University of Moratuwa

TROPOSPHERIC RANGE ERROR CORRECTIONS FOR THE GLOBAL POSITIONING SYSTEM IN SRI LANKA

Submitted in partial fulfillment for the Degree of Master of Engineering in Electronic & Telecommunication Engineering

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June 2000

The work presented in this dissertation has not been submitted for the fulfillment of any other degree

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The author is indebted to .....

Prof. I. J. Dayawansa for all the valuable guidance, inspiration and most of all for proposing this title for the dissertation

Dr. S.A.D. Dias for all the advice, encouragement and most of all for enlightening me on how to undertake a dissertation of this nature

Dr. J.A.K.S. Jayasinghe and **Mr. B.S. Samarasiri** for the valuable comments and suggestions provided at the periodic reviews

Dr. Mohottala, Mr. Jayathilaka Banda and **others at the Department of Meteorology** for all the help and assistance provided in collecting lifeline data for the project

Wipula, my boss, my batchmate, my partner and my friend for the sharing, brotherhood and support

Ajith, Biyan and **Athauda** my colleagues at Airport & Aviation Services (Sri Lanka) Ltd., for the numerous assistance provided in sourcing useful information

My beloved mother who is not among the living, for her jewels of wisdom, **my father** for the wheels of courage and **my sister** for the rays of hope

Dinindu and Chinthani my children for their boundless patience and understanding

Manjula my wife, for ..... Everything !!!

ABSTRACT

The Global Positioning System is the most accurate positioning and navigation system in use today. It uses the time of arrival of radio signals transmitted from satellites placed in high altitude orbits around the globe.

The ideal GPS theory assumes free space radio propagation whereas in reality, the signals have to propagate through the atmosphere. When propagating through the atmosphere, the finite refractive index of the various layers of the atmosphere causes the electromagnetic waves to travel distances that are longer than the corresponding free space distances. This causes an error in the observed time of arrival which is carried on to the positional computation.

The error due to refraction in the troposphere is of particular interest. Unlike the ionosphere, the troposphere is non-dispersive. Its refractive properties depend more on physical parameters such as pressure and temperature. Due to this reason, the refractivity tends to depend on the location as well. It has been shown that a good correlation exists between the refractivity at the surface of the earth and the range error. Hence this error may be determined using the refractivity at the surface of the earth.

In this dissertation, the effect of the troposphere on GPS observations made within the geographical extent of Sri Lanka is studied. The range errors at reference locations within Sri Lanka are determined for different parts of the year. The results are compared with established results for the region and reasons for discrepancies are briefly discussed.

The design of a conceptual GPS receiver processor that can self-correct tropospheric range errors at the surface of the earth by sensing the pressure and the temperature is proposed. A computer program is used to simulate the operation of this receiver.

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LIST OF ABBREVIATIONS USED

CEP	Circular Error Probable
DRMS	RMS Radial Distance Error
GDOP	Geometric dilution of precision
GPS	Global Positioning System
PDOP	Position dilution of precision
SA	Selective Availability
SEP	Spherical Error Probable
TDOP	Time dilution of precision
TOA	Time of Arrival
UERE	User Equivalent Range Error
UTC	Universal Time Transfer

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