COMPARISON THE ACCURACY OF COMPUTING POINT COORDINATS BETWEEN DIFFERENT INSTRUMENTS AND APPLICATIONS OF GPS

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ABSTRACT

The study was aimed to determine the coordinates of the points were measured by different ways and different instruments, the most precise way using the differential global positioning system (DGPS) that will be the reference measurements in comparison, less precise way using navigator GPS. Google earth (pro.), and the other applications of GPS mobile (Samsung and I-phone). In this research (8 points) were chosen that are occasional in location. The comparison of the different observations can give us an idea of the extent to which the accuracy of the observations differs from the different devices used in the observing, as well as through the knowledge of the best device and the best way to measure coordinates accurately to serve the desired purpose.

Keyword: navigation, precise way, remote sensing, errors.

مقارنة الدقة في حساب احداثيات النقاط بين مختلف اجهزة وتطبيقات نظام التموقع العالمي GPS

هدى وجود عبد الودود غيداء صبيح هادي عمر علي إبراهيم ريم إبراهيم مصطفى
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كلية العلوم/ جامعة بغداد كلية العلوم/ جامعة بغداد كلية الهندسة/جامعة بغداد كلية العلوم/جامعة بغداد

المستخلص

تهدف الدراسة الى المقارنة بين دقة قياس الاحداثيات من حيث الاختلاف في طريقة رصد الاحداثيات.عند حساب الموضع المطلق، يحدد المستقبِل الثابت أو المتحرك موقعه ثلاثي الأبعاد نسبة الى نظام إحداثيات ومحاور مركز الأرض .تم قياس إحداثيات النقاط بطرق مختلفة و بواسطة اجهزة مختلفة، الطريقة الاولى الأكثر دقة باستعمال نظام تحديد المواقع العالمي التفاضلي (DGPS) الذي سيمثل القياسات المرجعية في المقارنة، الطريقة الثانية أقل دقة باستعمال نظام تحديد المواقع الملاحي، الطريقة الثالثة بأستعمال Google earth pro.، وتطبيقات GPS الأخرى للهاتف المحمول (Samsung و I–Phone) يمكن أن تزودنا المقارنة بين القياسات المختلفة بفكرة عن مدى اختلاف دقة القياسات والناتج عن الأجهزة المختلفة المستخدمة في الرصد، وكذلك من خلال معرفة أفضل جهاز وأفضل طريقة لقياس الإحداثيات بدقة بما يناسب الغرض المطلوب.

كلمات مفتاحية: ملاحة, تحسس نائي, اخطاء , اتقان.

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INTRODUCTION

Recently remote sensing utilization vanquish data accuracy troubles, any basin aspect may be acquired either direct form remotely sensing imageries or indirectly by using morphometrically analyses on the extracted topographically information form (2). Remote Sensing and GIS technologies, and their applications, have achieved in succeeded development (11). The Remote sensing progress has increased the achievement of accuracy for getting information sent from satellites to solve many subjects related to land and environmental conditions (1) .GIS, GPS and RS technologies are utilized in collection for agriculture utilization (20). Typically, Spatial technologies are well appropriate for applications of most resource management tasks (3). Remote sensing is a modern method, it can be utilized for studying natural resources and then develop plans for exploitation (12). The rapid developments of spatial technologies like GIS, GPS, and Remote Sensing, have constructed many new tools for extension profe (8). The physically basis of Remote Sensing is the electromagnetic radiation whether its sources natural or artificial (14). Some of remotely sensed imagery bands spectral reflectance may be used for visually interpretation with rates of potential error (9). Surveying by using the Global Navigation Satellite Systems (GNSS) receiver can give users a perfect location of points as a three dimensional position with respect to the origin of an Earth Center Earth Fixed Coordinate System ; a prerequisite for any survey project. Currently, two (GNSS)1 provide GPS navigation, positioning and timing services for all users of GPS receivers: GPS, GPS and GLONASS was operated by the Ministry of Defense of the Russian Federation (17). The advancing of the GPS technology is diversifying the approaches in the way that let it be integrated with RS and GIS (16). This study was aimed to investigate the differences in the accuracy between the correctable and uncorrectable data that was received from satellites to compute the coordinates of the points.

MATERIALS AND METHODS

The survey of the region was University of Baghdad, was done by using Differential Global Position System (DGPS), type Topcon GR5, Navigator GPS (type Garmen) and GPS application by mobile (Samsung and I-phone). The coordinate system of the observed data set was adopted as a geographic and projection coordinate system by : (WGS84/UTM-ZONE 38).

DGPS: Is based on the principle that all receivers in the same vicinity simultaneously experience common errors (18). In this research Static method was used to observe the coordinates of the points.

P.P.Static

1-This method was used to observed the coordinates of ground control points by receiving the signals from the available satellite in the region by the Base and the Rover receivers in the same time. The time of observing was four hours to get a high accuracy data.

2-Correct the base point by sending its file to the on-line positioning user service (opus) to submit it directly to NGS (national geodetic survey) for automatic processing.

3-Insert all the file points to the processing program (Topcon tools) and correct the control points according to the new base coordinates, so that they have the same rate of the correction.

Navigator GPS and GPS mobile application

In this way the signal is received directly from the available satellites at that time so in this way the data includes errors that will not be corrected as that which observed in DGPS.

