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A Simple Time–Space Diversity Scheme Using Extended Shaping Pulse

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Abstract
This paper proposes a new time–space diversity scheme for data transmission through flat fading channels. Extended pulses are used to shape the modulated symbols at different time slots. The proposed transmitter does not change the transmission rate of the modulated symbols after the shaping process. One transmitting antenna is used to transmit the shaped symbols. Multiple antennas are used in the receiver to collect the transmitted symbols. The diversity gain in the proposed system is the product of the numbers of time slots through which the modulated symbol is transmitted and the number of receiving antennas. The proposed transmitter uses neither space–time codes nor spreading codes. The received signal suffers from intentional inter-symbol interference due to the correlation between the shaped symbols. Instead of using equalizers to remove this interference, multi-symbols detectors are used to exploit this interference to achieve the desired diversity gain. Buffers store the replicas of the desired symbol after the multi-symbols detector during its diverse period. Two-dimensional maximal ratio combiner adds these replicas in one decision variable. The proposed system achieves high diversity gain in flat fading channels with one transmitting antenna, and without affecting the used communication resources.

Keywords Time diversity · Space-diversity · Correlated shaping symbols · Inter-symbol interference · Multi-symbols detectors · Maximal ratio combiner

1 Introduction

Channel fading is a big problem in wireless communications. There are two types of channel fading. Flat fading that reduces the received signal to noise ratio (SNR). Frequency-selective fading that distorts the received signal causing inter-symbol interference (ISI). It also reduces the received SNR. Signal diversity is used to provide the receiver with different faded replicas of the transmitted signal. The receiver uses these replicas and signal combining techniques to enhance signal detection and to decrease the bit error rate (BER) in the received data. Signal diversity is usually done through time, frequency, and space. In time diversity, the modulated symbol is transmitted through different time slots. Although

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