ANTENNAS AND PROPAGATION

Modeling, Simulation & Measurements

Edited by

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IIUM PRESS

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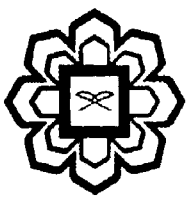

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Md. Rafiqul Islam & Jalel chebil: Antennas and Propogation: Modeling, Simulation & Measurements
Bibliography p.
Includes Index
ISBN

ISBN: 978-967-418-138-3

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed By:
IIUM PRINTING SDN.BHD.
NO. 1, JALAN INDUSTRI BATU CAVES 1/3
TAMAN PERINDUSTRIAN BATU CAVES
BATU CAVES CENTRE POINT
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Chapter 17

Propagation Path Loss Modeling for Wireless Applications

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

17.1 Introduction

The propagation path loss between a transmitter and a receiver is the main topic of interest in this chapter. Evaluating the performance of the path loss attenuation requires an accurate understanding of fundamental concepts; namely radio wave propagation and propagation path loss models which their development is imperative for reliable wireless system design. Radio wave propagation is a complex process comprising three basic propagation mechanisms called reflection, diffraction and scattering. Most cellular radio systems operate in environments where there is no direct path between the transmitter and receiver. Presence of high-rise buildings and other objects cause severe diffraction loss.

Propagation path loss models are an essential step in planning a mobile radio system as they help interference estimations, frequency assignments and evaluation of cell parameters. They basically predict what will happen to the transmitted signal while in transit to the receiver. These models are divided into three basic classifications: theoretical, empirical, and physical. Empirical models are based on observations or measurements. Measurements are typically done in the field to measure path loss. Many propagation empirical path loss models are available to predict path loss over irregular terrain. All these models aim to predict signal strength at a specific receiving point [1]. However, their approach differs in terms of its complexity and accuracy.

This chapter presents a detailed account concerned with radio wave propagation over terrestrial surface, the basic propagation mechanism and the most common propagation empirical path loss models used to predict attenuation between transmitter and receiver. Beside, the chapter reviews some of the previously conducted studies in tropical areas.

17.2 Free Space Propagation Model

The free space propagation model is used to predict received signal strength that assumes a transmit antenna and a receive antenna to be located in an otherwise empty environment. Neither absorbing obstacles nor reflecting surfaces are considered. As with most large-scale radio wave propagation models, the free space model predicts that received power decays as a function of the T-R separation distance raised to some power. The free space power received by an antenna and assuming no losses in the

system is given by the Friis free space equation [1]:

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