THE SUMMARY OF Ph.D. DISSERTATION

Major Information and Computer Science		SURNAME, Firstname AHN, chang-jun

Title

Adaptive Transmission and Diversity Schemes for Broadband Mobile Multimedia Communication Systems

Abstract

This dissertation discusses two major topics, namely a diversity scheme and an adaptive data transmission, for realizing future broadband mobile multimedia communication systems. By using a diversity scheme and an adaptive data transmission, the system performance can be improved significantly. Since the system performances are degraded due to the inter-symbol interference (ISI) and multi-user interference (MAI), efficient schemes to reduce the interference are considered in this dissertation. This dissertation consists of seven chapters.

Chapter 1 describes the perspective on broadband mobile multimedia communication systems and background of the studies. The scope of this dissertation is also described.

In Chapter 2, multiple pre-Rake filtering based on predicted channel impulse response in transmitter and Rake combiner in the receiver is proposed. The pre-Rake system is known as a technique in TDD DS/CDMA system to reduce the mobile complexity and achieve the same BER performance like Rake receiver. The pre-Rake system itself is not optimum, since the channel impulse responses of uplink and downlink are slightly different in a TDD system, so the signal-to-noise ratio (SNR) can be maximized with a matched filter based Rake receiver, which has not been considered in the conventional pre-Rake system. Furthermore pre-Rake system is sensitive to the Doppler frequency. Even though the pre-Rake system has the ability to suppress other user interference, it is not efficient to maximize the received signal in high Doppler frequency. Since Rake combiner is utilized for the detection method in the proposed system, the maximized signal can keep the orthogonality better than the pre-Rake system, and proposed system can reduce the Doppler frequency effect. From these reasons, the proposed system achieves better BER performance than that of the pre-Rake system with increasing the number of users in high Doppler frequency.

In Chapter 3, adaptive array antenna based on radial basis function (RBF) network is proposed as a multi-user detection for WCDMA system. RBF is a kind of neural networks. It is a highly interconnected network of relatively simple processing units that operate in parallel, so it can provide high computational processing with simple nonlinear processors. Due to its massive parallelism and robustness, it can achieve high performance for channel tracking in multi-user case. It is shown the proposed system obtains more accurate channel response vector

using RBF output signal than that of the conventional sample matrix inversion of common correlation matrix (CCM-SMI) based on the MF. From the simulation results, it is shown that proposed scheme achieves better BER performance than those of the conventional systems.

In Chapter 4, we propose the code orthogonalizing filter (COF) based adaptive array antenna using CCM-SMI of time domain signals for multi-carrier DS/CDMA systems. The proposed system calculates the weight using the correlation matrix of time domain signals before FFT operation, so it can reduce the calculation time and the complexity of weight calculation than the conventional scheme, while maintaining the system performance. Moreover, COF is considered to reduce the demerit of adaptive array antenna system using CCM-SMI that requires heavy computational complexity when the signal environment frequently changes. It is shown that the proposed system obtains more accurate channel response vector using COF than that of the conventional CCM-SMI based on the MF, without increasing the matrix size. From the analysis and simulation results, it is shown that proposed scheme achieves better BER performance than that of the conventional system.

In Chapter 5, pilot symbol assisted high-speed packet transmission system based on adaptive OFDM using a novel lookup table is proposed to consider the demodulated errors and evaluate the BER performance using various adaptive modulation schemes like adaptive all-carrier modulation (AAM) and adaptive sub-carrier modulation (ASM) with conventional lookup table and lookup table that consider the demodulation errors. From the simulation results, ASM with novel lookup table satisfies the target BER and obtains better throughput performance than those of the fixed and conventional adaptive modulation schemes in high Doppler frequency.

In Chapter 6, we consider the space-time processing scheme for high data transmission system, particularly, unitary space-time modulation for OFDM. Unitary space-time modulation (USTM) for the coherent and differential systems is investigated in a flat fading channel. However, many wireless channels are frequency selective in nature. Therefore, OFDM is a reasonable approach to solve the frequency selectivity due to the multi-path fading. In this case, the system obtains increased diversity orders including the number of transmit antennas, the number of receiver antennas, and the frequency selectivity due to the different channel delay profiles between transmitter and receiver antennas. It is necessary to apply error control coding to further approach the channel capacity limit. By utilizing error correction code with a bit interleaving, the diversity order can be further increased. The increased diversity order can significantly improve the convolutional coding performance of USTM/OFDM for frequency selective fading channel. From the analysis and simulation results, it is shown that convolutional coded USTM/OFDM system with bit interleaving obtains full diversity gain and high data rate in the frequency selective channel.

Finally, Chapter 7 concludes this dissertation.