

HUSSEIN ALI ABED. PERFORMANCE OF FRAMELET-OFDM SYSTEMS IN
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Abstract

Ultra-Wideband (UWB) system has recently been proposed as a technology for short-range, high data rate communication. There are two main proposed physical layers for this technology: Orthogonal Frequency-Division Multiplexing (OFDM) proposal known as Multiband OFDM and Code Division Multiple Access (CDMA) based technique.

In this thesis, the possibility of using Framelet transform filter bank for multicarrier modulation in OFDM for Ultra-Wideband channels is studied and compared with Fourier based and wavelet based systems. It is shown that for Framelet, only one of the two wavelet functions can be used for modulation, while the other one should be supplied with zeros to avoid cross-talk between the two corresponding channels. Further more, a modification of the filter bank should be carried to achieve orthogonality. This is achieved by replacing the original low pass filter with one, which is orthogonal to the high pass wavelet filter. On the other hand, it was found that for the framelet and wavelet based system, adjacent symbols are overlapped in time, which prevent the use of the cyclic prefix for eliminating the effect of ISI. This required more complex time domain equalizers for dealing with ISI in these systems. For this reason, the wavelet and Framelet based system, due to the elimination of the cyclic prefix, their BER performance are worse than FFT based system with cyclic prefix. However, with the use of an effective MMSE equalizer, wavelet and Framelet-OFDM systems show better performance than FFT-OFDM with the same type of equalizer. Moreover when equalizer is used, the proposed Framelet based system outperforms all the other systems in terms of BER vs. $(E_b/N_0)_{dB}$. In channel model 1 (CM1), the simulation results shows that Framelet-OFDM reaches BER of 10^{-5} at $E_b/N_0 = 11$ dB while DWPT-OFDM, DWT-OFDM and FFT-OFDM reach BER of 10^{-5} at E_b/N_0 equal to 12 dB, 12.5 dB and 15 dB respectively. Moreover, the effect of the mother wavelet type used in modulation on the BER performance was also studied. We also highlight on the effect of increasing the number of levels used on the system performance. Finally we use spread spectrum combined with our proposed OFDM system as similar to Multicarrier-CDMA for multiple access of the channel by different users.

Keywords: UWB. OFDM. Framelet. Wavelet. MMSE Equalizer.