Google Earth Pro

Initially, Google Earth Pro was the update of Google Earth (10).Recently, the Pro represents the standard version of the Google Earth Desktop Application as of version 7.3(6).To determine coordinates for a location:

1-Activate Google Earth program.

2-With mouse movement over different locations, coordinates will be appeared in the lower right corner (7).

RESULTS AND DISCUSSION

Correcting the DGPS data using Topcon tools as shown in the Figure 1 according to the base point that was corrected in (OPUS)

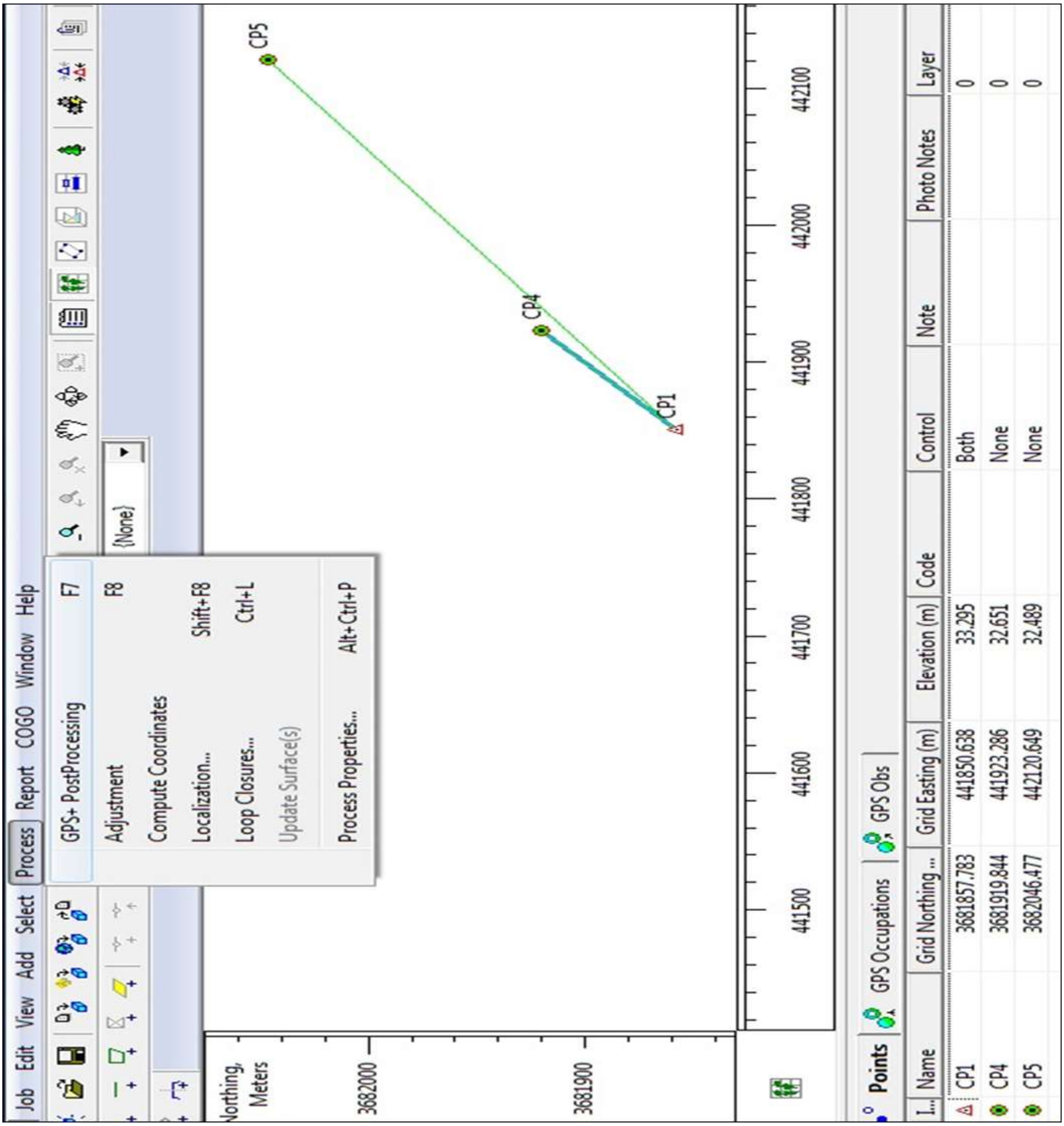

Figure 1. Correcting part of a set of study points with Topcon tools depending on the base point

Converting the units of the data from Geographic System WGS 84 Longitude Latitude, degree, minute, second as shown in the Table 1 to X,Y, Elevation in meters by projection system using (UTM-ZONE 38 N), as shown in the Table 2

