This Final Year Project attached here:

Title : L-BAND MOBILE SATELLITE SIGNAL PERFORMANCE USING HANDHELD GPS RECEIVER

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Dedicated to my beloved family and friends.

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ABSTRAK

Projek tahun akhir ini memperkenalkan satu kaedah untuk mengkaji isyarat jalur L dari satelit mobil dengan menggunakan *Global Positioning System* (GPS) mudah alih. Dalam projek ini, satu sistem penerimaan data yang mudah dan berkos rendah dicadangkan bagi menjalankan eksperimen kajian isyarat di lokasi yang berbeza bagi satelit mobil. Kajian prestasi isyarat telah dijalankan bagi factor sudut ketinggian dan sudut azimut. Analisis yang dihasilkan adalah penting untuk kajian prestasi isyarat. Model matematik yang mewakili persekitaran satelit mobil yang berbeza dibentuk daripada keputusan dan analisis yang dihasilkan. Model matematik ini adalah penting untuk membangunkan simulator satelit mobil yang dapat meramal prestasi isyarat untuk lokasi satelit mobil yang berlainan. Simulator satelit mobil dibina dengan menggunakan bahasa pengaturcaraan Visual Basic 6.0. Fungsi simulator satelit mobil adalah untuk meramal prestasi isyarat bagi kedudukan satelit mobil yang berbeza tanpa menjalankan eksperimen. Oleh itu, program ini telah menyenangkan process pengajian pretasi isyarat satelit mobil. Daripada kaedah ini, pangkalan data bagi setiap isyarat dari satelit yang berbeza dapat dibinakan.

ABSTRACT

This project presents a method to analyse the signal performance from the L-Band Mobile Satellite (MS) by using the handheld Global Positioning System (GPS) receiver. In this project, a simple and low-cost data acquisition system that can be used to carry out measurement for different mobile satellite environments is proposed. The analysis of the signal performance under different MS environments is performed with respect to the elevation and azimuth degree. The analysis produced forming an important part in the studies of the signal performance. The mathematical models that the represent different MS environments are derived from the results and analysis obtained. These mathematical models are important components in order to develop the MS simulator that will be able to predict signal performance under different MS environments. The MS Simulator was designed using Visual Basic 6.0 programming language. The main feature of this MS Simulator is the ability to predict the signal performance under different MS environment without carrying out the actual experiment. Thus, it enables the user to easily perform signal analysis. Besides, the databases of the propagation data for different satellites can be built by implementing the method used in this project.

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ABBREVIATIONS

ADS	_	Automatic Dependent Surveillance
ADS-B	_	Automatic Dependent Surveillance-Broadcast
AMSS	_	Aeronautical Mobile Satellite Service
ATC	_	Air Traffic Control
AVLS	_	Automatic Vehicle Location System
BSS	_	Broadcast Satellite Service
C/A	_	Coarse/Acquisition
CDMA	_	Code Division Multiple Access
CES	_	Coast Earth Station
COMSAT	_	Communication Satellite Cooperation
DAB	_	Digital Audio Broadcasting
dB	_	Decibel
DBS	_	Direct Broadcasting Satellite
DGPS	_	Differential Global Positioning System
DSSS	_	Direct sequence spread spectrum
DTH	_	Direct-to-Home
EGNOS	_	European Geostationary Navigation Overlay Service
FAA	_	Federal Aviation Administration
FES	_	Fixed Earth Stations
FSS	_	Fixed Satellite System

GES	_	Ground Earth Station
GEO	_	Geostationary Earth Orbit
GIS	_	Geographic Information System
GNSS	_	Global Navigation Satellite System
GPS	_	Global Positioning system
HEO	_	Highly Elliptical Orbit
ITU	_	International Telecommunication Union
LBS	_	Location-Based Service
LEO	_	Low Earth Orbit
LES	_	Land Earth Station
LMSS	_	Land Mobile Satellite Service
LOS	_	Line-of-Sight
MTime	-	Malaysia Time
MDGPS	_	Maritime Differential Global Positioning System
MEO	_	Medium Earth Orbit
MES	_	Mobile Earth Station
MMSS	_	Maritime Mobile Satellite Service
MS	_	Mobile Satellite
MSS	_	Mobile Satellite System
NASA	_	National Aeronautics and Space Administration
NAVSTAR	_	NAVigation System with Time and Ranging
NLOS	_	non-LOS
NMEA	_	National Marine Electronics Association
P-Code	_	Precise Code
PDA	_	Personal Digital Assistant

