low cost, low power consumption, compact size smart antennas have been reviewed. Folded monopole ESPAR, Small Director Array, RCR based smart antennas have been reviewed. The antennas were able to achieve electronic beam array having wide angular range.

This paper [4] focused on designing of wide band and uniform circular array with high gain having adjustment of elements for smart antennas. Here, array of 15 elements has been designed & fabricated. Impedance bandwidthof38.3 %(3.95-5.82GHz) and pattern bandwidth of12.8 %(4.4-5GHz) has been calculated which achieves good performance as compared to basic array.

In this paper [5], a complete cycle beams witch's d planar patch antenna with compact size is designed having three dipole radiators with arrangement of hexagonal loop. Impedance band width of 10dB for frequency 2.3 to 2.45 GHz has been calculated between resonance modes. The radiation pattern rotates for every

60º in six steps to complete 360 º in azimuthal plane. Forazimuthalplanecoveragethreepindiodeshavebeenuse d.Sincebeamcoverage is complete so losses have been minimized.

Smart antennas canal so be used in underwater acoustic communication using OFDM [6] [7]. Under water Acoustic network sensor has been designed using2D&3Darchitecturesomeparameterslikemultipath fading, noise, delay spread, bit error rate has been considered using OFDM. For faster wireless transmission under water, smart antennas can be used because they help in minimizing propagation delay and increasing data transmission rate.

In this paper [9], Massive Multiple Input Multiple Output Beam forming (BF) technique is used to develop the 5G system and Millimeter (mm) wave is used to provide higher frequency. Conventional BF can provide the Channel State Information (CSI) to end terminals but adaptive BF cannot provide CSI. But adaptive BF is highly efficient for changing their behavior according to the requirement of the channel. In such a hybrid BF technology can be used to implement 5G technology which uses both analog and digital BF technology to transmit and receive the signal without distortion. The major challenge in the implementation of 5G technology is to find out the best beam forming technique. This paper deals with the performance of various beam forming techniques for implementing 5G technology. Table 1 below shows comparison of various antennas used for smart applications.

TABLE 1 COMPARISON OF SMART ANTENNAS

S.No	Antenna Type	Technology	Key points
1	Compact Smart Antenna	IE3D	Increase in SNR
2	SOTM	Ka Band	High performance mm based smart antennas
3	Low cost smart antenna		compact size, low power consumption
4	Uniform circular array	calibration element	enhanced average array gain
5	compact planar patch antenna	CST	360 degree beam coverage
6	Smart Antenna	OFDM	Decrease in propagation delay & increase in data rate
9	Non Linear adaptive smart antennas	MMIMO	Hybrid Beam forming provides high data rate & low BER

III. SMART ANTENNAS

Smart antenna system contain multiple antennas or adaptive antenna arrays which helps in better digital signal processing algorithms. Smart antenna systems can perform various functions such as DOA (Direction of Arrival) estimation of the signals. Based on latest technologies, capacity demand and quality of service (QoS) requirements can be enhanced in wireless & mobile Communication [18].

Smart antennas can be implemented in two approaches named as switched beam in which the rear finite numbers of fixed, pre-defined antenna patterns with beam structure with combination of strategies and secondly, in adaptive array in finite radiation patterns are used which are made adjustable as per requirement in real world according to the radio environment [10][11]. Capacity of smart antenna is more as compared to switched beam systems if coverage are assess populated and interference will be less. There are some advantages of adaptive array antennas like increase in range, security enhancement etc.

Figure1 shows formation of beam using switched beam in which beams are fixed having one beam active in terms of the desired signal made by adjustment of phase only. This technique is also called phase array. It contains array of directional antenna elements which can cover whole region.

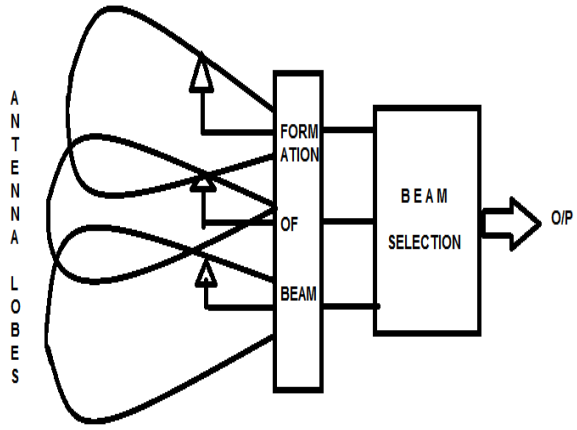

Figure1: Switched Beam Array

Figure 2 below shows adaptive array using beam forming. In this technique, array of antennas are used to transmit radio signals in desired direction instead of transmitting in all the directions. In this figure, w_1 & w_2 are weights to calculate desired signal which reduces the interference signal [16]. Here array of two elements are used& y (t) is the output signal.

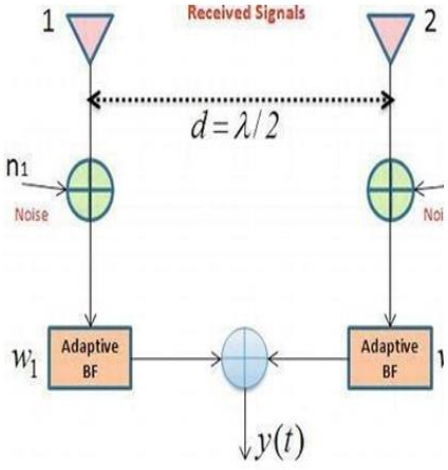

Figure 2: Adaptive array Beam forming Block diagram

Weights can also be calculated using adaptive algorithms. These weights can be varied for each element of antenna array Distance between two consecutive arrays must be ideal value i.e λ/2.It can be used in various approaches in wireless communication eg. Least Mean Square, Minimum Mean Square Error etc higher SNR, improved array gain, minimum Co Channel interference can be achieved using beam forming algorithms.