Table 1.The Coordinates of the study points by geographic system WGS 84

point	DGPS			Navigator			Google Earth pro.			I-phon		Samsung	
Name	longitude	latitude	Elev. (m)	longitude	latitude	Elev. (m)	longitude	latitude	Elev. (m)	longitude	latitude	longitude	latitude
CP 1	44°22'32.11"	33°16'27.07"	33.295	44°22'32.1"	33°16'27."	30	44°22'32.13"	33°16'27.03"	45	44°22'32.52"	33°16'27.48"	44°22'32.90"	33°16'26.90"
CP 4	44°22'34.91"	33°16'29.10"	32.651	44°22'34.7"	33°16'29.0"	23	44°22'34.77"	33°16'28.98"	43	44°22'34.68"	33°16'29.28"	44°22'35.17"	33°16'29.12"
CP 5	44°22'42.51"	33°16'33.25"	32.489	44°22'42.5"	33°16'33.2"	27	44°22'42.46"	33°16'33.22"	39	44°22'42.24"	33°16'33.6"	44°22'42.21"	33°16'33.32"
CP 7	44°22'46.30"	33°16'29.93"	33.602	44°22'46.2"	33°16'29.9"	27	44°22'46.36"	33°16'30.18"	41	44°22'45.84"	33°16'29.64"	44°22'47.04"	33°16'30.25"
CP 8	44°22'50.09"	33°16'29.91"	32.407	44°22'50.1"	33°16'30.0"	25	44°22'50.14"	33°16'30.01"	39	44°22'53.76"	33°16'39.36"	44°22'49.32"	33°16'30.34"
CP 9	44°22'39.36"	33°16'22.05"	32.349	44°22'39.3"	33°16'22.1"	28	44°22'39.23"	33°16'22.17"	45	44°22'39.00"	33°16'22.08"	44°22'39.53"	33°16'24.03"
CP 10	44°22'33.41"	33°16'23.55"	33.224	44°22'33.4"	33°16'23.6"	29	44°22'33.40"	33°16'23.59"	43	44°22'33.24"	33°16'23.52"	44°22'33.79"	33°16'23.68"
CP 19	44°22'40.09"	33°16'24.82"	32.139	44°22'40.4"	33°16'24.8"	39	44°22'40.41"	33°16'24.8"	49	44°22'40.08"	33°16'24.96"	44°22'40.66"	33°16'24.92"

(UTM-ZONE 38 N)

Calculate the distance between each case of measuring and the reference point

Table 2. The Coordinates of the study points by Projection System using (UTM-ZONE 38 N)

point	DGPS			Navigator			Google Earth pro.			I-phon		Samsung	
Name	X	Y	Elev.	X	Y	Elev.	X	Y	Elev.	X	Y	X	Y
CP 1	441850.64	3681857.78	33.295	441850.2	3681855.6	30	441850.99	3681856.53	45	441861.162	3681870.323	441870.885	3681852.402
CP 4	441923.52	3681920.02	32.651	441917.8	3681916.8	23	441919.643	3681916.17	43	441917.37	3681925.423	441930.016	3681920.419
CP 5	442120.79	3682046.77	32.489	442120.4	3682044.9	27	442119.351	3682045.56	39	442113.729	3682057.298	442112.902	3682048.679
CP 7	442218.21	3681943.71	33.602	442215.5	3681942.7	27	442219.681	3681951.34	41	442206.13	3681934.789	442237.284	3681953.391
CP 8	442316.25	3681942.72	32.407	442316.4	3681945.2	25	442317.433	3681945.52	39	442290.127	3681937.21	442296.281	3681955.812
CP 9	442037.32	3681702.13	32.349	442035.6	3681703.6	28	442033.767	3681705.76	45	442027.801	3681703.021	442041.869	3681705.992
CP 10	441883.7	3681749.31	33.224	441883.2	3681750.7	29	441883.211	3681750.39	43	441879.059	3681748.257	441893.316	3681753.099
CP 19	442056.76	3681787.48	32.139	442064.5	3681786.6	39	442064.776	3681786.57	49	442056.268	3681791.548	442071.265	3681790.227

of DGPS on X-axis and Y-axis,

Δy

Δx

Calculate the distance between each case of measuring and the reference point of DGPS on X-axis and Y-axis, then calculate the Standard Deviation error , to calculate the value of the data dispersion that represents the distance from the average value relative to the reference data of DGPS, as shows in the Tables 3 and 4.

Table 3. Computing the standard deviation,and the distance on X-axis between each case and the reference points of DGPS

X-axis (m)									
point	DGPS	Navigator	Distance (ΔX)	Google Earth pro.	Distance (ΔX)	I-phon	Distance (ΔX)	Samsung	Distance (ΔX)
CP 1	441850.64	441850.209	0.429	441850.99	0.352	441861.162	10.524	441870.885	20.247
CP 4	441923.52	441917.836	5.687	441919.643	3.88	441917.37	6.153	441930.016	6.4930
CP 5	442120.79	442120.382	0.41	442119.351	1.441	442113.729	7.063	442112.902	7.8900
CP 7	442218.21	442215.491	2.719	442219.681	1.471	442206.13	12.08	442237.284	19.074
CP 8	442316.25	442316.397	0.146	442317.433	1.182	442290.127	26.124	442296.281	19.970
CP 9	442037.32	442035.565	1.759	442033.767	3.557	442027.801	9.523	442041.869	4.5450
CP 10	441883.70	441883.212	0.484	441883.211	0.485	441879.059	4.637	441893.316	9.6200
CP 19	442056.76	442064.517	7.76	442064.776	-8.019	442056.268	0.489	442071.265	14.508
		average	**2.42425**		**2.548375**		**9.574125**		**12.793375**
		median	**1.1215**		**1.456**		**8.293**		**12.064**
		std.deviation	**2.84450396**		**2.564980197**		**7.61584057**		**6.450808054**

