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著者(和文)	Ye Huiyu
Author(English)	Huiyu Ye
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論 文 要 旨

THESIS SUMMARY

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学生氏名： Student's Name	YE HUIYU	指導教員（主）： Academic Supervisor(main)	府川　和彦
		指導教員（副）： Academic Supervisor(sub)	

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The dissertation proposes semi-blind interference cancellation schemes for user equipments (UEs) with single receive antenna and multiple receive antennas, respectively, in a heterogeneous network (HetNet), which can achieve near-optimum performance with low complexity and do not require information on training sequences of the interfering signals.

Chapter 1 addresses the background of the research. HetNet is one of the promising approaches to accommodate explosively increasing data traffic and connected devices in mobile wireless networks. On the other hand, the inter-cell interference (ICI) becomes a crucial problem for the realization of HetNet. Although there exist interference mitigation solutions on the side of base stations (BSs), they may require a large amount of backhaul traffic and computational complexity in order to collect and process information from both UEs and BSs, which can be prohibitive in a dense area of small cells. UEs with advanced interference cancellation techniques are expected to ease this burden and to improve the receiving performance. Considering the complicated ICI conditions in a HetNet, this dissertation focuses on the nonlinear cancellation scheme, which is robust against multiple interfering signals regardless of the number of receive antennas. Moreover, considering the fact that only limited information on ICI is prior known to UEs, the interference cancellation scheme should be designed to work properly in a semi-blind manner, and with low computational complexity.

In Chapter 2, the downlink signal model of a HetNet employing multiple-input multiple-output orthogonal frequency-division multiplexing (MIMO-OFDM) with spatial multiplexing is introduced, and several interference cancellation schemes on the UE side are reviewed in order to figure out the direction of schemes to be developed in the dissertation. The channel is assumed to be quasi-static due to the low mobility of UEs in the dense small-cell area. Considering the complexity, performance, and feasibility between symbol-level and bit-level interference cancellation schemes, the symbol-level one is chosen. Interference rejection combining (IRC) is a kind of the linear interference cancellation scheme that can operate semi-blindly, and has been adopted in 4G standard. However, IRC requires more receive antennas than the total number of desired and interfering streams. The optimal blind nonlinear cancellation scheme, maximum likelihood detection (MLD), searches all possible signal candidates and the corresponding channel estimations, which requires

prohibitive computational complexity. While carrying out MLD only during the training period, multiuser detection (MUD) only during the data period can reduce such computational complexity when the channel is time-invariant. However, the computational complexity remains high. Replacing MLD by Viterbi algorithm (VA) based schemes or quantized channel approach based schemes can achieve considerable performance while requiring much lower computational complexity. Incidentally, VA based schemes may eliminate correct signal candidates before convergence of channel estimation, which degrade performance. Meanwhile, the quantized channel approach does not eliminate candidates and achieves good performance with low complexity, but faces the problem of local minima.

Chapter 3 investigates the most challenging problem of interference cancellation with single receive antenna. To reduce a prohibitive amount of computational complexity of the optimum MLD drastically, the proposed scheme enhances the quantized channel approach, and iterates both channel estimation and MUD of signals received during the training period, in the same manner as the expectation maximization (EM) algorithm. In addition, a recalculation scheme is introduced to avoid inaccurate channel estimation due to the local minima. Using the estimated channel, the proposed scheme performs MUD of both the desired and interfering signals during the data period. Computer simulations of a single OFDM subcarrier under one and two interfering signals conditions show that the proposed scheme outperforms a conventional scheme based on generalized VA (GVA), and can achieve almost the same average bit error rate (BER) performance as MUD under the maximum likelihood (ML) criterion with the channel estimated from sufficiently long training sequences of both the desired signal and the interfering signals, while reducing the computational complexity significantly compared with full search involving all transmitted signal candidates.

In Chapter 4, the semi-blind interference cancellation is extended and modified to the multiple-receive-antenna implementation. The proposed scheme applies the quantized channel generation and local search of the previous chapter in order to coarsely estimate the transmitted symbol matrices during the training period instead of providing the channel estimates, which can reduce the computational complexity of generating quantized channel matrices, compared with the direct application of the single antenna algorithm into multi-antenna case. Coarsely estimated symbol matrices with small replica errors are selected and fed into the newly proposed joint estimation, which precisely estimates channel matrices with the coarsely estimated symbol matrices by taking received signals at all receive antennas into consideration. Using the selected channel estimate, the proposed scheme performs MUD of both the desired and interfering signals during the data period. Computer simulations of a single subcarrier in a MIMO-OFDM system with two receive antennas under two-interfering-stream conditions demonstrate that the proposed scheme outperforms IRC with perfect knowledge of channel state information (CSI) and MUD with channels estimated by the conventional scheme based on GVA. The proposed scheme for multiple receive antennas inherits the features of that with just a single receive antenna, which achieves

near-optimum performance with sufficiently long training period, while reducing the computational complexity significantly compared with full search involving all transmitted signal candidates.

Finally, Chapter 5 concludes the dissertation and provides suggestions for future works.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

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