Abstract

Impulse Radio Ultra Wideband (IR-UWB) systems used in multipath rich channels are very susceptible to signal distortion due to Inter-Symbol Interference (ISI) as well as signal attenuation due to destructive fading. Equalizers can be used to undo signal distortion due to Inter-Symbol Interference but any signal attenuation due to destructive fading would still be present and this would lead to lower effective data transmission rates.

In this report, we propose a solution, which we refer to as the Real-Time Channel Estimator (RTCE), which helps to undo signal distortion due to Inter-Symbol Interference while reducing the effects of destructive fading as well and thus permitting higher effective data transmission rates. This is particularly useful for Impulse Radio Ultra Wideband systems operating between 3.1 GHz and 10.6 GHz which are subject to the low power emission restrictions imposed by the Federal Communications Commission (FCC).

In essence, the Real-Time Channel Estimator would estimate the Channel Impulse Response (CIR) function for the entire bandwidth of the IR-UWB communication channel and represents this in a well conditioned matrix form. We measure the singularity of this matrix, using the Singular Value Decomposition technique, to minimize the effects of perturbations due to channel noise. It would then attempt to determine the transmitted signal from the received signal using the Gaussian elimination technique.

In the following sections, we review most of the commonly used equalization techniques and compare their performance against our proposed solution in a multipath channel with destructive fading characteristics. We then compare the Bit Error Rate (BER) of these different types of equalizers over various Signal-to-Noise-Ratio (SNR) values and their computational complexity and show that our proposed solution performs better than most commonly used equalizers.