Towards A Channel Model for Joint GNSS and Mobile Radio Based Positioning

Author(s) - Institution(s):
Wei Wang, DLR
Thomas Jost, DLR
Andreas Lehner, DLR
Fernando Perez Diaz, DLR
Uwe-Carsten Fiebig, DLR

Corresponding author email: wei.wang@dlr.de

Corresponding WG group: WG1

Abstract:

Global navigation satellite systems (GNSSs) provide high position accuracy as long as pure line-of-sight (LoS) conditions between the satellites and the receiver exist. However, in critical environments like urban canyons, the position accuracy by GNSSs very much deteriorates due to shadowing, diffraction, and reflection of satellite signals. Augmenting GNSS based positioning by mobile radio signals of opportunity very much helps in these environments and improves the position accuracy compared to a GNSS-only solution.
An essential tool to assess receiver performance for combined GNSS and mobile radio based positioning, coherent channel models considering both GNSS and grou nd mobile radio propagation effects are essential. The DLR land-mobile satellite (LMS) channel model is widely used for the simulation of the position accuracy of mobile satellite navigation receivers. However, there is a lack of channel models which are suitable to model all characteristics required for mobile radio based positioning. As one of the most accurate channel models for mobile radio communications, the WINNER channel model lacks two features which are important for positioning application: Firstly, the WINNER channel model does not consider the absolute propagation delay between transmitter and receiver: in non LoS (NLoS) situations, this model is unable to predict the delay bias of the first propagation path with respect to the geometric LoS (GLoS) path, defined as the NLoS bias in this letter. In contrast to most communication applications, the delay bias is essential for the evaluation time-based range measurements. Secondly, the time evolution of channel impulse responses is not incorporated in current WINNER channel model. The time evolution of the channel is an important input to tracking algorithms used for positioning purpose. A recent work within the COST2100 is aiming to refine WINNER model by implementing time variant characteristics. However, there is still a lack of opportunity to provide the NLoS bias. Moreover, the coherent combination of the mobile radio channel model and satellite channel model is missing.
In this work we proposed a coherent combination based on a ray tracing philosophy. As an example, we extend the WINNER channel model in order to graduate the two features. The virtual reflectors whose statistics are derived from the original WINNER channel model are utilized. These reflectors generate echoes with a specific life time. The concept of virtual reflectors allows evolving a realistic time-variant impulse response. Furthermore, we combine the extended WINNER model with the DLR LMS channel model by apply ing the same virtual environment, where the NLoS bias is generated by ray tracing scenarios for both satellite and mobile radio channels. Thus, a coherent combination between the WINNER and the DLR LMS channel model is established.