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Smart Antenna

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ABSTRACT:

One of the most rapidly developing areas of communications is "Smart Antenna" systems. This paper deals with the principle and working of smart antennas and the elegance of their applications in various fields such a 4G telephony system, best suitability of multi carrier modulations such as OFDMA etc., This paper mainly concentrates on use of smart antennas in mobile communications that enhances the capabilities of the mobile and cellular system such a faster bit rate, multiuse interference, space division multiplexing (SDMA),increase in range, Multi path Mitigation, reduction of errors due to multi path fading and with one great advantage that is a very high security. The signal that is been transmitted by a smart antenna cannot tracked or received any other antenna thus ensuring a very high security of the data transmitted. This paper also deals the required algorithms that are need for the beam forming in the antenna patters.

Keywords: ***4G telephony system; OFDMA; SDMA;***

Introduction

A smart antenna is a multi-element antenna where the signals received at each antenna element are intelligently combined to improve the performance of the wireless system. The reverse is performed on transmit [1-3]. These antennas can increase signal range, suppress interfering signals, combat signal fading, and increase the capacity of wireless systems [4-5]. There are two basic types of smart antennas, the first type is the directional antenna, and the second type is an adaptive array.

Types of antenna

Directional Antennas

Directional antenna which forms a narrow beam in the desired direction. This can be implemented by a switched multi-beam antenna in which one of several beams (or antenna elements) is selected for reception and transmission [6-7]. Generally, this is the beam with the strongest signal.Directional antenna can provide higher gain, and reduce interference by directing beam-formers towards a desired direction.

ADAPTIVE ARRAY

In adaptive array the signals from several antenna elements (not necessarily a linear array), each with similar antenna patterns, [8-10]are weighted (both in amplitude and phase) and combined to maximize the performance of the output signal. The adaptive array will form a narrow beam in a line-of-sight environment without multipath, [11-13] but can also optimally suppress interference and provide fading mitigation and gain in a multipath environment.

WIRELESS AD HOC NETWORKS

Wireless ad hoc networks are networks of hosts that may be mobile, with no preexisting infrastructure (if the infrastructure is fixed and regular, then this network can be considered a mesh network.

The advantages of ad hoc networks are that they:

- Can require less transmit power (for longer battery life).
- Are easy and fast to deploy.

- Have performance that is not critically dependent on the infrastructure.

Applications include home networking, meetings and conventions, and military and emergency networks.

In a wireless environment, consider the case where nodes A and B, as well as nodes B and C, are close enough to communicate, but nodes A and C are too far apart to hear each other.

If node A is transmitting to node B, node C may not hear the transmission and, thinking that the channel is clear, may transmit to node B, with the result that the packets from node A and C collide at B, with both packets lost. One method to avoid this problem is the use of a request to send (RTS) packet, as in the standard IEEE802.11: if node A has a packet to send to node B, it sends an RTS to node B, node B responds with a clear to send (CTS), node A sends the data, and node B sends an Acknowledgment.

Generally speaking, as the gear ratio is high for the transmission system, motor control precision has very small impact to the tracking precision. For example, for a system with the gear ratio of 20000:1, the tracker only covers an angle of 0.314mrad when a one complete circle is finished by the motor. Therefore, all kinds of the motor can satisfy the precision of the tracking system.

IMPACT OF SMART ANTENNA IN AD HOC NETWORKS

Most systems today only consider the use of omnidirectional antennas for ad hoc networks. However, this reserves the spectrum over a large area, wasting network resources. Smart antennas not only can mitigate this problem, but also can provide the other advantages also. The main type of smart antenna that has been considered on ad hoc networks is the directional antenna. The reason is that they are considered easier and less costly to implement, as well as easier to study and, analyze. Since smart antennas are a physical-layer technique existing approaches for MAC/routing in ad hoc networks can be used with smart antennas.

DIRECTIONAL ANTENNAS IN AD HOC NETWORKS

Directional antennas provide a higher gain. If the transmitter (node A) knows the location of the intended receiver (node B), then the RTS can be sent with a directional beam, although it would be received with an omnidirectional beam at node B, since node B would not know that the RTS was sent. Node B would then send the CTS with a directional beam (as would be done with the data and Acknowledgment packets as well). This increases range and reduces the required transmit power (so as to reduce interference levels and increase battery life). However, the main issue with directional antennas is that they do not work well in multipath environments, which are typical of most wireless systems.

ADAPTIVE ARRAY IN AD HOC NETWORKS

Adaptive arrays do work well in multipath environments. They provide multipath mitigation as well as the full array gain the adaptive array can be adjusted to optimally trade-off these gains (which cannot all be achieved simultaneously) to maximize link and/or network performance. In addition, unlike multibeam antennas, the adaptive array can listen omnidirectionally, but beam form when the packet is received, thus obtaining the adaptive array gains even when a packet arrives from an unknown location. This increases the range for the RTS packet even when the location of the transmitting node is unknown a priori, unlike directional beam systems.

