Military Grid Reference System (MGRS) for the Future Joint Operations by the Sri Lankan Defense Forces

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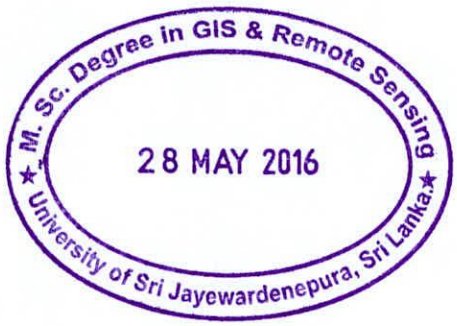

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DECLARATION OF THE CANDIDATE

I do hereby declare that work described in this thesis was carried out by me under the supervision of Mr CLK Navarathne and Dr HMI Prasanna and report on this thesis has not been submitted in whole or in part to any University or any other institution for another Degree/Diploma.

Date 28 March 2016 .....

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LIST OF ABBREVIATIONS

DMA	Defense Mapping Agency
GPS	Global Positioning System
ITRS	International Terrestrial Reference System
LRRP	Long Range Reconnaissance Patrol
LTTE	Liberation Tigers of Tamil Eelam
MGRS	Military Grid Reference System
NATO	North Atlantic Treaty Organization
WGS84	World Geodetic system 1984
UPS	Universal Polar Stereographic
UTM	Universal Transverse Mercator

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Military Grid Reference System (MGRS) for the Future Joint Operations by the Sri Lankan Defense Forces

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ABSTRACT

The Military Grid Reference System (MGRS) is used North Atlantic Treaty Organization (NATO) militaries for locating points on entire earth surface. The MGRS is derived from the Universal Transverse Mercator (UTM) grid system and based on WGS84 ellipsoid. The angular measurements converted to grid coordinates by using series of mathematical equations. Sri Lankan military forces use WGS84 and grid system based on National coordinate system. However using two systems will result difficulty in Military joint operations especially in target indication and obtaining indirect fire support and close air support for acquisition of targets. Therefore study was ultimately undertaken to develop a Military Grid Reference System for the use of military forces in Sri Lanka while maintaining the accuracy and precision in military joint operations.

In this study WGS84 system is used to project and develop military grid system for match our context. Accordingly system requires coordinate transformation between Geodetic/Projected coordinate systems and it takes considerable time which may resulted in accuracy issues. In this study algorithms use to develop computer program that converted from WGS84 values in to grid coordinates. After compute of sample data it finds that fitting scale factor for Sri Lankan context to develop MGRS that will minimize the error of coordinate's conversion. As well as Statistical methods were used to find the exact value of scale factor by comparing the distance difference of geographic coordinates and grid coordinates. The parameter can used in order to evaluate MGRS for Sri Lankan context. Locally defined suitable MGRS could be used for Sri Lankan defense forces to minimize these issues and to achieve accuracy and the precision for effective joint operations in future.

Key words

Military Grid Reference System, coordinate transformation, joint operations, parameter, WGS84

Chapter One

INTRODUCTION

1.1 Introduction

The Military Grid Reference System (MGRS) is the geo coordinate standard used by North Atlantic Treaty Organization (NATO) militaries for locating points on the earth (wikipedia.org). The MGRS is derived from the Universal Transverse Mercator (UTM) grid system and the universal polar stereographic (UPS) grid system, but uses a different labeling convention. The MGRS is used for the entire earth. In the Global context there is lot of countries use their own coordinate system (MGRS) to use in Military operations. The grid coordinate may represent the location to nearest 10, 100 or 1000 meter increment.

Air power comprises the application of military strategy and strategic theory to the realm of aerial warfare. Airpower has been used to conduct lightning strategic strikes, to complement land offensives, to instill fear and lower morale similarly to a fleet in being, and to create broad-based destruction behind enemy lines. A mass technological base is considered necessary for the development of airpower. More over Air power plays a vital role in the war to bring down the power of enemy by using surprising air strikes to accurately hit vital strategic operational bases in enemy area. Especially in joint operations that the target acquisition is a significant part in an air attack. Particularly in air force which should able to attack targets of ground forces were given. In local context 30 years of insurgency was experienced in the country.

Then Sri Lankan military forces carry out a humanitarian operation to overcome the problem. Strategic air attack can be expected to break and enemy will bring down the political regime. Mainly air power used to control the power in enemy party. However target acquisition should be done properly by minimizing the civilian's damage. But there were some cases that civilians have been killed and injured in air attacks. In year 2006 the Sri Lankan Air Force have bombed Liberation Tigers of Tamil Eelam (LTTE) military complex targeting a meeting of top leaders in Puthukkudiyiruppu area. Also

there were some civilian settlements in the area. However media reported that six civilians were injured and rushed to hospital after Sri Lanka Air Force fighter jets dropped bombs near Puthukkudiyiruppu town.