Table 4. Computing the standard deviation, and the distance on Y-axis

Y-axis (m)									
point	DGPS	Navigator	Distance (ΔY)	Google Earth pro.	Distance (ΔY)	I-phon	Distance (ΔY)	Samsung	Distance (ΔY)
CP 1	3681857.783	3681855.605	2.178	3681856.525	1.258	3681870.323	12.54	3681852.402	5.381
CP 4	3681920.015	3681916.796	3.219	3681916.17	3.845	3681925.423	5.408	3681920.419	0.404
CP 5	3682046.765	3682044.939	1.826	3682045.561	1.204	3682057.298	10.533	3682048.679	1.914
CP 7	3681943.706	3681942.741	0.965	3681951.34	7.634	3681934.789	8.917	3681953.391	9.685
CP 8	3681942.718	3681945.222	2.504	3681945.524	2.806	3681937.21	5.508	3681955.812	13.094
CP 9	3681702.133	3681703.59	1.457	3681705.757	3.624	3681703.021	0.888	3681705.992	3.859
CP 10	3681749.306	3681750.696	1.39	3681750.388	1.082	3681748.257	1.049	3681753.099	3.793
CP 19	3681787.475	3681786.571	0.904	3681786.57	0.905	3681791.548	4.073	3681790.227	2.752
		average	**1.805375**		**2.79475**		**6.1145**		**5.11025**
		median	**1.6415**		**2.032**		**5.458**		**3.826**
		std.deviation	**0.79626771**		**2.286791311**		**4.25398129**		**4.242115838**

between each case and the reference points of DGPS

Map of Arc GIS used for showing the location of the points on the study area and show the dispersion of each point relative to the reference point of DGPS that is caused from the error in the observation of different method, as shown in the image 1 and Figure 2.

Image 1. The study points in university of Baghdad

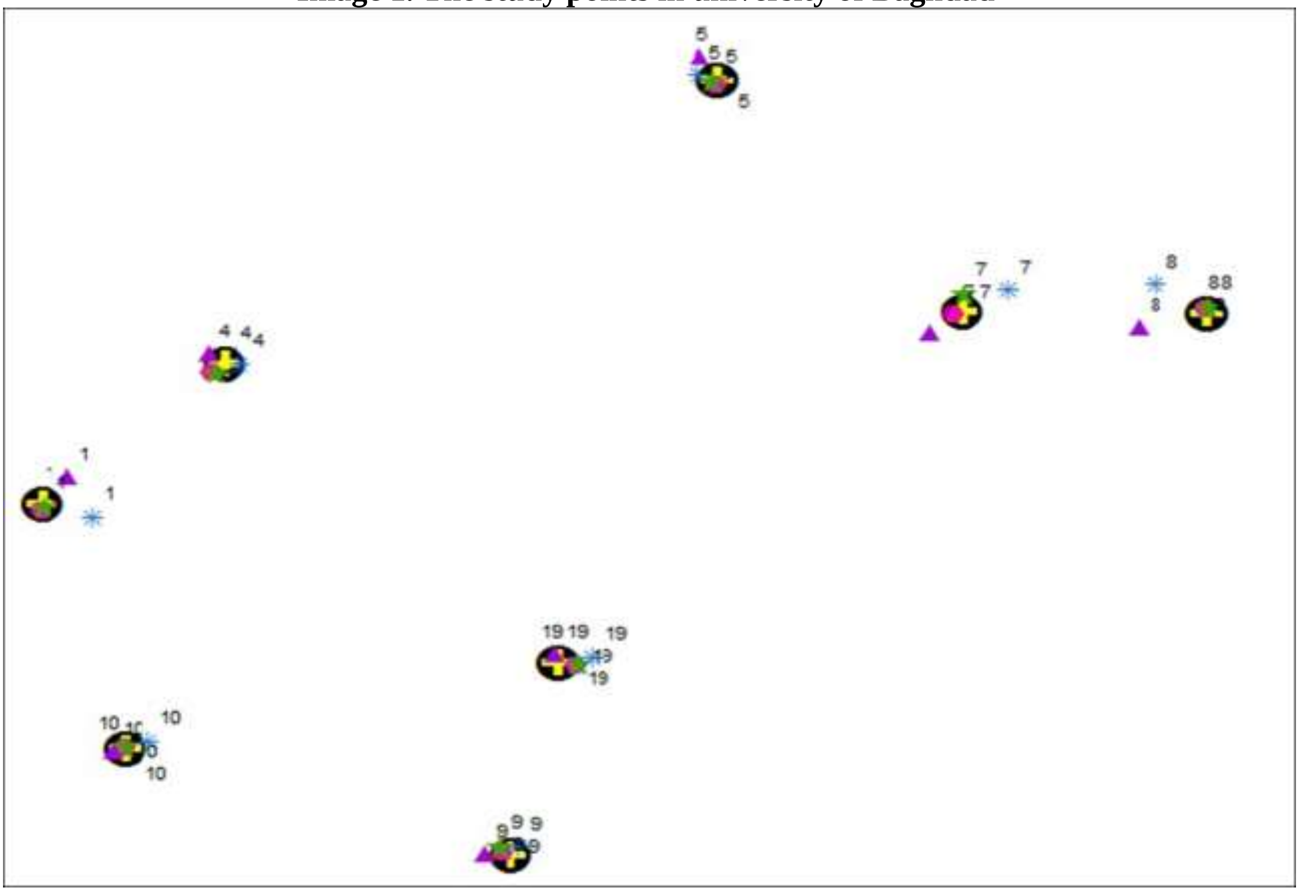

Figure 2. The study points with different mark for each point relative to the observing method