Although the hidden-node problem still exists, the ability to suppress up to $M - 1$ interferers means that effect of the interference is at most only the loss of the interfering packet. Indeed, up to M users can transmit to an adaptive- array node and all packers can still be correctly received. Even the association problem is reduced somewhat, since beam forming on receiving the beacon provides multipath mitigation that is not present in a directional beam system. Concerning cost and implementation complexity, adaptive antennas are the main smart-antenna technique being currently implemented in WLANs, and they are being introduced

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cost effectively, including in single chip solutions. Furthermore, on the handset/client side, the use of directional beams is problematic, since the device-formfactor and interaction with nearby objects (such as the head and hand) make generating beams difficult. Adaptive arrays, on the other hand, can be readily implemented even in very small form factors and adjust to the interactions in the environment.

CROSSLAYER OPYIMIZATION

Smart antennas are physical layer technique and ad hoc network is a media access control (MAC) layer technique. Adding smart antennas to an ad hoc network using cross layer optimization technique can provide gains that are in excess of M fold. Overall system performance can be enhanced by interacting with the higher layers of the open systems interconnection model of the International Standards Organization (OSI/ISO) protocol stack. Smart antenna techniques can be developed combining parameters in the physical, data link (medium access control, MAC)and network layers (radio resource management, routing, transport, etc.); that is, in a cross-layer fashion rather than attempting to optimize the designs in isolation from one another. A layer-isolated approach often proves inefficient when the performance evaluation takes into account higher layers.

At the physical layer, channel estimation is performed to obtain the instantaneous SNR of a link, which affects the data rate chosen, which in turn affects the transmission delay. The routing protocol then makes a routing decision based on the delay associated with each link. The routing decisions in turn affect the network load distribution and impact the lower layer parameters. Thus the performance of the layers is inter-related.

Conclusion

Smart antennas in wireless ad hoc networks can greatly increase the performance of the network. Smart antenna implemented as adaptive arrays, rather than directional antennas, can greatly enhance the performance in typical wireless environment with multipath. Both types of smart antennas can provide an array gain that is increased in receive output SNR averaged over any fading

References

[1] Z. Ding, C. Zhong, D. W. K. Ng, M. Peng, H. A. Suraweera, R. Schober, and H.V. Poor, “Application of Smart Antenna Technologies in Simultaneous Wireless Information and Power Transfer,” IEEE Communications Magazine, vol. 53, no. 4, pp. 86-93, April 2015.

[2] N. Nguyen-Trong, L. Hall, and C. Fumeaux, “A frequency- and patternreconfigurable center-shorted microstrip antenna,” IEEE Antennas Wireless Propag. Lett., vol. 15, pp. 1955-1958, Mar. 2016.

[3] A. Senapati, K. Ghatak and J. S. Roy, "A Comparative Study of Adaptive Beamforming Techniques in Smart Antenna Using LMS Algorithm and Its Variants", International Conference on Computational Intelligence and Networks (CINE-2015), KIIT University, Bhubaneswar, January 12-13, 2015.

[4] P. Brahma, P. Nandi, A. Senapati and J. S. Roy, "Reduction of Side Lobe Level of Thinned Phased Array Antenna Using Genetic Algorithm", International Journal of Computer Applications, vol. 112, no. 8, pp. 13-15, Feb 2015.

[5] Y. Zeng and R. Zhang, “Full-duplex Wireless-powered Relay with Selfenergy Recycling,” IEEE Wireless Communications Letters, vol. 4, no. 2, pp. 201-204, April 2015.

[6] J.-S Row and C.-W. Tsai, “Pattern reconfigurable antenna array with circular polarization,” IEEE Trans. Antennas Propag., vol. 64, no. 4, pp. 1525-1530, Apr. 2016.

[7] W. Lin and H. Wong, “Polarization reconfigurable wheel-shaped antenna with conical-beam radiation pattern,” IEEE Trans. Antennas Propag., vol. 63, no. 2, pp. 491-499, Feb. 2015

[8] L. Zhou and Y. Ohashi, "Efficient codebook-based MIMO beamforming for millimeter-wave WLANs," in Proc. IEEE Int. Symp. on Pers., Ind. and Mobile Radio Comm. (PIMRC), Sept 2012, pp. 1885–1889.

[9] F. Sohrabi and W. Yu, "Hybrid digital and analog beamforming design for large-scale MIMO systems," in Proc. of the IEEE International Conf. on Acoustics, Speech and Signal Processing (ICASSP), April 2015

[10] M. Rzymowski, P. Woznica, and L. Kulas, "Single-anchor indoor localization using ESPAR antenna," IEEE Antennas Wireless Propag. Lett., vol. 15, pp. 1183–1186, 2016.

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