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A Review on Blind Channel Estimation in MIMO OFDM

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Abstract: The main objective of this paper, is to review the work already done in the field of blind channel estimation in MIMO- OFDM system. From the higher order statistics to the second order statistics, from statistical model approach to deterministic approach, we outline basic ideas behind several new developments, identifiability conditions and the assumptions required by these approaches, and the algorithm specific characteristics and their performance. This review presents an introductory reference for this currently active research area.

Keywords: Blind channel identification, MIMO-OFDM, statistical approach and deterministic approach.

I. INTRODUCTION

Channel estimation plays very important part to recover the original signal at the output of the system. Channel estimation can be performed in three ways. They are

1) Training-based channel estimation
2) Blind channel estimation and
3) Semi blind channel estimation, but the blind channel estimation has become popular in digital communication systems due to its capability to improve the bandwidth efficiency.

To estimate a channel, its transfer function needs to be identified. The difficulty in this problem starts from the fact that the input to an unknown channel (the transmitted signal) is not available at the output of the channel (receiver input). The solutions to the blind identification problem can be found in [1] where the chief tool is the use of higher order statistics of the channel output. On the other hand, paper [2] serves the results that are based on the second order statistic. By analysing the paper [1] and [2], it is observed that blind channel estimation using second-order Statistics can potentially achieve finer performance for a particular time averaging interval than methods based on higher order statistics. These kinds of approaches are called statistical approaches, which uses statistical information of input of the system. But there are some cases when we do not have sufficient time samples to estimate statistical information, those approaches comes under deterministic approaches. For example, in a fast fading environment, under wireless communication the multipath channels vary rapidly, and there is very less data samples equivalent to the same channel characteristics. In this kind of scenario, it is not reasonable to conclude that the estimates of the signals are close enough to their true (known) values. Hence, it may be easier to solve this problem by treating the input as a deterministic signal which has been done in [3].

Now the next most important factor is to achieve high data rate and large system capacity over wireless networks and the MIMO-OFDM is one of the promising scheme for this. MIMO-OFDM allows an impressive increase in data rate and capacity in a mobile wireless link without additional power or bandwidth consumption. And it also allows a significantly reduction in system complexity.

II. LITERATURE REVIEW

A. Blind channel identification based on second order cyclostationary statistics.

Y. Li and Z. Ding, IEEE. 1993. This paper proposed a blind channel identification method under a special rank condition. It rely on assumptions on the statistics of the input sequence which uses second order statistics. Researchers create a relationship between the rank condition and identifiability of channels using second order statistics and investigated the problem occurring in channel identification based on second order statistics. This paper concludes that the channel identification can be done for both uncorrelated and correlated input.

B. Blind identification and equalization based on second-order statistics: A time domain approach Lang Tong, Thomas Kailath IEEE. 1994. A new method for blind identification and equalization is developed in this paper. Using oversampling, researchers are able to identify possibly non minimum-phase channels with the help of only second-order statistics. This leads to more accurate estimation with a smaller sample size than methods using higher-order statistics. It solve the problem occurring in channel identification based on second order statistics The results shows more accurate estimation with a less number of samples than methods using higher-order statistics. But this approach applicable only for high SNR. For the proposed algorithm to be efficient and valid at low SNR, a larger number of symbols are required, which obstruct the effectiveness of the proposed method for rapidly varying channels.

C. Direct blind equalizers of multiple FIR channels: A deterministic approach G. B. Giannakis and C. Tepedelenlioglu, IEEE.1999. A new blind identification

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method based solely on the system outputs is proposed here. It relies on deterministic approach**.** In this paper, researchers consider the system input to be an unknown deterministic signal and study the problem of blind identification of multichannel systems without requiring the knowledge of the input statistics. With proper channel order selection, the algorithm can accomplish blind identification based solely on the system outputs without any statistical information on the input process.

D. Blind channel estimation in MIMO-OFDM system W. Bai, C. He, L.-G. Jiang, and H.-W. Zhu IEEE. 2002. In this paper, the research is further extended for MIMO-OFDM systems, a new subspace-based method is proposed for MIMO-OFDM systems by utilizing the redundancy introduced by the cyclic prefix (CP). In this the blind channel estimation in MIMO-OFDM systems based on the noise subspace method is investigated. The algorithm only requires knowledge of the upper bound on the channel length, it exhibits low sensitivity to stationary noise.

E. Blind channel estimation in MIMO-OFDM system C. Shin, R. W. Heath, Jr., and E. J. Powers IEEE 2007. It presents a blind channel estimation technique based on subspace approach. Researchers use virtual carrier in this. The presence of VCs provides another appropriate resource that can be used for channel estimation therefore potentially increasing channel utilization. The proposed method can be applied to MIMO-OFDM systems without CPs regardless of the existence of VCs as a result obtain an accurate channel estimate with less number of OFDM symbols thus this method improves transmission bandwidth efficiency.

F. Robust subspace blind channel estimation for cyclic prefixed MIMO OFDM systems: Algorithm, identifiability and performance analysis

F. Gao, Y. Zeng, A. Nallanathan, and T.-S. Ng IEEE.2008.The statistics-based approaches have been proposed by introducing remodulation. Since the proposed approach allows blind channel estimation for the CP based MIMO OFDM, it is compatible with many existing standards and the coming 4G wireless communication standards. The proposed algorithm exhibits many advantages such as robustness to channel order overestimation, capability of assuring the channel identifiability etc.

G. Subspace-Based Blind Channel Estimation for MIMO-OFDM Systems With Reduced Time Averaging Chao-Cheng Tu, Benoît Champagne, IEEE. 2010 The main contribution of this paper is in developing and evaluating a new scheme to overcome some fundamental limitation of the subspace-based approach when applied to MIMO-OFDM transmission over time-varying channels. Researchers propose a novel subspace-based blind channel-estimation algorithm with reduced time averaging, as obtained by exploiting the frequency correlation among adjacent subcarriers in MIMO-OFDM systems they have proposed a novel subspace-based estimation method that requires a significantly smaller number of time samples. These algorithms primarily exploit the orthogonality of the noise and signal subspaces of the correlation matrix of the received signals to estimate the unknown channel coefficients.

III. CONCLUSION

The paper shows the development in the schemes to overcome some fundamental limitation when applied to MIMO-OFDM system in time varying channel. The contribution of this paper is not only that it shows that the proposed blind approach can work with a small number of time samples but that it may also come with improved performance and robustness over existing statistical and deterministic methods and it also shows that the estimation accuracy is improving with each new schemes.

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