PERFORMANCE & IMPROVEMENT OF VARIOUS ANTENNA DESIGNS IN MODERN WIRELESS COMMUNICATION SYSTEM

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ABSTRACT

Today' s, The rapid development of electronics and wireless communications led to great demand for wireless devices that can operate at different techniques and methods have been introduced. Among these techniques, in modern communication devices over mini micro-strip antenna, Ultra-wideband antenna and Broadband polarization diversity antennas are commonly used due to their low profile and low volume. In this speedy dynamical world in wireless communication high gain, large bandwidth, multiband and high efficiency are playing a key role for wireless applications. In This paper presents a review upon the most recent research efforts associated with those techniques to design micro strip patch antenna and enhance the overall performance. The various existing surveys are also discussed to identify the research deficit for the scope of future research.

KEYWORDS

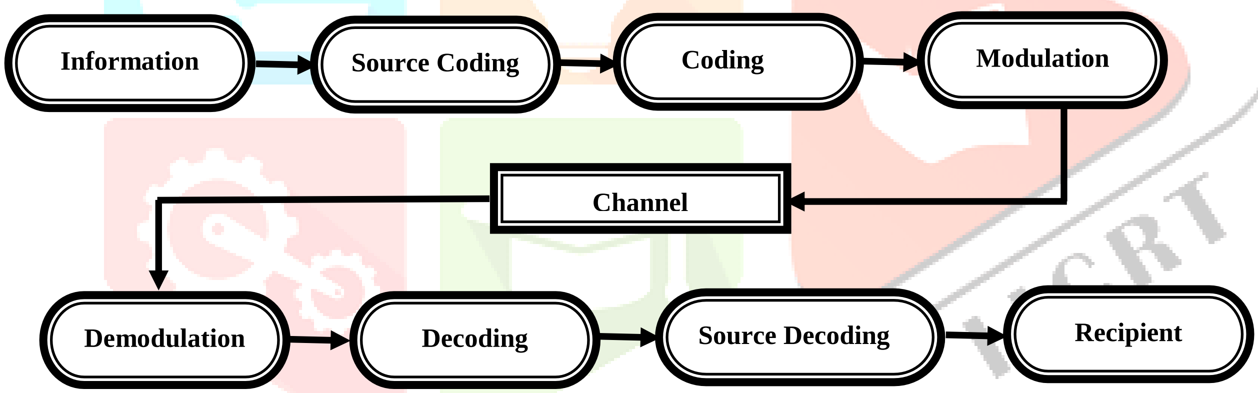
Mini micro strip antenna, Ultra wideband Antenna, Broadband polarization diversity antenna, Reception apparatus, Modern remote Communication framework, Mobile terminal, base station controller (BSC), Macro diversity, Space diversity. SISO with antenna diversity, Single-input, single-output (SISO), Multiple-input, multiple-output (MIMO) and Multi-com with multiple antennas.

INTRODUCTION

In this paper, Modern Wireless communication networks have become more popular than expected at the time of 1960s and 1970s when the cellular concept was first developed. According to ITU' s latest status, there are 76.2 mobile subscriptions for each 100 people which is 4.4 times the number of fixed telephone lines. On World Statistics Day, October 20, 2010. The International Telecommunication Union (ITU), the UN Agency for ICT, announced its eagerly awaited mobile estimates for 2010. By the end of the year there will be 5.3 billion mobile subscriptions. That is equivalent to 76 per cent of the world population and is a huge increase from 4.6 billion mobile subscriptions at the end of 2009. Nearly a billion of these are 3G subscriptions, and potentially mobile Web users. The mobile telephony is becoming more and more ubiquitous. In developed countries, the growth is slowing down with average penetration rates above 100 per cent. But in developing countries, growth is still strong and therefore more and more people will be connected to telephones that never had access to a telephone at all in the past, thus mobile revolution is continuing. The telecom story continues to grow in India also. As the number of users is increasing so there is need to invent new technologies to fulfil the requirement of users.

