UNIVERSITI TEKNOLOGI MARA

THE DOCTORAL RESEARCH ABSTRACTS

Volume: 9, Issue 9 April 2016

NINTH ISSUE

INSTITUTE of GRADUATE STUDIES

IGS Biannual Publication

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The ability to accurately characterize the wireless communication channel is essential for testing and designing any wireless communication systems. It fulfills the demand for a better quality of communication service in terms of higher bits rate and the use of spread spectrum technology. One of the challenges for wireless channel characterization is the need to demonstrate an appropriate method to characterize the wireless channel hence, effective channel mitigation technique can be developed to minimize deleterious effect arise from the channel namely the short terms variations due to multipath fading. This propagation environment affects the transmitted signal in terms of scattering, diffraction and reflection as it traveled towards the receiver causing the signals to be received distorted or interfered. Therefore, the central issue in this thesis is to determine appropriate techniques to characterize such a channel. A statistical property was adopted to represent properties of the channel which was categorized under wide sense stationary uncorrelated scattering (WSSUS) conditions. In achieving research objectives, four methods are employed namely Cross Correlation Function (CCF), Cross Ambiguity Function (CAF), Cross Wigner Ville Distribution (CWVD) and Cross S Transform (CST). The transmitted signals used are pass band modulation signals and linear FM signals. CCF and CST can determine the time delay profile of the channel while the other two methods were capable of estimating all the parameters required. Both the CAF and the CWVD are able to describe the signal spreading under multipath condition. The time delay spread is estimated based on peak detection between the paths while Channel Impulse Response (CIR) is estimated based on time marginal. Doppler spread in contrast is estimated from the spread of each path in Doppler axis direction. It was found that all the four methods had estimate the time delay profile correctly while CAF and CWVD with certain specifications had estimated the Doppler spread up to 98% accuracy. CWVD had shown to be better compared to other three methods in terms of computation of the Doppler spread and the duration of the signals used. In conclusion, the methods proposed in the time frequency domain were able to perform the channel characterization under multipath condition regardless of the propagation media encountered and the number of paths existed in the channel.