Stochastic Geometry and Simulation Models for Analyzing 3GPP TR 38.901 Path Losses in 5G Network Deployment Scenarios

Alexander Askerov[1], Elena Makeeva[2], Irina Kochetkova[3]

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In 5G and 6G wireless networks, the use of the terahertz radio frequency range allows for high data rates and low latency communication. This makes it crucial to accurately model the propagation characteristics of signals, particularly their attenuation (path loss). By carefully considering path loss, one can take into account the specific challenges and requirements of different usage scenarios. The 3GPP TR 38.901 specification provides detailed models for describing path loss in various environments, including urban macrocells (UMa) and microcells (Umi), rural environments (Rma), indoor environments (inH), and factories (inF).

This paper presents stochastic and simulation models based on formulas provided in the 3GPP TR 38.901 specification. It considers the user to be located at a random distance from the base station within the cell. Stochastic geometry techniques are used to capture the random spatial distribution of users within the coverage area of the base station. The distribution functions of signal attenuation from the base station to the user are analyzed for both line-of-sight (LOS) and non-line-of-sight (NLOS) cases. This provides insights into the variability of the signal strength. Monte Carlo simulation is used to validate the results.

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[1]RUDN University, Moscow, Russian Federation, alexander.askerov@gmail.com
[2]RUDN University, Moscow, Russian Federation, elena-makeeva-96@mail.ru
[3]RUDN University, Moscow, Russian Federation, kochetkova-ia@rudn.ru