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Keio University

Thesis Abstract

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Thesis Title

Impact of Channel Estimation Error and PAPR Reduction for Precoding Techniques in TDD-CDMA

Thesis Summary

In this dissertation, we focus on precoding techniques in time-division duplex code-division multiple-access (TDD-CDMA) system that can be realized by exploiting channel reciprocity. The study focuses on Pre-Rake and Joint Transmission (JT) techniques because of their simple algorithms compared to other precoding techniques. In First, we analyze the impact of channel estimation error on the Pre-Rake technique, because the assumption of perfect channel knowledge is not practical for real mobile communications. Second, we propose a modified JT technique to reduce peak-to-average power ratio (PAPR) that results in a low cost mobile station and base station.

Chapter 1 presents an introduction of this thesis. First, we explain the background of wireless mobile communications. We then discuss requirements for wireless mobile communication system that includes a low cost communications, a high spectral efficiency and a high data rate communications, with a large capacity and coverage. This study focuses on the low cost communications that can be realized by exploiting channel reciprocity feature in TDD-CDMA system, using precoding techniques; Pre-Rake and JT. TDD-CDMA is introduced with discussion of differences between TDD and frequency-division duplex (FDD), followed by the description of the TDD-CDMA systems. We then introduce channel reciprocity feature and precoding techniques that are the main key technology of this thesis. We finally present the motivation of our study and overview of each chapter to clarify problems and objectives of this study.

Chapter 2 presents our study on impact of channel estimation error in Pre-Rake TDD-CDMA system. We investigate the impact of channel estimation error by computer simulation and numerical analysis. For comparison, we also present impact of channel estimation error for rake system. The channel estimation error consists of both amplitude and phase error. The results show that the channel estimation error causes performance degradation, owing to large multi-access interference caused by a high orthogonality loss among spreading codes of different users.

Chapter 3 presents the proposed modified JT technique to provide a low PAPR in TDD-CDMA system. The newly proposed JT technique is done by selecting a certain paths out of the total paths that processed in JT. Our proposed JT performs a lower PAPR than that in conventional JT system. To improve PAPR and BER performance, we combine the proposed JT with clipping technique. The results show that the combination of our proposed path selection technique with clipping technique provides a low PAPR without severe bit-error-rate (BER) degradation.

Chapter 4 concludes this dissertation. The future possible study to improve BER degradation caused by imperfect channel estimation error in Pre-Rake TD-CDMA is also discussed. For the proposed PAPR reduction technique in JT-TDD-CDMA, we introduce possible studies such as spectral re-growth, which can be expanded in future works.