JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Survey On Adapting Bandwidth With Ground Plane Antennas

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Abstract : The design of several reconfigurable antennas and their uses in the contemporary environment are reviewed in this study survey. The design of these antennas presents additional difficulties. Additionally, the many techniques for rearranging the frequency bands are covered in this work. Examples of both hybrid and single parameter reconfigurations are examined along with their respective performances. The characteristics of the current antenna, including its size, efficiency, and gain, are contrasted. This paper presents the different switches that were installed in the antenna to accomplish the reconfiguration. The advantages and disadvantages of various switches, including mechanical switching, MEMS, pin diodes, and varactor diodes, are also discussed. To activate and deactivate the antenna's construction, the diodes are turned on and off. In a similar vein, mechanical switching mechanisms employ mechanical actuators. Various examples are used to review the mechanisms of polarization reconfiguration between linear and circular, as well as pattern reconfiguration between directional and omnidirectional. Furthermore, a thorough review is conducted on multiple designs of MIMO antennas and reconfigurable filtering antennas.

IndexTerms - Antenna; MIMO ; Reconfigurable Antenna; multi-band antennas; Frequency Reconfiguration; PIN diodes

I. Introduction

This paper providing a survey on the Reconfigurable ground plane antenna for improvising bandwidth.The need for increased bandwidth is growing as new wireless communication methods are introduced. To improve the efficiency of spectrum utilization, the idea of reconfigurable antennas is presented. Reconfigurable antennas may dynamically alter important operating factors like frequency, band width, pattern, and polarization, in contrast to static antennas. Reconfigurable antennas are gaining a lot of interest because of their notable ability to use the spectrum effectively. Reconfigurability in antennas is commonly accomplished using field effect transistors, varactor diodes, PIN diodes, and microelectromechanical switches.

Recently, a number of reconfigurability antenna designs based on p-i-n diodes have been published. Frequency reconfigurability can be achieved, for example, by choosing adding or removing certain antenna structure components. In few of survey papers the antenna employs five p-i-n diodes that are placed inside the ground plane's slot to enable frequency reconfigurability by allowing the antenna to flip between nine frequency bands.

Some papers discussed regarding a micro-strip frequency reconfigurable patch antenna comprising a coaxial probe, two lumped capacitors, four varactor diodes, and a square radiating patch may produce circular polarization at various resonant frequency bands.

It is currently difficult to create frequency reconfigurable antennas that cover more than two frequency bands.A small frequency reconfigurable antenna that resonates at ten distinct frequencies is proposed in on paper. To achieve reconfigurability, two PIN diodes are utilized as switches in the antenna slot to change the slot's length.

II. LITURATURE SURVEY

1) Swarup Das et al. [1] proposes a tiny four-element Multiple Input Multiple Output (MIMO) antenna for the Terahertz frequency band, measuring only 125 µm by 125 µm. With a moderate gain, it displays consistent radiation properties. There are permissible limits for other MIMO performance factors, such as the Envelop Correlation Coefficient, Diversity Gain, Channel Capacity Loss, and Total Active Reflection Coefficient. Comparing the design to other SWB MIMO antenna designs, it features more antenna elements with smaller physical dimensions. The scheme makes use of ordinary metallic squares, extended ground planes, and elliptical, Minkowski, and circular square fractal curves on radiating patches. With an operational impedance bandwidth of 0.72 THz to 10 THz and over 20 dB isolation, the system increases bandwidth and improves isolation between antenna parts. Its highest gain of 8.2 dBi and appropriate radiation characteristics are present. Numerous applications in the THz frequency band can benefit from this SWB MIMO antenna design.

