Ph.D. Dissertation Defense
Candidate: Amir Laufer
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Title: High Rate Space Time Code with Linear Decoding Complexity for Multiple Transmitting Antennas.

Abstract

The multipath nature of the wireless channel results in a superposition of the signals of each path at the receiver. This can lead to either constructive or destructive interference. Strong destructive interference is frequently referred to as a deep fade and may result in temporary failure of communication due to a severe drop in the channel signal-to-noise ratio (SNR). To avoid this situation signal diversity might be introduced. When having more than one antenna at the transmitter and/or receiver, forming a Multiple-Input Multiple-Output (MIMO) channel, spatial diversity can be employed to overcome the fading problem. Space time codes (STC) have been shown to be used well with the MIMO channel. Each type of STC is design to optimize a different criterion (rate, diversity) while other characteristics of the code are its performance (error rate) and decoding computational complexity. The Orthogonal STC (OSTC) family of codes is known to achieve full diversity as well as very simple implementation of the Maximum Likelihood (ML) decoder. However, it was proven that with a complex symbol constellation one cannot achieve a full rate code when the number of transmitting antennas is larger than 2. Quasi OSTC are codes with full rate but with the penalty of more complex decoding and in general doesn’t achieve full diversity.

In this proposal, we explore new techniques for STC transmission/decoding such that a full rate code can be transmitted and decode with linear complexity. We introduce the Row Elimination Method (REM) for OSTC transmission which basically involves the transmission of only part of the original OSTC codeword resulting in a full rate. Given an adequate OSTC and applying the REM the decoder computational complexity remains linear although the transmitted codeword isn’t orthogonal anymore. In addition, we present a new OSTC that comply with the new scheme requirements. The performance of the new scheme is studied under various setups such as the presence of limited feedback and multiple antennas at the receiver.

The performance of any STC system is severely degraded due to imperfect channel state information. To minimize this, long, time (rate) consuming training sequences must be used and/or complex decoding scheme at the receiver. We suggest the use of adaptive techniques to tackle this behavior. Namely, the bootstrap algorithm is used to further refine the received signals, resulting in better effective rate and performance in the presence of channel estimation errors.

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List of Publication