Each mark of the point represents the method of observing as shown below:

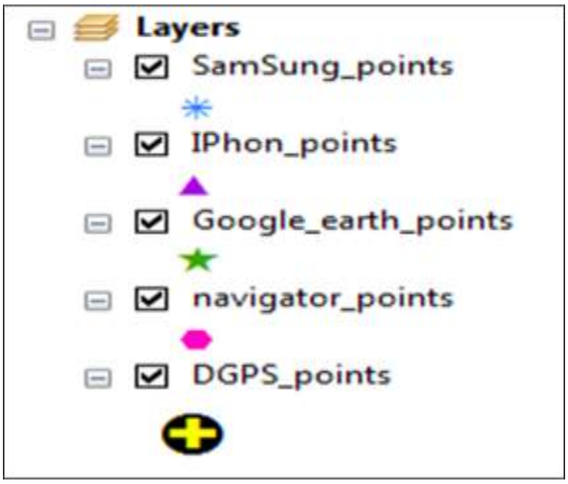

Figure 3. Representing the observing methods by a different marks in GIS.

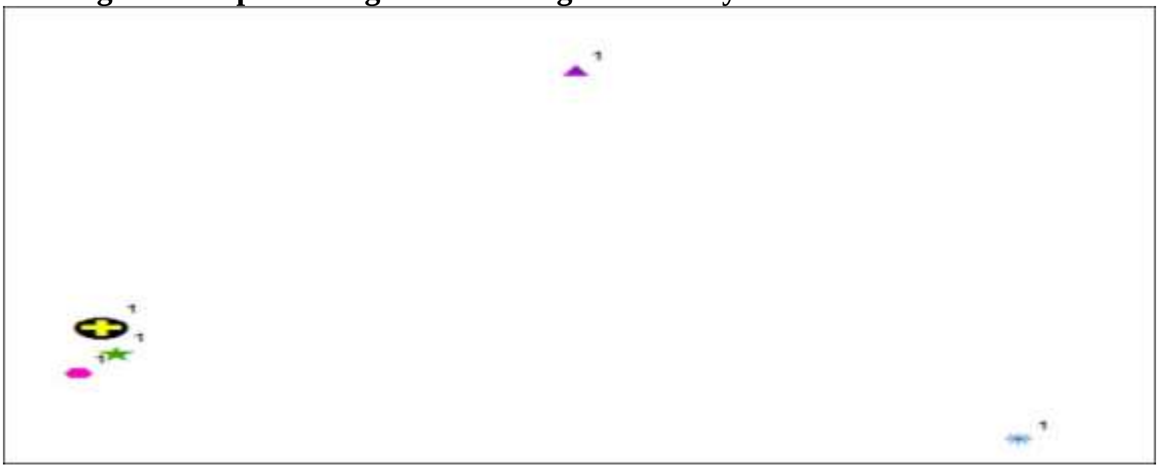

Figure 4. The study point (CP 1) with different observing method

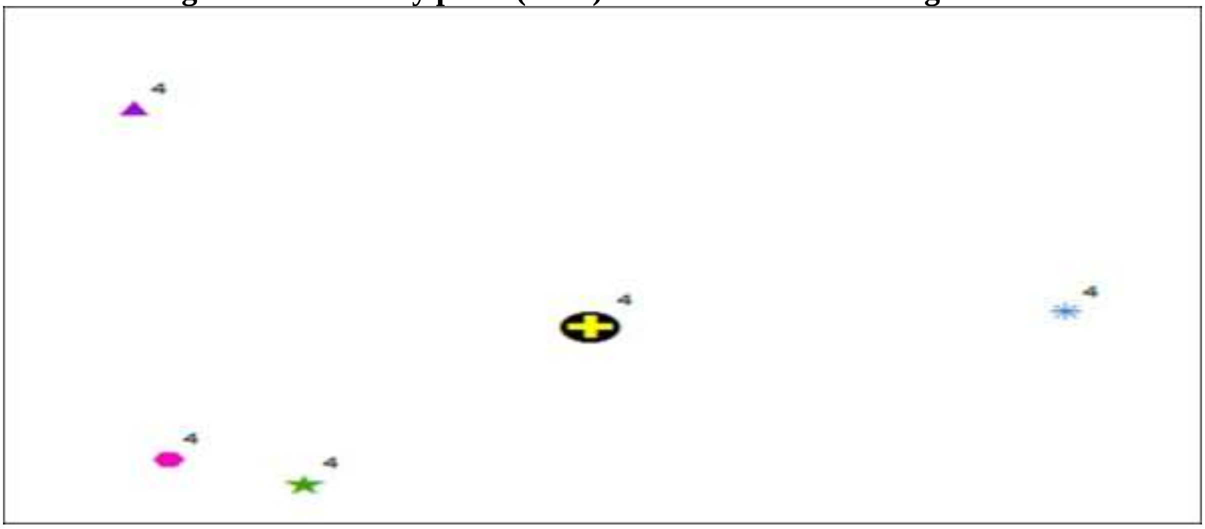

Figure 5. The study point (CP 4) with different observing method

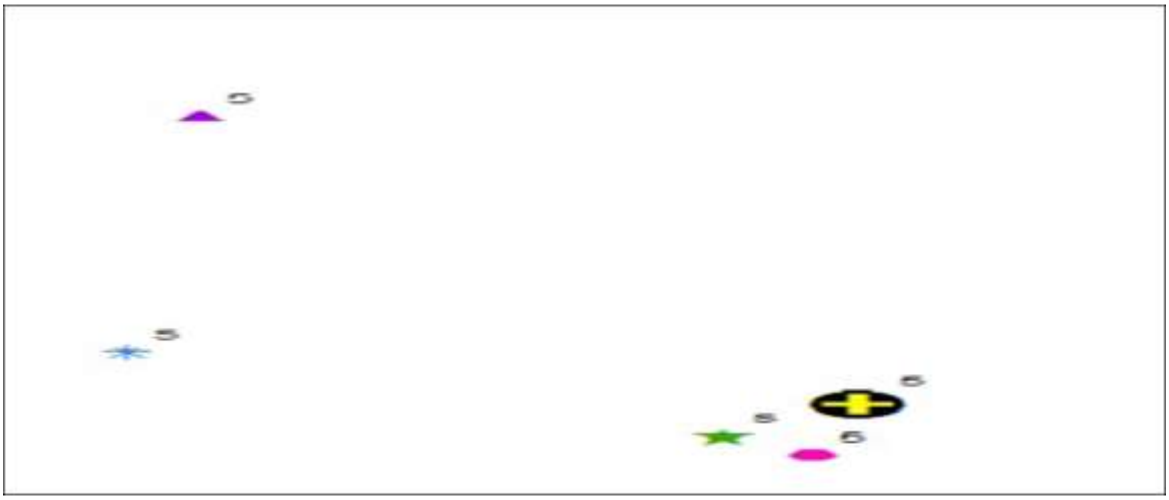

Figure 6. The study point (CP 5) with different observing method.