2) Behbod Ghalamkari et al. [2] gives idea about Octagon-star fractal microstrip patch antenna with wide bandwidth for terahertz applicationsDesign looks at a wide-band Octagon-Star fractal Microstrip patch antenna with a rectangular ring

resonator and defective ground construction, with a focus on 0.6-11.5 THz. The antenna is qualified for terahertz applications such weapon screening, communication services, explosive detection, water content imaging, and concealed object imaging because of its fractal design, uneven ground plane, and loading techniques, which give broad bandwidth and high gain. With an S11 bandwidth of 10.9 THz, the proposed antenna has a peak realized gain of 16.64. It has omnidirectional 2D radiation patterns at frequencies of 1, 3, 5, 7, 9, and 11 THz in Phi= 90 (E-Field) and Phi= 0 (H-Field). A more focused pattern results from increasing frequency. The peak gained decreases exponentially with increasing frequency.

3) Sumeet Singh Bhatia et al. [3] gives description For A rhombus-shaped fractal antenna with a malfunctioning ground plane is utilized in UWB wireless applications. In comparison to comparable structures, it may generate a greater impedance bandwidth due to its tiny size of 30 x 24 x 1.6 mm3. After the ground plane was adjusted and optimized, the frequency range of 1.72 to 19.25 GHz was covered by a bandwidth of 17.53 GHz (167.19%). At 2.4 GHz, the antenna's maximum achieved gain was 6.48 dB. The far-field radiation patterns at 2.4, 7.8, 13.4, and 18.5 GHz were measured for the antenna.

4) Bo Yin et al. [4] This research presents a fractal rectangular Dielectric Resonator Antenna (RDRA) for wireless communication that is wideband, with symmetric radiation patterns, and low cross-polarization. The antenna employed Hook-Shaped Electric Dipole (HSE-Dipole) and Koch-like Fractal Rectangular Dielectric Resonator Antenna (FRDRA), which are equal to magnetoelectric dipoles. The RDRA has a 15% size reduction, which enhances impedance matching. The antenna is powered by a substrate integrated waveguide feeding network with a bandwidth of 19.5% impedance. With minimal cross-polarization, an average gain of 5.96 dBi, and a front to back ratio (FTBR) of more than 20 dB, the prototype demonstrates remarkable radiation performance. Furthermore, a complementary antenna is introduced using fractal geometry and a magnetoelectric dipole antenna. The ME complementing antenna theory improves the antenna's FTBR and radiation performance. Koch-like fractal shape improves minimization and matching of impedance. The antenna's multidimensional regulation makes it possible to map the correlations between performance and structural characteristics. In addition, it can accomplish circular or dual polarization, which is useful for various communication applications .

5) Changiz Ghobadi et al. [5] This research presents an ultra-wideband (UWB) fractal antenna designed for microwave applications in the medical field. Three straight-line conductors and four epsilon shapes make up the antenna architecture, which offers an impedance bandwidth of 2.58 to 20.95 GHz. The antenna runs at a wavelength of 116.3 mm and measures 26 mm by 22 mm. For various applications, a reconfigurable patch antenna is recommended. CST software is used for full-wave analysis, and ADS software is used for circuit model configuration and validation. A prototype is constructed to verify the findings of wave research and theoretical solution outcomes. The proposed antenna has a high realized gain magnitude of 7.21 dB at 20.95 GHz. In this work, a fractal antenna operating in the 2.58 GHz to 21 GHz frequency range is presented for ultra-wideband (UWB) applications. With an average efficiency of above 85%, the low-profile antenna provides a wide bandwidth ratio, a fractional bandwidth of 157%, and a gain of 7.21 dB. In medical, it's utilized to find tumor cells in the throat and breast. The epsilon shape is appropriate for wireless UWB, WiMAX, and other systems due to its acceptable diversity .

6) Jagtar Singh Sivia et al. [6] An ideal fractal antenna design with a modified ground structure for wideband applications is presented in this research. After a number of modifications, the antenna's design was finalized, with a maximum bandwidth of 1.88 and 0.20 GHz. Through the use of both vertical and horizontal expansions in the partial ground plane, the maximum bandwidth in the frequency range of 3-6 GHz was raised to 2.48 GHz. Radiation efficiency, gain, and return loss are among the antenna's performance parameters that fall within acceptable boundaries.The recommended antenna is suitable for wireless applications such as WLAN and WiMAX. For wideband applications, the study offers an ideal fractal antenna design with a modified ground structure. In order to boost bandwidth, a defective ground plane is introduced in the final iteration. The manufactured antenna has a bandwidth of 0.69 GHz and 1.406 GHz, whereas the simulated antenna has 2.48 GHz. Compared to current antennas, the suggested antenna is smaller and more portable. With a gain of 5.8 dB and a bandwidth of 2480 MHz, it has less bandwidth and gain than current antennas. Wireless technologies including WLAN (5.15–5.35 and 5.72–5.82 GHz) and WiMAX (3.4–3.6 GHz) can benefit from the suggested antenna.