<table>
<tr><th colspan="2">Waveband</th><th>Wavelength</th><th>Frequency</th><th>Mode</th><th>Use</th></tr>
<tr><td colspan="2">Long wave</td><td>30000m~3000m</td><td>10kHz~100kHz</td><td>Ground wave</td><td>Ultra-long range radio comm... & navigation</td></tr>
<tr><td colspan="2">Medium Wave</td><td>3000m~200m</td><td>100kHz~1500kHz</td><td rowspan="2">Ground wave and Sky wave</td><td rowspan="3">AM radio broadcasting</td></tr>
<tr><td colspan="2">Intermediate waves</td><td>200m~50m</td><td>500kHz~6000kHz</td></tr>
<tr><td colspan="2">Short wave</td><td>50m~10m</td><td>6MHz~30MHz</td><td>Sky wave Microwave</td></tr>
<tr><td rowspan="4">Microwave</td><td>Meter wave</td><td>10m~1m</td><td>30MHz~300MHz</td><td>Approximately rectilinear wave</td><td>FM radio broadcasting</td></tr>
<tr><td>Decimeter</td><td>1m~0.1m</td><td>300MHz~3000MHz</td><td rowspan="3">Rectilinear wave</td><td rowspan="3">Television Radar Navigation</td></tr>
<tr><td>Centimeter wave</td><td>10cm~1cm</td><td>3000MHz~30000MHz</td></tr>
<tr><td>Millimeter wave</td><td>10cm~1cm</td><td>3000MHz~30000MHz</td></tr>
</table>

The above Table 1, the present radio-recurrence range. Current remote correspondence framework principally comprises: the 2G portable cell organize framework spoke to by GSM, IS-95; the 3G by CDMA2000, WCDMA, and TDSCDMA. It additionally incorporates WLAN, WMAX, the radio TV framework and the satellite correspondence framework. The correspondence framework can be separated into the simple correspondence framework and the computerized transmission framework, with the last supplanting the previous. The models for the correspondence framework are outlined in Figure 1.



Now discuses about the some of the antennas are

Micro-strip (2.4GHz): Commonly applied on radio equipments of broad frequency ranges, such as airborne or portable devices.

Ultra-wideband antenna: With signal broadband of 500MHz or more. Mainly spherical antennas, ellipsoidal monopole or bi-conical antennas. At early periods it was used mainly in military systems.

Conical antenna: An antenna used widely in ultra-wideband EMPs

TEM horn antenna: The main form of UWBs. Constructed mainly by two triangle panel and other components.

Diagonal spiral antenna: This antenna's performance is not closely linked to its frequency. Its diagonal angle determines the structure, and they are one beamed, two beamed or four beamed.

Log-periodic antenna: This antenna's performance adjusts periodically along with the logarithms of its frequency.

Planar monopole antenna: It adopts mainly the structure of round disk, elliptical disk or planar square**]**, but requires a vertical floor to support it.

LITERATURE

A technique used by researchers is etching slots or cuts on the patch or on ground. A number of antennas have been achieved by using this technique because the slots of different shapes influence the current paths on the patch and results various modes at the resonant frequencies. A triband bowtie antenna is proposed using this simple technique. This antenna was obtained by inserting two pairs of slot with different length of isosceles triangle without increasing area of triangle. This antenna is designed to operate for three different bands in wireless applications. Antenna was resonated at three different bands but its dimensions were made for middle frequency band. This antenna was resonated for 3.5 GHz, 4.5 GHz and 5.8 GHz. A very wide impedance bandwidth of 162% is reported and it is achieved by circle like slot with printing C-shaped stubs on the bottom of the substrate. This antenna covers the range of frequencies between 2.5 and 25 GHz with dual band-notched characteristics of frequencies 5.1-6.2 GHz and 3-3.8 GHz for WLAN and WiMAX application.

Ultra Wide Band: an UWB antenna with dual band notch characteristics is reported. Modified crown-square shaped fractal slots in the ground-plane are implemented to enhance the impedance bandwidth to around 58%. In addition to this, two omega-shaped slots have been incorporated in the radiating patch to render band-notch characteristics centered at 5.5 GHz band assigned to IEEE802.11a and HIPERLAN/2 as well as X-band for satellite communication centered at 7.5 GHz band. Measured antenna gain is stable over the entire UWB region.

Another simple technique is stack patch in which a parasitic patch is stacked above the driven patch. This technique can be used for dual frequency operation and also for broadband because the bandwidth is enhanced due to strong coupling between two resonances of the patches.