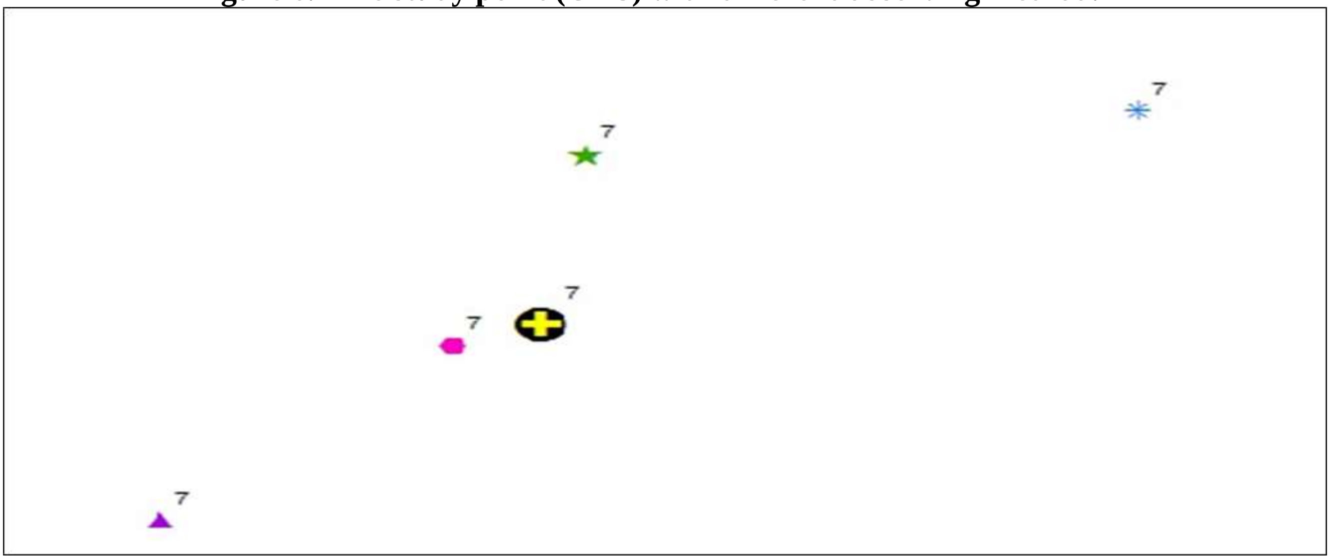

Figure 7. The study point (CP 7) with different observing method

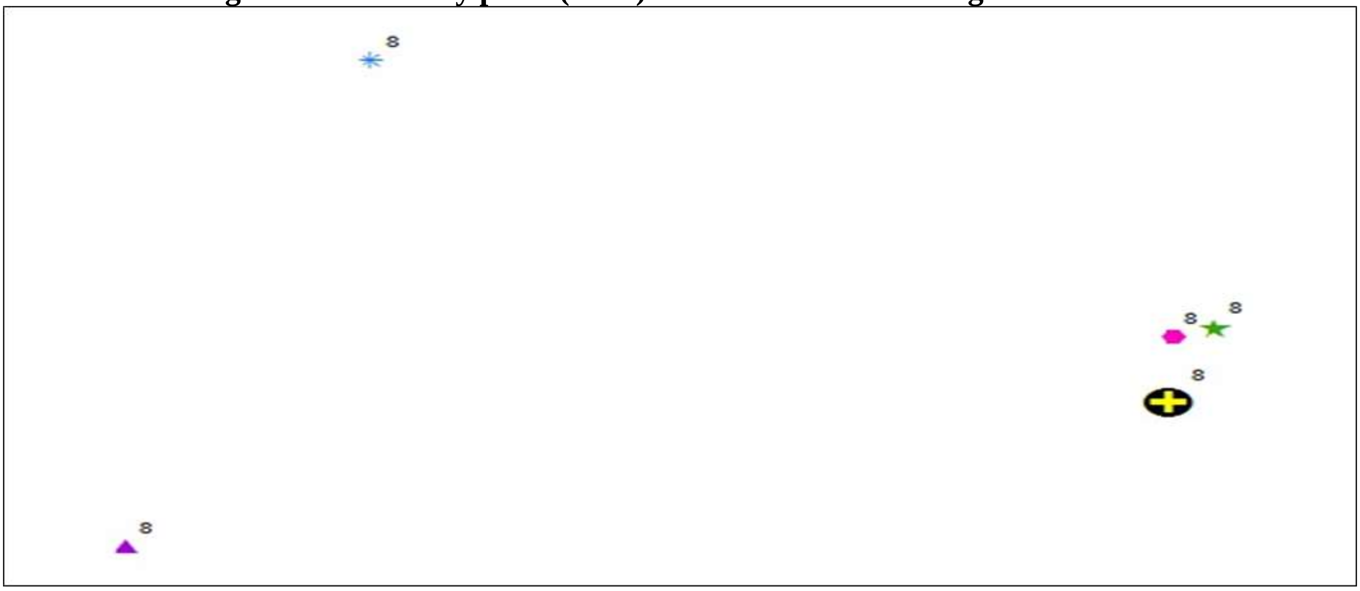

Figure 8. The study point (CP 8) with different observing method

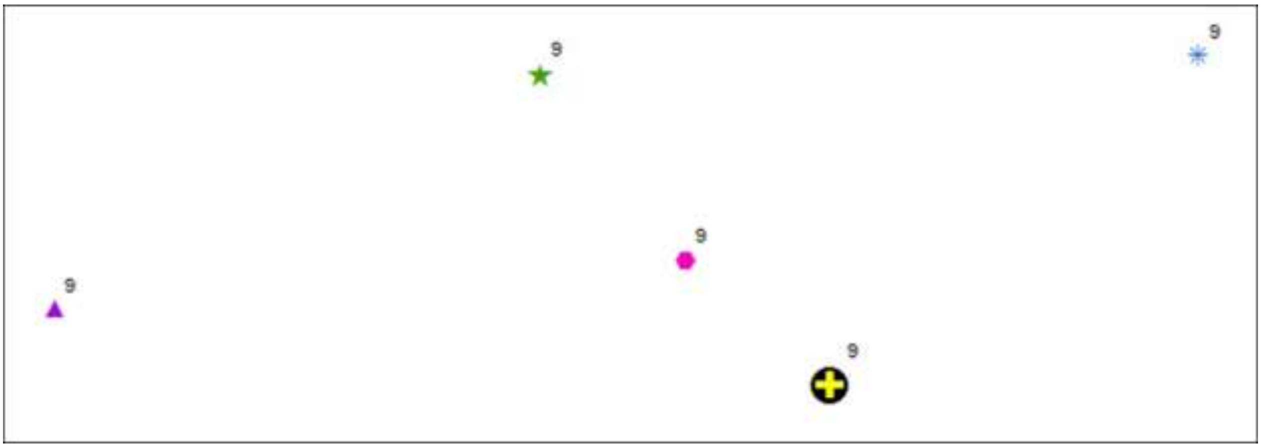

Figure 9. The study point (CP 9) with different observing method

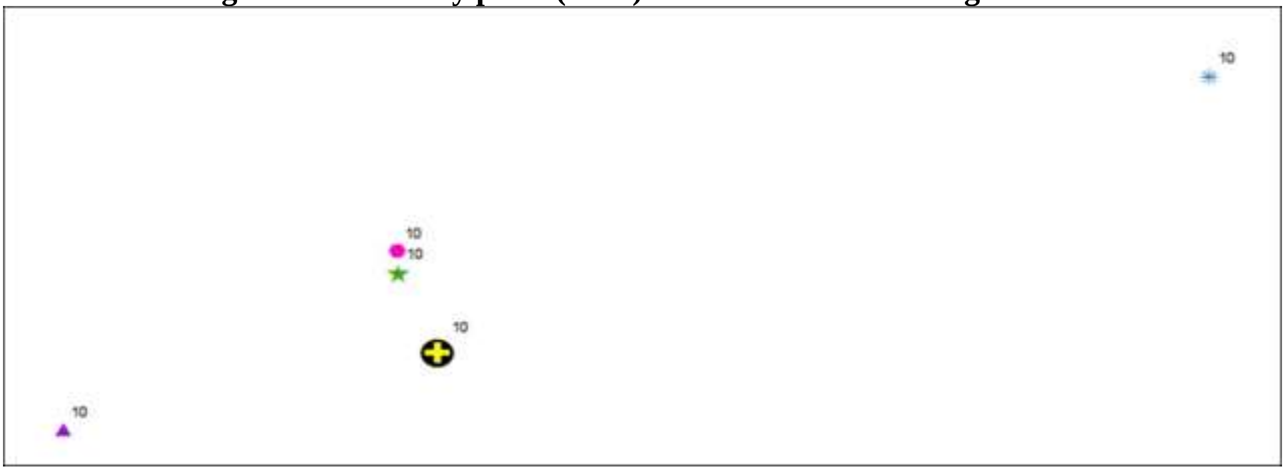

