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Analysis of Synthetic Storm Technique Based on Ku-Band Satellite Beacon Measurements in Malaysia

Abstract

Most of the existing rain attenuation prediction models were proposed based on measurements taken in temperate climates. These models are found not accurate in tropical regions and were thus modified in order for such models to be applied in tropical regions. Synthetic Storm Technique (SST) is one of the most reliable methods to estimate rain attenuation time series in Europe. However, due to the lack of measured data in the tropical regions of the world, the above-mentioned method is yet to be validated for those regions. This paper aims to investigate SST validity in Malaysia by focusing on both rain events and the overall statistical behavior. Its performance is assessed based on concurrent measurement of Ku-band satellite beacon and rain rate over University of Science Malaysia (USM) campus at Tronoh. Preliminary analysis shows that SST is capable of providing details of time-series of many rain events to reflect the dynamics of rain fade. However, it is unable to predict the entire range of rain intensity.

Chapter 13
Analysis of Synthetic Storm Technique Based on Ku-Band Satellite Beacon Measurements in Malaysia

Ali K. Lwas, I.M. Rafiqul, Mohamed Hadi Habaebi, Ahmad F. Ismail, Mandeep Singh, Jalel Chebil, Al-Hareth Zyoud and Hassan Dao

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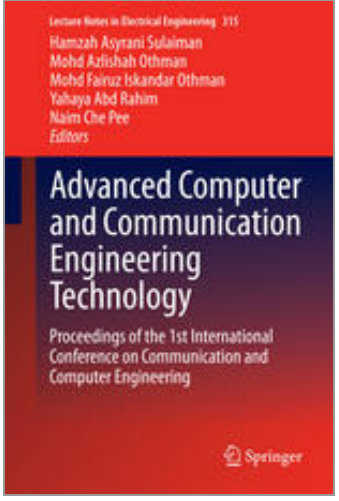
13.1 Introduction

Most severe conditions of propagation impairments such as rain, clouds and atmospheric gases are occurring frequently in tropical regions. Furthermore, rain-induced attenuation is the major issue at frequencies above 10 GHz which faces the signal of satellite communications, more especially in this area which is subjected to heavy rainfall. To design a reliable earth-to-satellite link, the effects of these are required to measure and understand clearly. Scarcity of measured data at higher frequencies is also an issue in tropics. This makes it difficult to test available propagation prediction models or to develop new ones. Thus, this fact gives a real reason of why the researchers are still in their researches improve and update prediction models to give abstract view about the behavior of the rain rate and attenuation phenomena in tropical regions [1].

The synthetic storm technique is a method which can transform a rainfall rate time series directly into a rain attenuation time series. This technique developed by [2] based on rain rate time series recorded in Italia. Compared to nine prediction models, this model overcomes all of them in the three Italian sites. In addition, study [3] focused on the applicability of the SST on single rain events affecting V-band satellite links. It finds that the SST gives specifics of time series of single rain events as well as matches long-term statistics. Also, in paper [4] performance of SST is evaluated for Ka bands over a tropical location in India. The analysis indicated that SST is an appropriate to estimate the fade characteristics from the rain rate time series measurements over this region. A new prediction model is proposed in [5] that bases on advantages of SC-EXCELL (stratiform-convective rain discrimination) and of SST, named SC-SST (Stratiform-Convective SST). From analysis, it is found to be in good agreement with beacon measurements collected at Kuala Lumpur from MEASAT-1 satellite.

This paper aims to investigate applicability of SST in Malaysia by comparing measured rain attenuation with that predicted by SST from rain rate both measured concurrently. Rain attenuation and rain rate measurements were conducted at USM campus (4.390 N, 100.980 E) at Tronoh, Perak (200 km from Penang), which faces very heavy rainfall frequently. The receiver antenna is pointing towards Superbird-C at 40.1 elevation angle and diameter size of 2.4 m. The beacon signal frequency is 12.255 GHz. The data logging system has a sampling rate of one sample per second and the rain gauge is of 1-min integration time. Section two of the paper provides brief on the SST. Results are introduced and analyzed in Section three. Section four concludes the contribution of the paper.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