ANTENNAS AND PROPAGATION

Modeling, Simulation & Measurements

Edited by

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Part II Propagation Measurements and Modeling

Chapter 19

Proposed Path Loss Models For Suburban Area in Kuala Lumpur

Jalel Chebil[1], Md Rafiqul Islam[1] and Ali Khadim[1]

19.1 Introduction

Path loss models are essential for appropriate wireless network planning as they assist in interference estimations, frequency assignments, and the evaluation of cell parameters. The log normal shadowing model and the Lee model are commonly used propagation models. They are characterized by its simplicity and good prediction accuracy. This study will determine new values for the path loss exponent n, and for the two parameters γ and L_0 of Lee model which are suitable for suburban environment in Malaysia. The performance of the adjusted two models is compared to four widely used empirical path loss models which are: Sanford University Interim, COST231 Hata, ECC-33 and Egli models. Section 19.2 and 19.3 will discuss the methods used in obtaining the new values for n, γ and L_0. Section 19.4 will compare between the results obtained by the two adjusted models and the four models.

19.2 Ajusted Log-Normal Shadowing Model

The log normal shadowing model was described in Section 17.6.3. Instead of using the values of the path loss exponent n fond in Table 17.1, it is suggested to estimate suitable values of n for suburban area of Kuala Lumpur. The measured data described in Chapter 18 will be used for this purpose. The values of the path loss exponent n can be computed from measured data using linear regression. In this method, the difference between the measured and estimated path losses is minimized in a mean square error sense over a wide range of measurement locations and T-R separations. The MMSE estimate can be found using the following equation [1].

$$E(n) = \sum_{i=1}^{N} \left(P_r(d_i) - P_p(d_i)\right)^2 \tag{19.1}$$

This equation expresses the sum of squared errors between the measured and estimated value, where $P_r(d_i)$ is the received power at distance d_i and $P_p(d_i)$ is the estimated power which is determined by using the path loss equation. N is the number of measured points. By using Equation (17.9), Equation (19.1) becomes

$$P_p(d_i) = P_r(d_o) - n10\log\left(\frac{d_i}{d_o}\right) \tag{19.2}$$

where d_0 is the close-in reference distance which is determined from measurements close to the transmitter, and d_i is the T-R separation distance. Substituting Equation 19.2 into Equation 19.1 yields the following Equation