Radiowave Propagation Prediction in Vegetated Residential Environments - Part I: Theoretical Modeling

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Abstract:

This paper is part I of a two-part paper that proposes a propagation prediction model in a macrocell vegetated residential area. The goal of this propagation model is to model the attenuation caused by the tree canopies in vegetated residential areas in a simplified mann er. The model is based on the Torrico-Bertoni-Lang model [1]. The model describes a vegetated residential area where rows of houses and trees are lying between an elevated transmitting antenna and the receiving antenna that is located at street level. In this scenario, the receiving antenna does not have a direct line-of-sight from the transmitter antenna and since the transmitter antenna is located around the heights of the house then propagation takes place over the top of the houses. With this viewpoint, the propagation loss is computed by using multi-screen diffraction where the houses are modeled as absorbing screens and the trees are modeled as phase screens. Using this approach, the total propagation loss is broken in three components, namely the free space loss, multi-screen diffraction loss, and the rooftop-to-street diffraction loss. In this paper two main contributions are observed, the first is that a simplified analytical model is proposed to compute the multi-screen diffraction loss in a vegetated residential environment, and the second contribution is to include in a simplified manner the effects of vegetation to the rooftop-to-street diffraction loss via the scattering theory of Foldy-Lax. The model serves as an important extension of the Walfisch-Bertoni urban model and the COST-231 Walfisch-Ikegami model for applications in vegetated residential areas. The model is valid at the UHF frequency band between 1 GHz and 3.5 GHz.