ANTENNAS AND PROPAGATION

Modeling, Simulation & Measurements

Edited by

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IIUM PRESS

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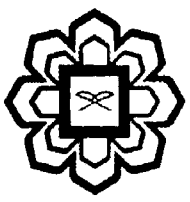

IIUM Press

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 24

Development of One-Minute Rain Rate Contour Maps for Radiowave Propagation in Malaysia

Jalel Chebil[1] and Tharek Abd. Rahman[2]

24.1 Introduction

Rainfall is a serious source of attenuation for the radio wave propagation for frequency band above 10 GHz. It is important for any microwave system designer to predict accurately the fading outage due to rain attenuation. The common rain attenuation prediction methods require one-minute rain rate data which is scarce in tropical regions. However, rainfall data with one hour interval or longer is available at many meteorological stations. A method for converting the available rain rate data to the equivalent one-minute rain rate distribution would be very useful for the radiowave engineers. In this chapter, rain rate conversion method and Moupfouma model are used to determine the one-minute rain rate statistics in 59 locations in Malaysia. Then, the one-minute rain rate contour maps are developed for different percentage of time.

24.2 Data collection

Two types of data are used in the analysis: hourly and one-minute rain rate data. Hourly rainfall data were obtained from the Malaysian Meteorological Service (MMS) for 35 stations in various location in Malaysia. These data cover a period of almost 12 years for each station. The one-minute rain rate data were collected for few years at the Universiti Teknologi Malaysia-Kuala Lumpur (UTM), at the Universiti Sains Malaysia-Tronoh (USM) and Sekolah Menangah Vokesional-Bota (SMV). In addition, long-term mean annual precipitation was obtained at 24 locations [1,2].

24.3 Prediction of the one-minute rain rate distribution

Based on the 1-min and hourly rainfall data, the authors [3] have shown that the 1-min and hourly rain rate distribution in Kuala Lumpur and Ipoh regions are best described by Moupfouma and the linear logarithmic model respectively. They also derived a model for the rain rate conversion factor which converts the hourly rainfall distributions into equivalent 1-min distribution. The model is given by

$$CF_{60} = R_1(P) / R_{60}(P) = 0.772\ P^{-0.041} + 1.141\ \exp(-2.570\ P) \qquad (24.1)$$

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