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Low Complexity Signal Detection Technique for SFBC-OFDM Systems

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Abstract— **In highly frequency selective channel, the performance of SFBC-OFDM system is severely degraded due to adjacent sub-carrier interference (ASI) effects. The ASI effects occur as the channel frequency response (CFR) does not remain constant over two adjacent OFDM subcarriers. As a result, the Alamouti method is not sufficient to separate the received signals perfectly at the receiver side. In order to cancel the ASI effects, several detection techniques are addressed namely parallel interference cancellation (PIC), successive interference cancellation (SIC), diagonalized maximum likelihood detection (DMLD), decision feedback detection (DFD) and maximum likelihood (ML). The ML method provides the optimum performance but the computational complexity is very high. Therefore, we propose a suboptimal modified decision feedback (MDF) detection method which achieves nearly same performance as the ML method with very less computational complexity compared to ML method. Finally, the performances of the above detection methods are compared in terms of symbol error rate (SER) and computational complexity.**

Index Terms — **SFBC, OFDM, ASI, Signal Detection, MDF**

1. INTRODUCTION

Recently, the transmit diversity techniques have gained a lot of popularity because they improve data transmission reliability without increasing transmit power or bandwidth [1]–[4]. The first transmit diversity scheme popularly known as space time block code (STBC) was proposed by Alamouti. Since then, the space-time block coding (STBC) scheme becomes one of the well-known signal processing techniques for a wide range of wireless communication applications. It has been used in many wireless communications such as LTE, Wi-Fi, WiMAX and radio receiver for civilian and military applications [4]. Typically, the space time block code (STBC) is applied for flat fading channel [5]. However, in actual scenario, the channel is frequency selective as opposed to flat fading. Since, orthogonal frequency division multiplexing (OFDM) system divides the frequency selective fading channel into numerous narrow parallel flat fading channels, the STBC scheme is combined with STBC technology [6]. The OFDM also provides another option for coding in frequency domain in the form of space frequency block code OFDM (SFBC-OFDM) [7]. However, in frequency selective channel, the SFBC OFDM systems suffer from ASI and hence, the overall system performance is degraded [7]. The signal detection methods for SFBC OFDM system have been proposed by various authors by cancelling the effects ASI effects in frequency selective channel. In [8], the authors proposed a parallel interference cancellation (PIC) to eliminate the ASI effect. A successive interference cancellation (SIC) method is proposed for STBC-OFDM system in [9]. As the properties of STBC OFDM scheme in fast fading channel is similar to SFBC OFDM in frequency selecting channel, the SIC scheme can also be applied to SFBC OFDM system. In [10], a diagonalized maximum likelihood detector (DMLD) is proposed to improve the system performance for SFBC system. But the DMLD method has more computational complexity. Hence, a similar performance with low computational complexity diagonalized zero forcing detection (DZFD) is proposed in [11]. The decision feedback (DF) method is originally proposed in [12]. Then, it is extended for STBC/SFBC OFDM system in [13]. The maximum likelihood (ML) detection method is addressed in [12]-[13]. An order Successive interference cancellation technique (OSPIC) was proposed in [14]. In [15], SFBC signal detection was proposed based on minimum mean square error (MMSE) for under water wireless communication. Recently, an adaptive slope function based on ANN is proposed in [16] to estimate the channel state information and to detect the symbol in SFBC-OFDM. A novel signal algorithm was proposed for STBC coded OFDM systems in underwater communication scenario based on generalized MMSE in [17]. A sorted QR decomposition method was proposed in [18] for signal detection in space time scheme. This method provides close performance to ML method with lower computational complexity. However, all the signal detection methods proposed in [8]-[18] provide a tradeoff between performance and computational complexity as compared to ML method.

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