7) Muhammad Dawood Idrees et al. [7] A hybrid meander-Koch fractal ring antenna for the 5 GHz WLAN band is outlined in this research. The antenna's design combines the geometries of a Koch curve and a meander to increase its effective electrical length and bandwidth. The total dimensions, encompassing the whole 5 GHz WLAN spectrum, are 45 × 25 × 1.6 mm3. The amount of segments in the convolutional shape reduces the antenna size, and the generator's IFS technique is compared to the conventional Koch curve antenna. The realized antenna prototype's viability is confirmed by the results of simulations and measurements.

8) Toachim Nicolaescu et al. [8] Fractal planar antenna designs revealed that smaller, better antennas were feasible. Investigated were modified Sierpinski monopoles and folded and unfolded Koch antennas. These antennas provide multiband capability and size reduction, showing promising performance in ISM bands (2.45 and 5.8 GHz) for the modified Sierpinski gasket monopole.

9) Amit Kumar Singh et al. [9] In order to enhance cross-polarization (XP) and impedance matching in microstrip antennas, a novel strategy is put forth in this study. When the DGS is incorporated into a rectangular MSA, the H-plane experiences a flat relative XP reduction of 22 dB. A confirmed equivalent circuit model (ECM) is shown, utilizing software from the Advanced Design System. After testing and fabrication, a prototype exhibits good agreement with the results of simulations. The suggested design, which operates between 2.32 and 2.58 GHz and has strong far-field radiation characteristics, may be helpful for IEEE 802.11b applications. The application of a DGS for improved impedance matching and XP level

suppression is investigated in this work. The study discovered that improved impedance matching and XP reduction occur when the DGS is positioned in the center. The suggested ECM opens up new possibilities for DGS position optimization and offers improved design information to the antenna community.

10) Jagtar Singh Sivia et al. [10] A defective ground-based fractal antenna with wideband frequency response has been designed for multiple applications, including wireless computer networking, mobile Wi-Max, microwave ovens, earth-to-space communication, satellite communication, WLAN, WiFi, Bluetooth, direct-to-home services, satellite communication for downlink, wireless fidelity, and satellite communication for uplink. By using microstrip line feeding, the antenna design matches the impedance. The 2.85 GHz frequency produced a gain of 6.83 dB, S11 value of -19.72 dB, bandwidth of 2830 MHz, and VSWR of 1.23 after multiple iterations to improve the antenna's performance. The recommended antenna shows wideband behavior with improved voltage standing wave ratio, gain, reflection coefficient, radiation pattern, and bandwidth. Direct-to-home services, Bluetooth, wireless computer networking, mobile Wi-Max, satellite communication, earth-to-space communication, wireless local area networks, Wi-Fi, radio frequency identification, microwave ovens, and wireless computer networking are just a few of the many frequency bands it covers. On a FR4 epoxy board measuring 32 mm by 30 mm by 1.6 mm, the antenna was built and tested. The antenna shows a bandwidth of 2830 MHz with a gain of 6.83 dB, a refection coefficient of -19.72 dB, and a VSWR of 1.23 at 2.85 GHz.

11) Dian Rusdiyanto et al. [11] This study describes the wideband microstrip antenna on a bow-tie patch antenna that makes use of Defected Ground Structure (DGS). An FR-4 substrate and a CST microwave studio are used in the development of the antenna for 5G applications. When fractional bandwidth is increased from 2.6% to 10.45% in the computed reflection coefficient, the observed reflection coefficient produces 13.37%, which is consistent with the simulated values.

