國立中央大學通訊工程學系
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編碼調變實驗室
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研究領域

- ◆錯誤更正碼 ◆Error-correcting codes
- ◆編碼調變 ◆Coded modulation
- ◆空間調變 ◆Space-time coding
- ◆非同調檢測 ◆Noncoherent detection

Research results

◆Improved Designs of Differential Spatial Modulation

Differential spatial modulation (DSM) is a multi-antenna technique that uses only one antenna to transmit signals at a time and avoids pilot overhead. By selecting the transmitting antenna, additional data bits can be transmitted. The conventional DSM is extremely complex. We aim to reduce the complexity of DSM in this thesis. The complexity of noncoherent maximum-likelihood (ML) detector of conventional DSM increases exponentially with the number of transmitter antennas. In this thesis, we propose a new ML detector whose complexity is roughly in proportional to the number of transmitter antennas. On the other hand, since the complex-valued antenna-index matrices causes the constellation of the transmitted signal has unlimited points, we have also proposed a systematically designed complex-valued antenna index matrices so that the transmitted signal constellation has a few signals points only. Both the proposed techniques decrease the complexity without sacrificing error performance.

In a recent paper, DSM used in downlink large-scale transmission antenna systems was proposed. This thesis also points out that it may be too far away from the signal continuously transmitted by the same antenna, resulting in bad error performance for time-varying fading channels. Therefore, we propose a method which has a better error performance in time-varying fading channels.

◆Bit Labeling and Code Searches for BICM-ID Using 16-DAPSK

Bit interleaved coded modulation with iterative decoding (BICM-ID) is suitable for continuous fading channels. Besides, BICM-ID using differential encoding can avoid the rate loss due to pilot symbols. In this thesis, we consider BICM-ID using 16-DAPSK (differential amplitude and phase-shift keying). According to the bit labeling of 8-PSK for BICM-ID, we propose two new bit labeling of 16-DAPSK. In addition, convolutional code for the new bit labeling are searched. Both the minimum distance and the simulation results show that the proposed labeling has better error performance than the original differential encoding, and the searched new codes can further improve error performance.

◆Differential APSK & QAM in Uplink Massive MIMO Systems

Massive MIMO systems are popular studies in recent years. Differential encoding scheme is not required to transmit pilot sequence for channel estimation, so it does not cause pilot contamination. A differentially encoded QAM (quadrature amplitude modulation) scheme for uplink massive MIMO was proposed recently which outperforms conventional differential APSK (amplitude-phase shift keying) scheme for 1000 receiver antennas.

In the predecessors' papers raise and try to resolve some questions about this differential QAM scheme. construct new tables for differentially encoded 16-QAM. compare differential 16-QAM with differential 16-APSK for the same detector, and compare the detector with a conventional detector for the same transmitter. Simulation results show that differential 16-APSK has the best error performance for any number of receiver antennas.

In this letter, we construct new tables for differentially encoded 32-QAM. We compare differential 32-QAM with differential 32-APSK for the same detector, and compare the detector with a conventional detector for the same transmitter. Simulation results show that differential 32-APSK has the best error performance for any number of receiver antennas. and changing the number of points inside and outside for 16-APSK.

In addition, for two-way two-phase relaying wireless communication, we propose a non-coherent detection method for relay points. According to the noise analysis of this detection method, we let the two transmitting end use the MPSK signal constellation diagrams rotating at different angles for phase difference encoding, and propose several architectures to improve the error rate of the relay point. The paper will first change the way the relay point judges the two transmitter signals to the basestation to determine the two user signals, and then extend it to more users.