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Evaluating the Relationship Between GPS Output and Planimetry System

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Abstract

This research involveda a study of the relationship between GPS coordinates and planimetry coordinates. It was found that there is a relation between GPS output coordinates and the coordinates of a distance point from the position of the GPS point . In order to pricist the direction of distance a reference point had been used which is
(Greenwich Mean observatory) GMO.

The angles between the studying points and Equator have also been calculated Greenwich line. Also calculated the angle between every two regions have been calculated.

Introduction

The interpretation of an image depends on its scale, texture, contrast ratio, and spatial resolution. The spatial resolution refers to the minimum distance between two objects at which they can be distinguished on an image (2) .

In order to evaluate the distance between two points which belongs to for two regions there are several ways to get that .In this paper, we have used the relationship between the out put of GPS and the information of planimtry system.

Remote sensing can be defined as the acquisition and recording of information about an object without being in direct contact with that object (1).And Remote sensing processes include:-

a- Record information by detecting, or sensing ,the interaction between the target and electromagnetic radiation .

b- Produce an image of the target (2) .

Global positioning system(GPS)

GPS was originally designed for military use at any time anywhere on the surface of the earth. Soon after the original proposals were made, it became clear that civilians could also use GPS, and not only for personal positioning (as was intended for the military).The first two major civilian applications to emerge were marine navigation and surveying (3) .

Nowaday applications range from in car navigation through truck fleet management to automation of construction machinery(3).

A network of satellites that continuously transmits coded information, which makes it possible to precisely identify locations on earth by measuring distance from the satellite (4) .

The determination of position may be described as the process of triangulation using the measured range between the user and four or more satellites. The ranges are inferred from the time of propagation of the satellite signals. Four satellites are required to determine the three coordinates of position and time.

Time is involved in the correction to the receiver clock and is ultimately eliminated from the measurement of position (5) .

The total GPS configuration is comprised of three distinct segments :-

a- The space segment - satellites orbiting the earth .

b- The control segment - stations positioned on the earth's equator to control the satellites.

c- The user segment - anybody that receives and uses the GPS signal (3) .

Although the earth may appear to be a uniform sphere when viewed from space, the surface is far from uniform. Due to the fact that GPS has to give coordinates at any point on the earth`s, surface ,it uses a geodetic coordinate system based on an ellipsoid. An

ellipsoid (also known as a spheroid) is a sphere that has been flattened or squashed .

An ellipsoid is chosen that most accurately approximates to the shape of the earth. This ellipsoid has no physical surface but is a mathematically defined surface.

There are actually many different ellipsoid or mathematical definitions of the earth 's surface.

The ellipsoid used by GPS is known as WGS 84 or World Geodetic system 1984 (3) .

A point on the surface of the earth (note that this is not the surface of the ellipsoid), can be defined by using latitude , longitude and ellipsoidal height .

An alternative method for defining the position of a point is the Cartesian coordinate system , using distances in the X ,Y and Z axis from the origin or centre of the spheroid . This is the method primarily used by GPS for defining the location of a point in space (3) .

Coordinate system

Local coordinate system

Local coordinate system (such as GPS coordinate) or coordinates used in a particular country where maps are based on a local ellipsoid , designed to match the geoids in the area .

Usually, these coordinates will have been projected on to a plane surface to provide grid coordinates .

The ellipsoids used in most local coordinate systems throughout the world which were first defined many years ago , before the advent of space techniques .

And tend to fit the area of interest well but could not be applied to other areas of the earth. Hence , each country defined a mapping system / reference frame based on local ellipsoid .

When using GPS, the coordinates of the calculated positions are based on the WGS 84 ellipsoid. Existing coordinates are usually in a local coordinate system and therefore the GPS coordinates have to be transformed into this local system (3) .

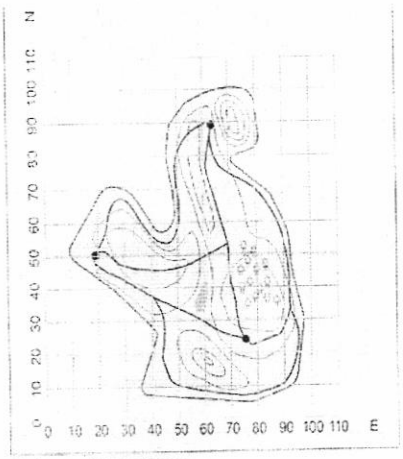
Map projections and plane coordinates

Most surveyors measure and record coordinates in an orthogonal grid system. This means that points are denied by Northing, Easting & optometric height (height above sea level). Map projections allow surveyors to represent a three dimensional curved surface on a flat piece of paper .

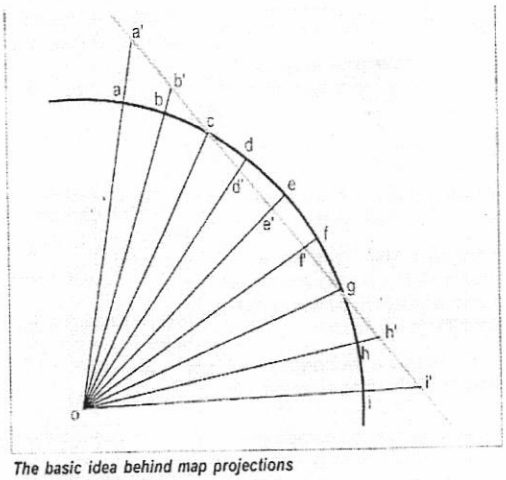
Such map projections appear as planes but actually define mathematical steps for specifying positions on an ellipsoid in the terms of a plane .

