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A Novel Radio Wave Propagation Modeling Method Using System Identification Technique over Wireless Links in East Africa

Solomon T Girma, **Dominic BO Konditi*** and Ciira Maina.

**Department of Telecommunication and Information Engineering*

Abstract

Transmission of a radio signal through a wireless radio channel is affected by refraction, diffraction and reflection, free space loss, object penetration, and absorption that corrupt the originally transmitted signal before radio wave arrives at a receiver antenna. Even though there are many factors affecting wireless radio channels, there are still a number of radio wave propagation models such as Okumura, Hata, free space model, and COST-231 to predict the received signal level at the receiver antenna. However, researchers in the field of radio wave propagation argue that there is no universally accepted propagation model to guarantee a universal recommendation. Thus, this research is aimed at determining the difference between the measured received signal levels and the received signal level calculated from the free space propagation model. System identification method has been proposed to determine this unknown difference. Measured received signal levels were collected from three randomly selected urban areas in Ethiopia using a computer, Nemo test tool, Actix software, Nokia phone, and GPS. The result from the simulations was validated against the received experimental signal level measurement taken in a different environment. From the simulation results, the mean square error (MSE) was 4.169 dB, which is much smaller than the minimum acceptable MSE value of 6 dB for good signal propagation, and 74.76% fit to the estimation data. The results clearly showed that the proposed radio wave propagation model predicts the received signal levels at 900 MHz and 1800 MHz in the study region.

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