IEEE 802.16a 分時雙工正交分頻多重進接之上行通道估測研究

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摘要

正交分頻技術近來因為能在行動環境中穩定高速傳輸而廣受注目，IEEE 802.16a 即是一個基於正交分頻多工技術用於無線都會網路的標準。

本論文的目的是根據 IEEE 802.16a 中分時多工正交分頻多重進接的規範，發展上傳通道估測的演算法。 規格裡只分配五個 pilots 來協助估測一個子通道。這樣嚴苛的條件使得傳統的通道估測方法不能使用。

在假設已知路徑延遲時間的條件下，我們發展了一個適合的演算法。首先，我們先用最小平方估測方法獲得一個大約的通道增益估測值。然後利用通道連續變化的特性，我們結合了前後兩個時間的通道資訊去平均掉雜訊的干擾。在低訊雜比下，估測效果有大幅改善。再來，我們採用適應性濾波器來追蹤通道變化，藉以解決時變通道所造成的誤差，使得錯誤率在高訊雜比下獲得改善。最後我們利用決策導向方法再一次的降低雜訊量，並使通道估測值更加精準。最後，我們提出來的估測演算法比只利用最小平方估測方法增加 7-8 dB 的效能增益。

根據我們的模擬結果，不論路徑延遲時間是否在整數個取樣點上，我們提出的估測方法都能正常運作，並且在不同形式的多路徑能量剖面下，其估測結果也大致不受影響。這說明了我們提出的估測演算法適用於各式各樣不同形式的通道。另外，在一個使用者的狀況下，載波間的彼此干擾並不嚴重，因為載波彼此的距離相距夠遠所致。

Study on IEEE 802.16a TDD OFDMA

Uplink Channel Estimation

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Abstract

In recent years, orthogonal frequency division multiplexing (OFDM) modulation technique has drawn great interest due to its advantage in mitigating the severe effects of frequency-selective fading in high-speed wireless communication. And the IEEE 802.16a standard is a wireless metropolitan area networks standard based on OFDM technique.

The goal of this thesis is to estimate the uplink channel with sufficient accuracy according to the time-division duplexing (TDD) orthogonal frequency division multi-access (OFDMA) specifications in the standard so that the transmitted data can be detected even when a large constellation is used. However there are only 5 pilot carriers within a subchannel to estimate the channel in the IEEE 802.16a OFDMA uplink. That strict condition makes the conventional channel estimation useless.

We develop a suitable algorithm under the assumption that we know the delay information. Firstly, the least square estimator roughly estimates the channel. Then by using the linear combination between decision-directed and least squares estimators, the noise power is effectively reduced in low SNR. Moreover, we use an adaptive filter to trace the time-variant channel along the time axis so that we get better performance in high SNR. The decision-directed estimator is used as the final stage. It can further reduce the noise power and get more accurate channel estimate. Finally the proposed estimator can achieve significant performance improvement over the least squares estimator about 7-8 dB in a multipath time-variant environment.

According to our simulations, the proposed estimator works well whether multipath time delays are at sample spaced positions or not. It is also robust under various multipath intensity profiles. For only one user, the ICI effect is not serious and just causes a little performance degradation in high SNR.