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Thesis Abstract

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Thesis Title

Resource Allocation and Reduced Complexity in MIMO Wireless Communication System

Thesis Summary

Recently, the demands for high speed internet access from the mobile wireless devices have grown very rapidly. Therefore, there is need to satisfy the demands of the capacity improvements in wireless communication systems. Fourth generation (4G) mobile technology promises the full mobility with high speed data rates for next generation mobile users. The main aim of 4G technology is to provide high speed wireless broadband services. Airport lounges, cafés, railway stations, conference arenas, and other such locations are required to have high speed internet services; in those places, 4G can play an important role. 4G is equipped with the proper arrangements at the physical layer to meet all the demands of those various scenarios. Spatial Multiplexing offers high channel capacity and transmission rate for the same bandwidth without additional power requirement by employing multiple antennas at the transmitter and receiver. Therefore, 4G like its predecessor 3G, would use the advanced versions of the Multi-Input Multi-Output (MIMO) antennas. The antennas used for the 3G system were smart enough to take care of many advanced operations at the signal level. This system must continue for 4G as well, and may even be made more sophisticated for 4G, as the number of signal-level decisions would be far greater in the case of 4G compared to 3G. There are many difficulties, however, in providing high speed wireless internet services in these environments, such as multipath fading and the inter-symbol interferences generated by the system itself. Therefore, high data transmission is limited by Inter-Symbol-Interference (ISI). As a result, Orthogonal Frequency Division Multiplexing (OFDM) technology is used to handle this problem. OFDM uses the spectrum efficiently by spacing the channels closer together as well as it gives the ability of reducing ISI. Users of multiuser OFDM system observe multipath fading but have independent fading parameters due to their different locations. The probability that a subcarrier in deep fade for one user may also be in deep fade for other users is quite low. Hence, multiuser system creates channel diversity as the number of user increases. Therefore, in multiuser MIMO-OFDM environment, the system needs to allocate efficiently its resources such as bits, antennas and subcarriers adaptively to the users. The resource management in 4G is much better than 3G. Optimization is present in the 3G system, but most of the optimizations are not that adaptive and dynamic. In contrast to that, 4G would have very smart adaptations in the resource management sector. Adaptive algorithms are used to provide optimization everywhere, from the modulation and coding, to the individual scalable channel bandwidth allocation. The combination of above technologies has been researched for the most promising technique for the next generation wireless systems.

Chapter 1 introduces the promising technologies of 4G such as OFDM, MIMO, efficient resource allocation in wireless communication system and reduction of complexity in that system, which can be used for the development of next generation wireless communication.

Chapter 2 presents the resource allocation scheme for Multi-Input Multi-Output Orthogonal Frequency Division Multiple Access (MIMO-OFDMA) broadband mobile wireless communication system for next generation. In the wireless communication systems, the different data throughput requirements for each user with various kinds of services and multimedia applications might be occurred. In this case, this system should provide the service to the users with proportional data rate fairness among users in the system. It is well known that using MIMO and OFDMA together gives rise to greater system capacity. Therefore, we consider the proportional data rate fairness in the MIMO-OFDMA mobile broadband wireless system case to give the higher capacity throughput in the next generation wireless.

In chapter 3, we propose the resource allocation scheme to use the more radio frequency spectrum more efficiently by using same frequency to transmit for different user's data at the same time in the system. In chapter 2, users are separated in frequency domain but not in chapter 3. Different user's data can overlap in the same frequency at the same time. Therefore, we can use scarce spectral resources more efficiently in the MIMO-OFDM wireless communication system environments under the consideration of proportional data rate fairness constraint and QoS requirements among users in the system.

Chapter 4 describes the singular value decomposition (SVD) based reduced complexity antenna selection method for the practical MIMO communication system with linear receivers. In the conventional MIMO communication systems, most of the antenna selection methods considered are suitable only for spatially separated uni-polarized system under Rayleigh fading channel in non-line of sight (NLOS) condition. There have a few antenna selection schemes for the cross-polarized system in LOS condition and Ricean fading channel, and no antenna selection scheme for the MIMO channel with both LOS and NLOS. In the practical MIMO channel case, influence of LOS and NLOS conditions in the channel can vary from time to time according to the channel parameters and user movement in the system. Based on these influences and channel condition, uni-polarized system may outperform a cross-polarized. Thus, we consider this kind of practical MIMO channel environment when developing the antenna selection scheme. The reduced complexity in antenna selection is proposed to give the higher throughput in the practical MIMO channel environment. In the proposed scheme, suitable polarized antennas are selected based on the calculation of SVD of channel matrix and then adaptive bit loading is applied to increase the throughput of the system under the constraint of target bit error rate (BER) and total transmit power of the MIMO system. The proposed system and selection method not only consider reducing the complexity but also the effects of adaptive modulation and total transmit power constraint under the target BER rate in the MIMO system.

Finally, chapter 5 concludes this dissertation and discusses the further study of research works.