IV. CONCLUSION

Smart antennas are considered in two approaches for example adaptive array antenna which adjusts radiation beam of antenna by utilizing a special processing circuitry which provides either signals with phase or other control signals depend endosome special software. It provides excellent execution but at the expense of extra circuits, complexity, space and capital. Other approach to accomplish this is switching of beam which is comparatively simpler to execute and is economic. In beam switching systems, recon figural antennas in the currently ears have been developed as a best alternative to all these requirements like radiation pattern and space diversity, tuning of frequency and band width as per need, change in polarization etc. Smart antennas can be efficiently used in mobile & wireless communication. Smart antennas are compact in size which is requirement of today's research. For smart antennas better gain, less interference, Radiation pattern, less propagation delay, high data transmission rate can be achieved using different approaches of smart antennas.

REFERENCES

[1] G. Prajapati and K.C Mahajan, "Study and analysis of Smart Antenna in Wireless Communication Application ",Journalof Indian Research, Vol. 1 no. 3 pp. 69-75,2013.

[2] Q. Luo and S. Gao, "Smart Antennas for SatelliteCommunications on theMove", International Workshop on Antenna Technology: Small Antennas, Innovative Structures,and Applications (iWAT), IEEE, 2017

[3] Q. Luo and S. Gao, "Low-Cost Smart Antennas for Advanced Wireless Systems", International Workshop on Antenna Technology, IEEE, pp. 132-135, 2014.

[4] T. Li, F. Zhang and F. Zhang, "Wide-band and High-Gain Uniform Circular Array With Calibration Element for Smart Antenna Application", IEEE antennas and wireless propagation letters, vol. 15, pp. 230-233, 2016.

[5] A. Pant, L. Kumar, M.Parihar "Smart Antenna with Dynamic Radiation Pattern Capability for 4G Applications "Conference on Information and Communication Technology (CICT'18), IEEE, 2018.

[6] M. Jyotsna, W. Chavan," Smart Antenna Approach in Underwater Acoustic Sensor Network using OFDM: A Review", International Conference on Green Computing, Communication and conservation of energy (ICGEC) IEEE, Vol-1, PP 155-158, 2013

[7] Araújo DC, de Almeida ALF, Da Costa JPCL, de Sousa RT (2019) Tensor-based channel estimation for massive MIMO-OFDM systems. IEEE Access 7:42133–42147. https://doi.org/10.1109/ACCESS.2019. 2908207

[8] Chen J, Zhang X, Zhang P (2020) Bayesian Learning for BPSO-Based Pilot Pattern Design Over

[9] T.D Subha,C Arunachala Perumal, T.D Subash,"Nonlinear adaptive smart antenna resource management for 5 G through to surveillance systems" Materials Today: Proceedings xxx (xxxx) xxx, Volume 43, Part 6, 2021, pp 3562-3571

[10] Kaur A, Malik PK (2020) Tri State, T Shaped Circular Cut Ground Antenna for Higher 'X' Band Frequencies. 2020 International conference on computation, automation and knowledge management (ICCAKM), Dubai, United Arab Emirates, pp 90–94

[11] Lee H, Gong CA, Chen P (2019) A compressed sensing estimation technique for doubly Selective Channel in OFDM systems. IEEE Access 7:115192–115199[2]Q. Luo and S. Gao, "Smart Antennas for Satellite Communications on the Move", International Workshop on Antenna Technology: Small Antennas, Innovative Structures, and Applications (iWAT), IEEE, 2017

[12] Malik PK, Singh M (2019) Multiple bandwidth design of micro strip antenna for future wireless communication. Int J Recent Technol Eng. ISSN: 2277–3878 8(2):5135–5138. https://doi.org/10.35940/ijrte.B2871.078219 66.

[13] Malik PK, Tripathi MP (2017) OFDM: a mathematical review. Journal on Today's Ideas - Tomorrow's Technologies 5(2):97–111. https://doi.org/10.15415/jotitt.2017.52006 67

[14] Malik PK, Wadhwa DS, Khinda JS (2020) A survey of device to device and cooperative communication for the future cellular networks. Int J Wireless Inf Networks 27:411–432. https://doi.org/10.1007/s10776-020-00482-8

[15] Shaik N, Malik PK (2020) A retrospection of channel estimation techniques for 5g wireless communications. International Journal of Advanced Science and Technology 29(5):8469–8479 98.

[16] Tiwari P, Malik PK (2020) Design of UWB Antenna for the 5G Mobile Communication Applications: A Review. 2020 International conference on computation, automation and knowledge management (ICCAKM), Dubai, United Arab Emirates, pp 24–30

[17] Singh S, Sharma M, Palta P,, Gupta A, (2020), "Investigations on Millimeter Wave (mmW) Antenna for 5G Technology: Design Considerations and Applications", CGCIJCTR, Vol 3, issue 1, pp 149-153DOI: 10.46860/cgcijctr.2020.12.26.149

[18] Mohammad A, Mouin Y,(2019),"Adaptive Beamforming for Smart Antenna System Using Planar Antenna Array",IJCST,Volume 7 Issue 1,pp 40-44.