

Modeling the Frequency Dependence of Ultrawideband Spatio-Temporal Indoor Radio Channels

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Abstract:

In ultrawideband (UWB) wireless propagation channels, each multipath component (MPC) can exhibit delay dispersion or, equivalently, frequency dependence; even more, this dispersion can be different for different MPCs. While this effect is understood to have important implications for UWB system design, extraction of the frequency-dependence parameters from measurements has been lacking. This paper will provide both the theoretical tools for the parameter extraction, and provide experimental results of such parameters in UWB indoor channels. We first develop a method that extracts a single MPC. Based on the image principle, the method identifies locations and intensity of radio sources including both original and image sources (corresponding to MPCs) by a distributed antenna array. We show that the method provides spatial resolution better than 0.5m and is robust against possible measurement errors. Having applied the method to the measured channels in indoor line-of-sight scenarios, we track the detected image sources over (partially overlapping) frequency subbands to obtain frequency dependent properties of their intensity and location. The variation of the source intensity over the frequency was found to be significant. Furthermore, the locations of the image sources can vary as the frequency changes. Comparison of the results with models that do not describe varying per-path frequency dependence revealed noticeable difference in the shape of the CIRs, and as a result, in the delay spread and the number of significant delay bins for Rake reception.