Sri Lankan Army has deployed Long Range Reconnaissance Patrol (LRRP) in the battle field to carry out reconnaissance and sabotage operations in deep battle space. Most of times targets were given by these ground forces. In military operations Sri Lanka Army used their grid System base on Sri Lankan National coordinating system, while the Air force and Navy used WGS84 geodetic coordinate system. Accordingly it requires coordinates transformation between Geodetic/Projected coordinate systems and it takes considerable time which may resulted in accuracy issues. Locally defined suitable MGRS could be used for Sri Lankan defense forces to minimize these issues and to achieve accuracy for effective joint operations in future.

1.2 Problem Statement

Sri Lankan defense forces have been experienced fatal battle losses and defeats in battle against LTTE terrorists' attacks, due to poor coordination between ground forces and Air Force in target indication and obtaining indirect fire support and close air support for acquisition of targets. When consider about the inaccurate target acquisition was aimed due to lack of transformation between coordinate systems. Therefore there is an urgent need to correct the problem in accurate level of target acquisition.

Joint military operation is an integration of various armed forces into one unified command. The synergy that results from the integration of armed forces maximizes the effectiveness and efficiency. The success of Joint Operations depends on synchronizing the command, control and execution of missions. In a Joint Operation scenario, ground forces are the "Local Navigators" working together with "Global Navigators" as Air Force and Navy to accomplish the mission. It is important for ground forces to indicate precise enemy target locations for Air Force engage effectively. If the target indication and engagement process fails due to lack of coordination, collateral damages may occur.

This has been widely experienced in many occasions in past 30 years of war causing heavy damages and losses. LTTE terrorists exploit these situations to gain the maximum advantage. However in the later part of the war inaccuracy was reduced by using various adhoc techniques. Therefore the research is to identify suitable MGRS for Sri Lankan context to overcome difficulties when conducting joint military operations.

1.3 Significance of the Study

There are global common MGRS used by military forces in the world based on WGS84 ellipsoid. The existing systems are mainly match to global context. Therefore there is a local MGRS want to use in Sri Lankan context. Armed forces use different coordinate systems in Military Operations. Sri Lankan Army uses their conventional grid System based on National coordinate system while the Air force and Navy used WGS geodetic coordinate system.

The closest geographic coordinate system to the Sri Lanka is Everest 1830 as shown in Figure 1.1. Therefore Everest 1830 used to formulate the Kandawala, National grid system of Sri Lanka.

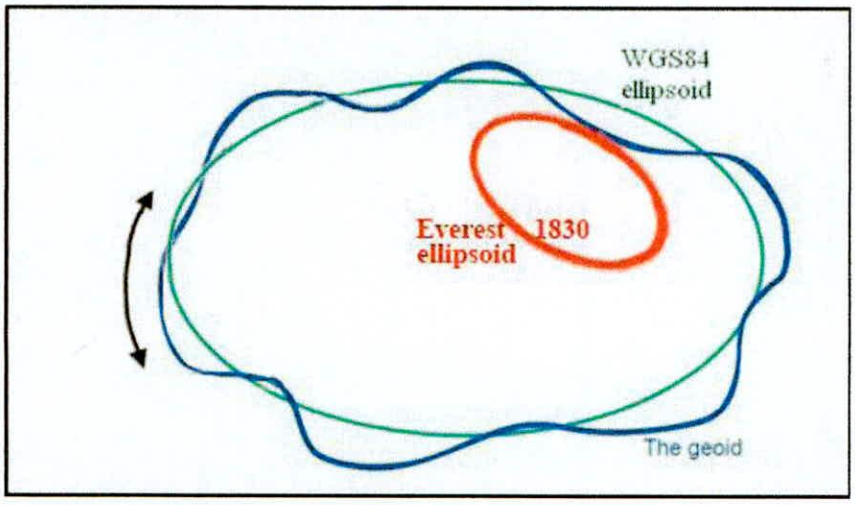

Figure 1.1: Everest 1830 ellipsoid

Source: created by researcher

Kandawala datum uses Piduruthalagala as its base point of False northing and easting. In the beginning, Survey department used 0N, 0E as its location. Due to negative coordinate values in south west region they changed it to 500,000N, 500,000E.

The transverse mercator projection on Everest ellipsoid (1830) with the following parameters is used to compute Kandawala co-ordinate system (Bomford, 1980).

Central meridian	- E 80° 46' 18.16710"
Latitude of Origin	- N 7° 00' 1.69750"
Scale factor	- 0.9999238418
False Northing	- 500000m
False Easting	- 500000m

Pidurutalagala trigonometrical station is used as the latitude of origin and central meridian.

Since Everest 1830 is a local ellipsoid the global navigators mainly Sri Lanka Air Force and Sri Lanka Navy cannot use it. Thus the ground forces should adjust their grid system based on WGS 84 ellipsoid. Meanwhile ground forces difficult to use angular measurements (Lat/Long) they is a need of projected coordinate system. Accordingly the researcher is going to develop MGRS by using WGS84 ellipsoid.

There are several independent researches can be find about the transformation WGS84 to Kandawala grid system. But it is hard to find any researches relating to military grid system in Sri Lanka. Therefore this study identifed technical or theoretical reason behind this problem and find out transformation parameters and evaluation of MGRS in suited for Sri Lanka. First task is to study existing Army grid reference system and find merits and demerits in the existing system. Then identify transformation parameters WGS84 to Sri Lankan Military Grid Reference system transformation.