On the Use of Ray Tracing for Performance Prediction of UWB Indoor Localization Systems

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Abstract:

The most important factors impairing the performance of radio-based indoor localization systems are propagation effects like strong reflections or diffuse scattering. To the full extent, these effects can be captured only by time-consuming measurement campaigns. Ray tracing (RT) offers the possibility to predict the radio channel for a certain environment, avoiding the need for measurements. However, it is crucial to include all relevant propagation mechanisms in the RT as well as to validate the obtained results. In this paper, we analyze if sub-band divided RT can yield realistic ultra-wideband channel impulse responses. We use the RT results for performance analysis of multipath-assisted localization, which depends directly upon the above mentioned propagation effects. In particular, it has been shown that the ratio of the signal energies of deterministically reflected paths to interfering diffuse components quantifies the amount of position-related information of deterministic multipath components. Comparison of this ratio to measurement data is thus useful to validate the sub-band divided RT. The results highlight the need for proper modeling of the diffuse multipath, as estimates of this energy ratio using RT are often overly optimistic. However, the obtained localization performance predictions using measurements and RT show general agreement.