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OPTIMAL PILOT DESIGN FOR MIMO-OFDM SYSTEM CHANNEL ESTIMATION IN TIME DOMAIN

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Abstract. *A least squares (LS) channel estimation scheme in time domain is proposed for MIMO-OFDM system based on pilot tones in this paper. The basic idea is that the time-domain samples generated by the pilot tones of the transmitter and the receiver are used to estimate the time-domain channel responses. Optimal pilot sequences (OPS) with regard to (w.r.t) the mean square error (MSE) of LS channel estimation are also presented; it is shown that the OPS are equipowered, equispaced, and position orthogonal. The bigger guard bandwidth can be used to avoid the transmitted data being distorted more effectively in the proposed OPS, because the maximum guard bandwidth (MGB) of proposed OPS is bigger than that of the conventional OPS. Through simulations, it is shown that the OPS derived in this paper outperforms the conventional OPS in terms of MSE and BER.*

Keywords: MIMO-OFDM, Optimal pilot sequences, LS channel estimation, Maximum guard bandwidth, IFFT

1. **Introduction.** Orthogonal frequency division multiplexing (OFDM) has attracted a lot of attention due to its high data transmission capability, simple implementation, and robustness against frequency-selective fading channels, which is obtained by converting the channel into flat fading subchannels. OFDM has been standardized for a variety of applications, such as digital audio broadcasting (DAB), digital television broadcasting subscriber lines (ADSLs) [1,2]. The multiple-Input Multiple-Output (MIMO) can achieve higher rates and diversity than Single-Input Single-Output (SISO) systems [3,4]. Combining OFDM with MIMO has been shown to provide a significant increase in capacity through the use of the transmitter and the receiver diversity [5-11].

Channel estimation is used for data detection and channel equalization [12]. Channel state information can be obtained in different ways: one is based on pilot sequences (PS); other is blind [13,14]. Comparing with the method of PS, blind channel estimation generally is limited to slow time-varying channels. We only consider the method of PS in this paper.

The frequency-domain least squares (LS) channel estimation scheme and optimal pilot sequences (OPS) are proposed in [9]. It is shown the OPS is equipowered, equispaced, and phase shift orthogonal. However in OFDM systems, to avoid the transmitted data being distorted by the low-pass filter on the transmitter side, the subcarriers that fall in the roll-off region of the filter transfer function are not used for transmission [15]. These subcarriers that are on both edges of the allocated bandwidth, are often referred to as virtual subcarriers. If some pilot tones fall in the region of the virtual subcarriers, the conventional optimal uniformly spaced approach will be useless anymore.