

Efficient CFO Estimation and Compensation Approach in OFDMA for Uplink Mobile WiMax

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Abstract—Synchronization is a complex task in uplink Orthogonal Frequency Division Multiple Access (OFDMA) for Mobile WiMax as each user presents different Carrier Frequency Offsets (CFO). Synchronization begins with the CFO estimation and followed by the compensation of residual CFO present in the received signal. This paper deals with various techniques in time and frequency domains to compensate the effect of CFO on the received signal for different estimation techniques. Simple time domain MultiUser Interference Cancellation (SIMUIC) performs in time domain. It employs delays in the compensation of CFO while synchronizing the last user. Decorrelation Successive Interference Cancellation (DC-SC) and Integrated Estimation and Compensation (IEC) perform in frequency domain for the compensation of CFO. These approaches are more complex for Inter-Carrier Interference (ICI) cancellation. In this paper, we propose a new efficient CFO compensation technique in frequency domain for different estimation methods. This technique is a modified version of IEC for reducing the CFO effect on the received signal with lesser computations. Simulation results show that the modified IEC performs better than SIMUIC, DC-SC and IEC for different estimation methods.

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1. INTRODUCTION

Orthogonal Frequency Division Multiple Access (OFDMA) is one of the multiple access schemes for future wireless broadband and high-speed networks. It provides high data rate and meets the required Quality of Service (QoS).

Mobile WiMax [1] employs OFDMA in uplink for achieving high data rate in wireless broadband network. In OFDMA, the total available subcarriers are grouped and each group assigns to a particular active user with one of the subcarrier assignment strategies. OFDMA is more prone to Carrier Frequency Offsets (CFO) owing to fluctuations in the frequencies at transmitter or receiver and the Doppler shift. Since each user has different CFO, synchronization becomes more difficult in OFDMA [2–5].

CFO leads to two types of interferences, namely, MultiUser Interference (MUI) and Inter Symbol Interference (ISI). MUI occurs due to the interference from subcarriers of another user. Inter-Carrier Interference (ICI) occurs due to the interference between their own subcarriers. Hence, synchronization is more critical in uplink OFDMA for mobile WiMax. It includes the CFO estimation for available active users in the system, and estimated CFOs [6, 7] compensate the effect of the appropriate offsets. An important task lies in the fact that there is a need to design a synchronization method, which can produce a good performance.

This paper deals with various techniques to compensate CFO effect on the received signal in time and frequency domains. Simple time domain MultiUser Interference Cancellation (SIMUIC) method operates in time domain. The synchronization of the last user is performed after all other users are demodulated. Hence, it takes larger time delay to compensate CFO during synchronization of the last user.

Decorrelation Successive Interference Cancellation (DC-SC) and Integrated Estimation and Compensation (IEC) techniques [8] are the frequency domain approaches designed to compensate the CFO effect on the received signal. In DC-SC, the decorrelation method reduces ICI and the successive interference cancellation method reduces MUI.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ADDITIONAL INFORMATION

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