12) Lee Yee Hui et al. [12] This paper investigates the construction of a monopole antenna with several defective ground structures (DGS) for ultra-wideband applications. Examining each design's bandwidth, the V-shaped DGS (2.98–14.9 GHz) had the biggest bandwidth, measuring 133.3%. The efficiency has a peak gain of 5.3 dB and a range of 30 to 64%. An R&S network analyzer is used to assess the antenna's performance after the V-shaped DGS is constructed on a Rogers RO4003C substrate, showing increased performance. In contrast to conventional antennas, the monopole antenna discussed in this study has V-shaped DGSs, good monopole radiation properties, and a 95.4% bandwidth. With its capability for over 2.98 GHz frequency use, the compact design and low-cost manufacture make it a great choice for UWB applications.

13) John J. Borchardt et al. [13] The paper offers a first-principles mechanism of operation for the U-slot patch based on CMT as disclosed by CMA. CMT is important for three reasons: The first three requirements are the presence of in-phase/anti-phase charge distributions, the ability to statistically explain the observed CMA frequency-splitting, and the completion of a circuit model that shows coupling between two resonators under CMT control. Roughly identical fractional bandwidth, ratio of dimensions, and normalized coupling coefficient are obtained via the CMT-based design technique.

14) Stub Ke Li et al. [14] A multiple-resonance method for wide-slot antennas with fork-shaped stubs is presented in this study. The impedance bandwidth can be increased by including an additional stub. After testing two designs, the suggested antennas demonstrated an impedance bandwidth of 148.6% (0.9-6.1 GHz) for S11 < −10 dB, which is 17.9% more than that of conventional antennas. The antennas' consistent radiation pattern qualified them for use in wireless communication networks. This study provides a wide bandwidth (BW) multiple-resonance approach for printed wire antennas (WS) with a fork-shaped stub. After testing two designs, the impedance BW was found to be 148.6%. The antennas were useful for a variety of wireless communication systems since they demonstrated stable far-field radiation and were simple to build. Two upgraded designs served as validation for the method.

15) Z. A. Nassr et al. [15] A frequency selective surface (FSS) integrated wideband planar antenna is presented in this paper. A simple square ring is utilized in the construction of the FSS array screen, and the substrate material is FR4. The antenna is positioned 28 mm away from the FSS setup and parallel to it. Directivity and gain along the broadside direction are improved as a result of the design's integration to produce a steady frequency response. The research provides a planar antenna integrated with a pass-band FSS structure for wireless communication using FR4 as the substrate. Using the FSS, the antenna's gain and directivity are boosted by 5.1 and 6.5 dB, respectively.

16) Yogesh Tyagi et al. [16] The integration of a high efficiency broadband 10-element linear SWA with differential feeding technique is covered in this chapter in order to alleviate the drawbacks of conventional SWAs. The method's design and simulation resulted in a 7.5% return loss bandwidth, enhanced antenna efficiency, and improved gain flatness characteristics. Also planned and built was a 2 × 10 planar broadband SWA with a 7.8% return loss bandwidth. Owing to their huge bandwidth, high power handling capability, and low manufacturing tolerances, the recommended differential feeding approaches are suitable for SWA devices operating at millimeter and sub-millimeter wave frequencies. The built-in SWA antennas are tested and explained; a prototype exhibits better than -17 dB return loss over 7.6% bandwidth and 90.2% efficiency.

17) Sahar Saleh et al. [17] A new Microstrip to Slot line transition design for a small Ultra Wideband Vivaldi Tapered Slot Antenna (VTSA) is presented in this research. After four models (A-D) are constructed and examined, it is clear that Model D has a consistent end-fire radiation pattern, increases bandwidth by 24.56%, minimizes size by 19.25%, and offers a maximum gain of 6.51 dBi. Hardware measurements are used to validate the proposed antennas. The study looks at how altering the transition shape affects the suggested VTSA's performance and compactness. Four models are designed by it: Model C (Trapezoidal/rectangular), Model B (Taper/Taper), and Model A (Rectangular/Rectangular). Model D's size is less than Model A's, which improves matching and bandwidth. The maximal gain of Model D is just 12.26% lower than that of Model A,

therefore it is still reasonable. All versions provide flat group delays, steady end-fire radiation patterns, good S11, and improved bandwidth through the UWB frequency region.

