

# Abstract

**Radwa khalil Ibrahim**

## **Channel Estimation Using Wavelet and Fractal Signals for WOFDM Based Systems**

The orthogonal frequency division multiplexing modulation technique is of great importance in modern communication systems. The main advantage of this modulation technique is the ability to treat wideband frequency Selective channels as a number of narrow band flat fading channels. Some of its other advantages include the prevention of inter-symbol interference and inter-carrier interference as well as providing efficient spectrum use. In this thesis channel estimation for wavelet orthogonal frequency division multiplexing based systems is done through the use of three newly generated pilot signals. These three new techniques presented in this thesis use Barker codes having optimum correlation properties as an initial point for the generation of each of them. For the first novel pilot generation algorithm introduced in this thesis the Barker code of length 13 is scaled using four different scaling factors producing four new multi-scaled versions of the initial Barker code. These newly generated sequences are later combined using the inverse discrete wavelet transform stage in the transmitter to generate a pilot block. The correlation between the transmitted pilot block and the received pilot block provides the necessary information needed to correctly estimate the delays introduced by the multi-path Rayleigh fading channel model used. The estimated delays are compared with those obtained when the conventional linear minimum mean square error technique is used to estimate them. In the second newly generated pilot sequence presented in this thesis. Combined barker codes are first generated by replacing each symbol from the initial Barker code of length 13 with a shorter length barker and then rescaling the newly generated vector four times. This time the pilot sequence is generated as well after the inverse discrete wavelet transform stage of the transmitter. Each of the individual constituents of the pilot signal is obtained after the received pilot goes through the discrete wavelet transform stage of the receiver. The correlation between the transmitted and received Barker codes at each scale is used to accurately estimate the delays introduced by the multi-path Rayleigh fading channel. For the generation of the third newly generated pilot sequence presented in this thesis, Barker codes having fractal type spectrum are created. This a different scaling was used in order to generate four scaled versions are then combined at the I stage of the transmitted generating a pilot signal with wideband and fractal properties. The received pilot block maintains its wideband and fractal nature at the receiving end. Each of the individual constituents of the pilot signal is obtained after the received pilot goes through the discrete wavelet transform stage of the receiver. The correlation between the transmitted and received Barker codes at each scale is used to accurately estimate the delays introduced by the multi-path Rayleigh fading channel used as well as the path gains.