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Hybrid modeling of the radio channel in an industrial context

Kaoutar El hariri[†], Pierre Combeau[†], Yannis Pousset[†], Rodolphe Vauzelle[†]

[†]Xlim-SIC, UMR CNRS 7252, Bât. SP2MI - Boulevard Marie et Pierre Curie,
86962 Futuroscope

kaoutar.el.hariri.essamlali@univ-poitiers.fr, +33(5)49496605

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Abstract Text:

The industrial world is interested in incorporating wireless communications systems into their production and storage processes via mobile robots for example. Depending on the heights of the receivers, we can differentiate two kinds of applications. Ensuring satisfactory performance for these new wireless communication systems requires precise modeling of the propagation channel. In this work we present an hybrid channel model for communications in industrial environments inspired by the Winner II geometric stochastic model [1].

This hybridisation model is based on a partitioning of the environment on deterministic criteria related to wave propagation configurations for visibility or non-visibility (weak and strong). In these environments, the propagation channel has different behavior than classically encountered indoor. Few models specific to these environments exist in the literature [2]. We propose an original contribution to the problem by combining the realistic characteristic of deterministic models with rapid calculation of statistical models, by proposing a semi-deterministic.

The implementation of our model is therefore based on a first step of partitioning the environment obtained through a deterministic simulation (ray tracing in the 3D environment) considering only one reflection. The simplicity of this parameter leads to a computation time related to partitioning almost zero second. The second step is then to launch in each zone (LOS, NLOS weak and NLOS heavy) a template WINNER, which takes the concept of clusters. The identification and characterization of clusters are obtained via a simulator based deterministic rays, combined with asymptotic frequency. This last point is crucial because the stochastic model typically considers only two configurations (LOS and NLOS) and only for higher receivers heights.

These two steps, deterministic and statistical reveal clearly the hybrid nature of our model. Our approach enable us to simulate in a fast and realistic way due to partitioning of the spatial environment into three areas. We validated our model by comparing the impulse responses, average delay and the delay spread of the hybrid model to those of a deterministic model. This comparison affirms a good concordance of the results. The mean error is estimated at 6.57% (3.87 dB) for the received power, 8.77% (2.45 μ s) for the average delay and 11.37% (3.98 μ s) for the delay spread. The gain in computation time is about 40.

[1] IST-WINNER D1.1.2 P. Kyösti, et al., "WINNER II Channel Models", ver 1.1, 2007.

[2] J.Karedal, "A measurement-Based Statistical Model for Industrial Ultra-Wideband Channels", IEEE Transaction on wireless communications, Vol 6, 2007.