18) Chenghui Wang et al. [18] Using the Theory of Characteristic Modes (TCM) for slot apertures, the proposed antenna begins with an H-shaped slot in an infinite ground plane. The geometry of the slot antenna is modified, and magnetic characteristic currents are measured. It takes the insertion of two pairs of differentially-fed capacitive coupling components to activate the first two modes. An integrated wideband feeding network is the intended configuration. Experimental and computational results demonstrate the broad bandwidth, good dipole-like radiation properties, and improved port isolation and cross-polarization levels of the proposed dual-polarized slot antenna. The work employed TCM analysis to comprehend the resonant behavior of an H-shaped slot antenna in an infinite ground plane. The study makes suggestions for altering the slot's geometry to enhance the antenna's effectiveness. Symmetric feeding arrangements and wideband baluns are used. An antenna prototype has been constructed, and the design has been confirmed. The antenna's large bandwidth, robust isolation, and pure polarization make it suitable for WLAN/WiMAX, LTE, CDMA2000, and GSM1900 communication systems.

19) Maryam S. Jameel et al. [19] This work offers a small Ultra-Wideband (UWB) antenna powered by a large bandwidth Coplanar Waveguide (CPW) for modern wireless communities. A slotted patch resonator printed on 1.5 mm-thick FR4 substrate with a dielectric constant of 4.4 was used in the design and simulation of the antenna. The antenna uses the 10.354 GHz bandwidth of the UWB spectrum to operate between 3.581 and 14 GHz. The maximal efficiency and gain within UWB are more than 3 dBi and 82%. The predicted S11 scattering response was found to be in good agreement with measurements for a UWB bandwidth of 10.354 GHz. The recommended antenna is smaller and has a larger bandwidth than earlier UWB-based antennas. We studied the rectenna simulation model using the Schottky diode model SMS 7630-005LF and two stubs.

20) Zaheer Ahmed Dayo et al. [20] This paper provides a novel multielement design for a compact, high-gain coplanar waveguide-fed antenna. The antenna was tested and verified experimentally after being constructed on a brand-new WangLing TP-2 laminate. The model performed remarkably well, with a peak realized gain of more than 9.0 dBi, an ideal radiation efficiency of more than 87.6%, and a strong relative bandwidth of 11.48% at 10 dB return loss. Other characteristics of the antenna model are a strong current distribution and symmetrical stable far-field emission patterns. In land, air, and marine military radar applications, the high-performance antenna is a practical choice. Because of its significant current density and symmetrical stable radiation patterns, the suggested antenna demonstrated optimal gain and radiation efficiency when compared to state-of-the-art technology, despite its compact size. This made it a competitive option for military airborne, land, and naval radar applications.

CONCLUSION

Even though there have been notable advancements in the field of reconfigurable antenna research, much work remains. Thus, in terms of reconfigurable antenna designs, we should conduct a thorough investigation into novel design techniques, especially with regard to the use of polarization reconfigurable antennas for MIMO systems.

Furthermore, in conventional communication systems, a multi-antenna array with a long range is frequently used to achieve the geographic diversity of the base station. Nevertheless, there hasn't been enough research done on how mobile terminals for MIMO systems should be designed with many antennas. As the distance between antennas decreases significantly, the issue of mutual coupling also gets more important. Physical constraints cannot be bypassed, even though some decoupling matching technology can help with this issue. For this reason, polarization reconfigurable antennas ought to be emphasized.

Reconfigurable antennas should become smaller in the near future. In particular, a significant role is being played by planar reconfigurable antennas. One of the biggest benefits is that planar reconfigurable antennas may readily integrate monolithically with MEMS switches and substantially lower the antenna's dimensions. Additionally, it is imperative that additional work be done on the investigation of efficient optimization techniques and the study of how complicated electromagnetic environments affect antennas.

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