UM-CRT model optimisation

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Abstract— **Many research on VANETs present new propagation models. This paper focus on the last optimisation of the UM-CRT model proposed by the XLIM-SIC Laboratory. The model is simplified in order to obtain a faster computation time without reducing the realism of the UM-CRT model and new criteria computed from the impulse response are also shown.**

I. INTRODUCTION

Vehicles wireless networks are called Vehicular Ad-hoc NETworks (VANETs). Finding an accurate channel model for VANETs simulations is an important research issue [1].

This short paper is organised as follows. Section II give a brief overview of the UM-CRT semi-deterministic model. Section III present the optimisation of the model and shows some results. Finally section IV conclude the paper.

II. UM-CRT MODEL

In [2], Ledy et al. proposed a semi-deterministic solution which benefits from both advantages of statistical and deterministic channel models. This new model is called UM-CRT because it is based on the statistical Spacial Channel Model Extended in it's Urban Micro (SCME-UM) environment [3], and deterministic Communication Ray Tracer (CRT) simulator [4].
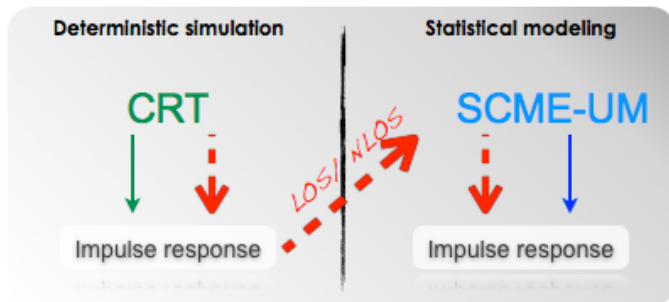

Figure 1. Principle of the UM-CRT model

Figure 1 shows the relationship between UM-CRT and both CRT and SCME-UM. For all radio links existing between nodes, CRT computes Impulse Responses (IRs) of all the received multi-paths according to a 3D environment. On the other hand, SCME-UM provides statistically generated IRs. Ledy et al. proposed to limit the search path by ray-tracing only to the direct path because it is well known that this path has the main impact on the received signal.

III. MODEL OPTIMISATION AND NEW CRITERIA

In the previous UM-CRT build, the Line Of Sight (LOS) criteria was determined using the computed delay of the first IR for each links. We modified it to create an IR only in LOS cases, so the Non LOS cases do not need to be computed.

Using this new build, two simulations with 20 nodes moving at 15m/s with 3 simultaneous communications takes less than 1 minutes while it took 3 minutes with the oldest build. Preliminary test shows that optimised UM-CRT and original UM-CRT give the same results in term of behaviour.

In addition to this optimisation, we also compute from the IRs two new metrics that are the Capacity and Probability of Outage. They are both good indicators of the quality of radio links and could be combined with LOS/NLOS criteria.
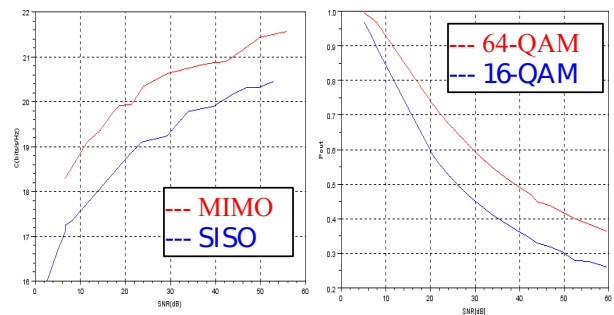

Figure 2. Capacity and Probability of Outage versus Signal to Noise Ratio

Figure 2 shows the two metrics depending on the SNR. The Capacity of Outage is computed for MIMO and SISO technologies, as the Probability of Outage is computed for 16 and 64 QAM modulation. We can therefore see that these indicators accurately reflects the properties/quality of the channel.

IV. CONCLUSIONS

In this paper, we presented an optimisation for the UM-CRT model. We showed that the results of this optimisation are very similar to the standard one, and that the simulation time had been improved. New criteria that may be used in combination with the LOS-NLOS criteria are also presented.

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