***MICRO-STRIP ANTENNA*:** As a recieving wire at present connected generally on the radio supplies of 100MHz~100GHz's recurrence space, the smaller scale strip radio wire utilizes miniaturized scale strip fix as its radiation source. Being conservative and light weighted, it can likewise thankless rascal into a framework with dynamic gadget and electric circuits. Up till now, smaller scale strip recieving wire's trial and registering techniques are both ready. When all is said in done, the scaling down of the recieving wire implies just to cut back its volume, and to leave its working recurrence in place.

Increase the dielectric constant: Micro-strip antennas of the half-wave radiation design usually work on the TM10 or TM01 model, their resonant frequency being: $f = c/2L\ (\varepsilon_r)^{1/2}$ (c: the speed of light, L: length of the patch, ε_r: relative dielectric constant). Because the resonance length is inversely proportional to the $(\varepsilon_r)^{1/2}$, the best way to downsize the radiation device is to use materials of greater dielectric constant. On the other hand, such material is limited by the transmission gain of the micro-strip antenna.

Load technology: Mainly the resistor loading and the short-circuit loading. The short-circuit loading can be divided into three types: loading the short-circuit probe, loading the short-circuit plate, and loading the short-circuit plane. The last method can reduce half of the length, and the probe method can further reduce 30% than that. Because of the characteristics of the antenna under the resonant frequency, we can further reduce the frequency and the size by adding a loading resistor near the coaxial feeder point.

Extend the surface current path: Another effective way to reduce the antenna size. It is based on the earth plate and the patch meandering technology. To extent the effective surface current path, it slots the non-radiation side of the patch.

PIF, PIL structure: Exclusively aimed at the antennas that is coaxial fed and use the air layer as the medium, this method solves the coaxial impedance effect. Its basic modes include the L-shaped probe technology and the L shaped micro-strip line feeding.

BROADBAND POLARIZATION DIVERSITY ANTENNA: As an effective communication technology, diversity technique compensates for channel fading and thus becomes research highpoint with the development of mobile communication technology. The feature of diversity technology is to choose the best signal, receive the sample signal through various means and then combine and classify them. The implementation process of this technology cost little and doesn't need to increase the transmission power or bandwidth. As a compelling correspondence innovation, assorted variety method makes up for channel blurring and consequently moves toward becoming investigate highpoint with the advancement of portable correspondence innovation. The component of decent variety innovation is to pick the best flag, get the example motion through different means and afterward consolidate and group them. The execution procedure of this innovation cost nearly nothing and doesn't have to build the transmission power or data transfer capacity. At present, principles grouping of decent variety recieving wire are appeared i.e. two types.

1. According to the purpose of diversity

Function	Description
Macro diversity	Purpose of which is to resist slow fading. Generally speaking, Two antenna sites are needed to send and receive two or more signals, in order to avoid signals sent by center being cut off by high points such as mountainside, thus the mobile station couldn' t receive the signals.
Micro diversity	Purpose of which is to resist fast fading. The technology belongs to one antenna site.
Space diversity	It is among the most common forms which use several separate antennas in the space. Though it' s easy to be done but it needs a lot of space. The advantage of this method is to receive several samples from emission signal without occupying extra frequency resources.

2. According to ways of receiving independent path signals

Frequency diversity	**It actually transmits signals through different frequencies, which could gain the multi-path benefit in communication environment.**
Angle diversity	Also known as pattern diversity, which separates signals of different directions through different pattern directions.
Polarization Diversity	The method of achieving diversity gain is to receive orthogonal planning components. It applies to terminal equipment with strict demands of volume because of its small overall volume.
Time diversity	It integrates interweaving technology and channel coding, which allows receiving terminal to receive several samples from emission signal simultaneously.

From all of the above reviews it is concluded that slot antennas are used typically at frequencies between 300MHz and 24GHz and are popular because they can be cut out of whatever surface they are to be mounted on, and have radiation patterns that are roughly omnidirectional. The polarization of the slot antenna is linear. The slot size, shape and the cavity offer design variables that can be used to tune performance. The stack patch technique is useful for dual frequency operation and also for broadband because the bandwidth is enhanced due to strong coupling between two resonances of the patches. Metamaterial loading is an ideal approach in which the metamaterial unit cell is closely placed near the patch and due to magnetic coupling effect; electric field is induced in the unit cell. After loading the patch with the metamaterial unit cell, the resonant frequency of the patch antenna is reduced making the antenna as Electrically Small Antenna (ESA).

