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## **Bandwidth Dependence of the Ranging Error Variance in Dense Multipath**

Abstract—It is well known that the time-of-flight ranging performance is heavily influenced by multipath propagation within a radio environment. This holds in particular in dense multipath channels as encountered in indoor scenarios. The signal bandwidth has a tremendous influence on this effect, as it determines whether the time resolution is sufficient to resolve the useful line-of-sight (LOS) signal component from interfering multipath. This paper employs a geometry-based stochastic channel model to analyze and characterize the ranging error variance as a function of the bandwidth, covering the narrowband up to the UWB regimes. The Cramér-Rao lower bound (CRLB) is derived for this purpose. It quantifies the impact of bandwidth, SNR, and parameters of the multipath radio channel and can thus be used as an effective and accurate channel model (e.g.) for the cross-layer optimization of positioning systems. Experimental data are analyzed to validate our theoretical results.

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