A Reduced Complexity Deterministic Blind Transceiver with Space-Only Block Coding in a Multi-User MIMO Context with Severe Multipath

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1 Introduction

In the context of a constantly increasing need for high datarate communications within a limited available bandwidth for wireless users, many recently proposed developements are focusing on Multiple Input Multiple Output (*MIMO*) systems [1]. In comparison with their SISO counterpart, these systems allow a spectacular increase of the transmission speed without using extra bandwidth by exploiting the spatial diversity that is brought by MIMO systems.
In this paper we focus on the design of *blind algorithms*, which are not based on the use of training sequences. Training requires some kind of protocol and always results in a transmission overhead, especially in the MIMO case where the number of transmission channels is large. One can make a distinction between *stochastic* and *deterministic* blind algorithms. Many stochastic algorithms have recently been proposed in the litterature but they require a large amount of received data. Deterministic blind algorithms, on the other hand can be applied on a much smaller amount of received data. This motivates our choice to focus on the development of deterministic blind algorithms.

2 A Recently Proposed Algorithm

A blind transceiver with Code Modulation for *Multi-User MIMO* systems was recently proposed by Geert Leus, Piet Vandaele and Marc Moonen [2]. This transceiver uses antenna arrays for both transmission and reception and is based on *code modulation*, with different codes for each transmit antenna. The receiver extracts the transmitted data symbol sequences from the received symbols exploiting the knowledge of the antenna-apecific codes, using subspace-decomposition based techniques. The proposed algorithm was initially designed to cope with flat-fading transmission channels. If one wants to focus on wideband transmission, it is however mandatory to cope with time-dispersive channels. The algorithm was thus extended to the case where multi-path effects arise at the cost of a severe increase of the computational complexity of the algorithm that has to deal with much larger data matrices. This final algorithm is efficient as well against ISI than against MUI.

3 DMT and CP-Only Modulation

In this work we propose an extension of this algorithm that makes it possible to cope with severe multipath effects while maintaining the computational complexity at reasonable levels. The first approach that we proposed therefore is to combine the initial algorithm with Discrete Multi Tone (*DMT*) transmission techniques that will deal with the ISI (We only consider the case where the cyclic prefix is longer than the channel impulse response) while the MUI is still treated by the algorithm. The coding is now done on a block-based approach. The data symbols are detected after the DMT transmission on a per tone basis. This technique decreases the computational complexity but the BER Performance is also reduced. The reason for that is that there is no optimal loading of the subcarriers in our blind context, the weak tones are thus causing the performance degradation. Another problem which is intrinsic to DMT transmission is the PAPR (Peak to Average Power Ratio) problem. In order to avoid these problems we explored an alternative technique: the Cyclic Prefix Only approch (*CP-Only*) which is closely related to DMT techniques (a cyclic prefix is added to the data symbols but no IFFT is performed by the transmitter). The decoding is again performed on a per tone-based approach. In this framework, the complexity is maintained at the same low level but the initial performance of the algorithm is restored.

References

[1] G.J.Foschini, M.J.Gans, *On Limits of Wireless Communications in a Fading Environment when using Multiple Antennas*, Wireless Personal Communications, 6:311-335,1998

[2] G.Leus, P.Vandaele, M.Moonen, *Deterministic Blind Modulation-Induced Source Separation for Digital Wireless Communications*, IEEE Transactions on Signal Processing, vol 49, NO. 01, January 2001