CONCLUSIONS

In this paper presents the development status of the wireless communication system and the basic research direction of antenna upon some selective research efforts associated with some significant techniques and their antenna applications then it mainly analyze several antenna modes of wireless communication system. These antennas all designed based on the rules of miniaturization. The antenna mainly applies flat structure for the convenience of integration and miniaturization of mobile terminal. To meet the development of modern communication system and relevant equipment, new antennas with high performance has developed rapidly.

However, only by breaking through current technology limitations and defects can the new antennas be fully developed in aspects of technology, products and standardization. Combined with communication industry, the mature and application of new type of antenna need concerted effort. In terms of new antennas, undoubtedly, there are many technology difficulties to overcome. For example, multi-standard antenna could flexibly control signals with different patterns by solving the problem of mutual interference of different signals; To solve this problem, equipment support such as high-performance phase shifter and combiner with high isolation is needed; and the intelligent antenna faces technology difficulties of realizing remote control technology and antenna beam scanning more than one dimension; active integrated antenna must breakthrough the limitation of existing device volume and performance, and applies radio frequency devices with multiple frequency ranges in antenna system, in order to integrate RF module and antenna module. There are ample opportunities for the use of metamaterials as a promising approach to enhance the gain, efficiency, bandwidth, and directivity of several basic radiating and scattering systems. Nevertheless, useful solution are still less and suffer from different problems like complexity of structure, reduced bandwidth, reduction of gain etc. There remain many challenging and potentially rewarding problems left to solve; we all look forward to sharing these solutions in the near future. The initial seed physics efforts are only now beginning to bear some engineering applications fruit. Our further study is to investigate a more challenging antenna design using a multiband approach. Multiband antenna can provide a filtering capability at RF level, so as to improve interference to other system.

REFERENCES

1) Jinal R. Patel and Jigar B. Chaudhari , “ Optimization and Return loss Reduction Of Micro strip Patch Antenna” , International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Issue 6, June 2015.
2) Darshansinh N Patel and Mohammed G Vayada, “ Improvement in Characteristics of Microstrip Patch Antenna with the Help of Zero Index Metamaterial Structure” , International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 4, Issue 6, June 2015.
3) Chirag Arora, Shyam S. Pattnaik and Rudra N. Baral, “ SRR Inspired Microstrip Patch Antenna Array” , Progress In Electromagnetics Research C, Vol. 58, 89– 96, 2015.
4) Emadian, S.R. Ghobadi, C. ; Nourinia, J. ; Mirmozafari, M.H. and J. Pourahmadazar, “ Bandwidth Enhancement of CPW-Fed Circle-Like Slot Antenna With Dual Band-Notched Characteristic” , IEEE Antennas and Wireless Propagation Letters, Vol.11, pp.543-546,2012.
5) R. K. Vishwakarma and S. Tiwari, “ Experimental Study of Stacked Rectangular Microstrip Antenna for Dual-Band” , Engineering, 2010, vol.2, pp. 85-90.
6) C. Vazquez, G. Hotopan, S. Ver Hoeye, M. Fernandez L. F. Herran, and F. Las Heras, “ Microstrip Antenna design based on Stacked patches for Reconfigurable two Dimen-sional planar Array topologies” , Progress In Electromagnetics Research, PIER 97, 95{104, 2009.
7) E.S.Angelopoulos, A.Z.Anatopoulos, D.I.Kaklamani, A.A.Alexandridis, F.Lazarakis, K.Dangakis; Circular and elliptical CPW-fed slot and microstrip-fed antennas for ultrawide-band applications [J], Antennas and Wireless Propagation Letters, DEC., 5(1), 294-297 (2006).
8) Wenjin Wang, Quanxing Jiang, Xiang Zhou; Optimization of large angle and broadband log-period dipole antenna (LPDA)[J], Safety and Electromagnetic Compatibility, 23,12-14 (2005).
9) Yang Wang, Naitong Zhang; Overview of Ultra-wideband wireless communication, Journal of Yunnan University of Nationalities, 14(1), 3-7 (2005).

10) K. L. Wong and N. H. Hsu, “ A broad-band rectangular patch antenna with a pair of wide slits” , IEEE Transactions on Antennas and Propagation, vol. 49, no. 9, pp. 1345– 1347, 2001.

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