PPS	_	Precise Positioning Service
PRN	_	Pseudorandom Noise
RF	_	Radio Frequency
RHCP		Right-Hand Circularly Polarized
SNR	_	Signal-to-Noise
SOL	_	Safety-of-Life
SPS	_	Standard Positioning Service
SVN	_	Space Vehicle Number
TOA	_	Time of Arrival
UHF	_	Ultra High Frequency
UTC	_	Universal Coordinated Time
VSAT	_	Very Small Aperture Terminal
WAAS	_	Wide Area Augmentation System

CHAPTER 1

INTRODUCTION

1.1 Project Overview

This is a research, experimental and analysis based project that is related to the Mobile Satellite (MS) communication operating in L-band. L-band refers to the frequencies between 1- 2 GHz and it is particularly effective in providing rapid and flexible communication through mobile and portable terminal or transportable earth station. Voice and data communication services can be provided through the link between the satellite and the ground terminal.

The advantage of the Mobile Satellite System (MSS) over Fixed Satellite System (FSS) is that the coverage of the system is spotty over rural area. The connection exists while on the move and this reflects the reliability of the system to the mobile users [1]. Therefore, its reliability is higher and more flexible in term of navigation system on moving vehicles.

In this project, a simple and low-cost data acquisition system that can be used to carry out measurement for different MS environments is proposed. Results obtained from analysis will be used to obtain mathematical models that represent

different MS environments. These mathematical models are important components in order to develop a MS simulator that will be able to predict signal performance under different MS environments.

1.2 Statement of Problems

The signal performance of MS is affected by factors such as ionospheric effect, multipath effect, the design of the antenna and shadowing effect. To have a better understanding of these problems, experimental work can be carried out for different MS environments.

The results from the experimental work can be used to develop mathematical models that can represent the MS environments or to be used to improve the current mathematical model used to represent MS signal performance.

Most of the experimental works have been carried out in the develop countries such as North America, Australia, Europe and Japan. Very little data represents areas in less developed countries such as in Africa and Asia. In order to have a more accurate model to represent the MS environments, more experimental works are needed especially in the less developed countries as more results will increase the accuracy of the model by taking the average value from the total results.

Current methods used to carry out experimental works utilize the existing Geo-stationary satellite network or airborne platform such as airplane and helicopter.

These methods are both complicated and expensive. Therefore, a simple and low-cost alternative to these methods is required in order to encourage more experimental works to be carried out in the less develop countries.

1.3 Objectives

The main objectives of the project are listed as follows:

(a) To propose a simple and low-cost data acquisition system for carrying out experimental work on the signal strength of the MS

A simple and low-cost data acquisition method is referred to the experimental setup of the equipments that is the connection formed between the GPS receiver with the computer. The satellite propagation parameters received from the GPS is send to the Hyper Terminal for data saving.

(b) To perform measurements for the signal strength under different environments such as open space, tree-shadowed and building-shadowed

The experiment is carried out in the open space (reference), in front of a tree and in front of a building. The measurements are then performed to determine the relationship between the signal performance with respect to the elevation and azimuth angle.

(c) To develop a program that will extract the satellite propagation parameters from the raw data obtained using the GPS receiver

C++ programming language is used to develop a program that is able to process the satellite propagation parameters and assign each values of time, signal-to-noise ratio (SNR), elevation and azimuth angles to the corresponding satellites is developed.

(d) To perform analysis on the measured satellite signal to obtain mathematical models for open space.

Analysis of the signal performance is made with respect to the elevation and azimuth angles. Results obtained will be used to develop mathematical models for open space.

(e) To develop an MS Simulator based on the analysis results that can predict MS signal performance under open space

The MS Simulator that is able to predict the signal performance for open space condition is developed based on the mathematical models obtained from the analysis. Also, the relationship between the (signal-to-noise) SNR and the elevation angle can be generated from the graph plotting function in the MS Simulator.

1.4 Expected Outcomes

At the end of this research work, the following outcomes are expected:

(a) A simple and low-cost data acquisition system for the experimental work

The data acquisition system is formed with the GPS receiver connected to the computer and the propagation data will be recorded continuously.

(b) Database consist of satellite propagation data of different satellites under different MS environments

Satellite propagation data from the measurements is obtained for open space, tree-shadowed and building-shadowed under clear sky condition.

(c) A program used to extract the satellite propagation parameters from the receiver

A program that is able to extract the satellite propagation parameters such as SNR, elevation and azimuth angle for different satellites is developed.