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Virtual Quadrature Phase Shift Keying with Low-Complexity Equalization for Performance Enhancement of OFDM Systems

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Abstract—The Zero-Forcing (ZF) equalizer suffers from two main problems; the noise enhancement and the high complexity due to direct matrix inversion, especially with a large number of sub-carriers. On the other hand, the Minimum Mean Square Error (MMSE) equalizer has a high complexity and requires estimation of the Signal-to-Noise Ratio (SNR). In this paper, we modify the structure of the traditional Orthogonal Frequency Division Multiplexing (OFDM) system by adding a Virtual Quadrature Phase Shift Keying (VQPSK) block that reduces the computational complexity of the equalization process, and duplicates the transmitted symbols.

Index Terms—OFDM, ZF, CFO, ICI, ISI.

I. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) communication systems were firstly proposed by Chang [1]. They have been used for several purposes in the field of wireless communication standards such as IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, and IEEE 802.11n [2], Digital Video Broadcasting (DVB) [3], and Digital Radio Mondiale (DRM) [4]. OFDM is based on Multi-Carrier (MC) modulation to improve the system performance. On the other hand, OFDM systems suffer from two main performance degradation sources; the large Peak-to-Average Power Ratio (PAPR) at the transmitter side, and the Carrier Frequency Offset (CFO) at the receiver side. The large PAPR results in low efficiency of the power amplifiers at

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