The way in which a map projection generally works is shown in the diagram . Points on the surface of the spheroid are projected on to a plane surface from the origin of the spheroid .

The diagram also highlights the problem that it is not possible to represent true lengths or shapes on such a plane . True lengths are only represented where the plane cuts the spheroid (points C and G) (3) .



A plane grid based map



The basic idea behind map projections

Calculations and Discussion

If we have two position $P_1(x_1,y_1)$, $P_2(x_2,y_2)$ obtained by using GPS which has a high accuracy, then we can calculate the distance **(d)** between them, also which has a high accuracy. The relation between them is :-

$$d = [(x_1 - x_2)^2 + (y_1 - y_2)^2]^{1/2} \ldots\ldots [1]$$

The direction cosines of a line are the cosines of the angles in α, β which the line or any parallel line makes with the coordinate axis.

The direction cosines of the line segment $P_1(x_1 y_{,1})$ to P_2 (x_2, y_2) are :-

$$\cos\alpha = (x_2 - x_1) / d \ldots\ldots [2]$$
$$\cos\beta = (y_2 - y_1) / d \ldots\ldots [3]$$

The angle (θ) between two lines whose direction angle are $\alpha 1$, $\beta 1$ and $\alpha 2$, $\beta 2$, given by:-

$$\cos\theta = \cos\alpha_1 \cos\alpha_2 + \cos\beta_1 \cos\beta_2 \ldots\ldots [4]$$

It gets the data longitude and latitude by using GPS and through, this data ,we calculate the distance from the studying regions to GMO by using the equation [1] as shown in table(1) , where (x1 ,y1)the coordinate for the studying region , and (x_2, y_2) the coordinate for GMO. We can see the distance for the regions {2, 3 ,4 ,5}converge because the taken coordinates were for points in the same region, while the region {1} is far from them.

Also, by calculating the distance , we find the angles between the studying regions and Equator, Greenwich line .

Finally , we calculated the angle for every two regions. The angle (θ)for region with region {1} is rather big related to the angles between the other regions, as shown in fig.(1).

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Table (1)The calwelatid dishaace of the shudiy ohject

Region	Longitude			Latitude			Distance	cosα	cosβ
	°	`	"	.	`	"	km		
1	44	15	59	33	23	11	6154.351	0.60150576	0.798382477
2	44	15	47	33	32	39	6164.662	0.603988345	0.796993087
3	44	16	9	33	32	28	6164.991	0.603902098	0.797058584
4	44	15	46	33	32	32	6164.528	0.603965461	0.797010411
5	44	16	32	33	32	24	6165.544	0.603829958	0.797113155

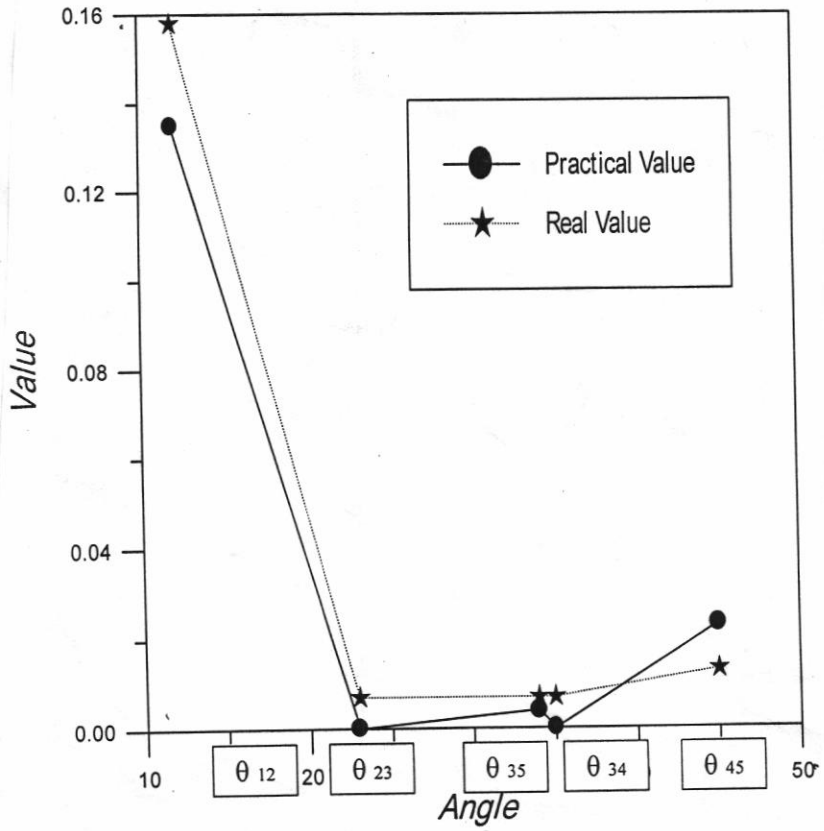

Fig.(1) Relationship between practical & real values (the real values on the ground).

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حساب العلاقة بين مخرجات GPS ومنظومة المساحة

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الخلاصة

يهدف البحث الى دراسة العلاقة بين احداثيات ال GPS (منظومة تحديد الموقع العالمي) التي تتضمن خطوط الطول والعرض والنظام التربيعي (المساحي) الذي يتضمن (x,y) ، حيث تم ايجاد المسافة (d) بين احداثيات المناطق المحددة (المختارة او موضوعة الحث) و احداثيات المرجع العالمي (كرينج GMO) . وكذلك تم حساب الزاوية (α, β) المحصورة بين المناطق (موضوعة البحث) وخط الاستواء اولا" تم كرينج ثانيا" على التوالي . ومن ثم تم حساب الزاوية (θ)المحصورة بين كل منطقتين من مناطق البحث .