Figure 10. The study point (CP 10) with different observing method

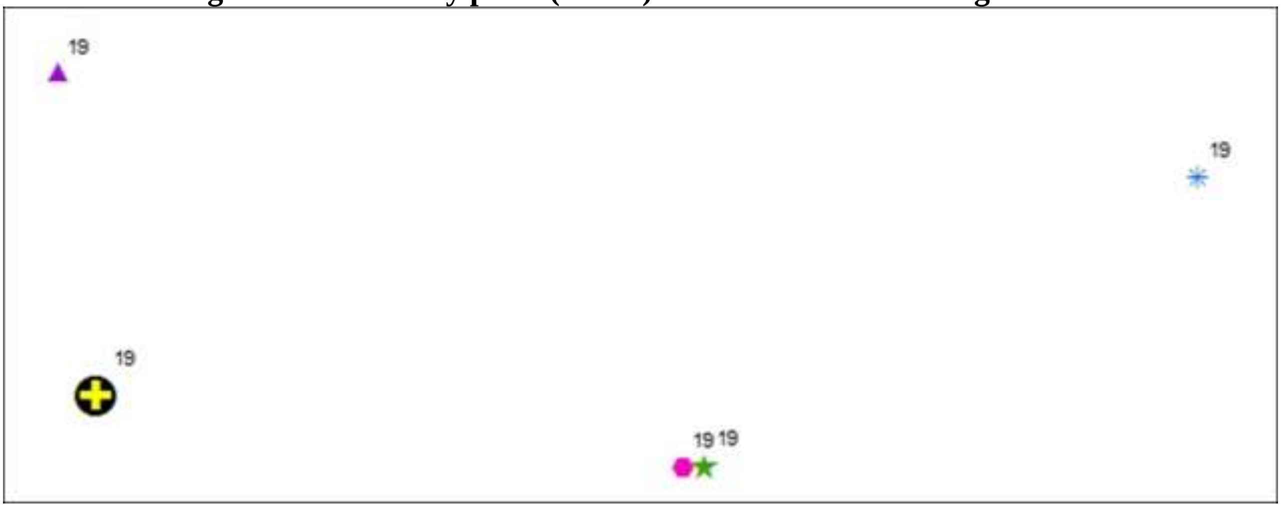

Figure 11. The study point (CP 19) with different observing method

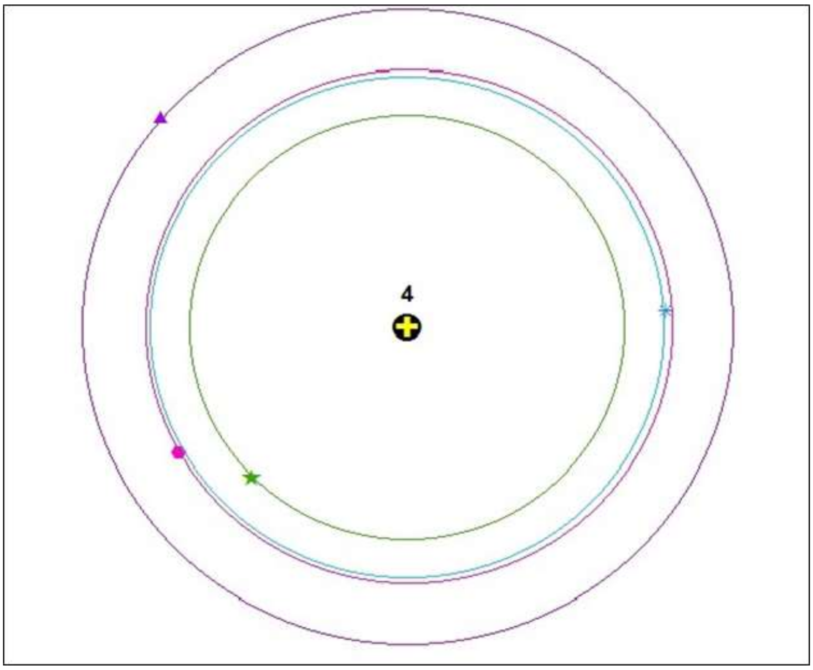

Figure 12. Sample of spacing the measurements of points (CP 4)

The dispersion of the measurements to the reference value of each method is not fixed and different by the difference of points location because of several reasons like:

1-The number of the available satellites.

2- Not all the data are correctable after observation

3-Errors in signals that have received from satellites

Now we can conclude that the most accurate method at all between all methods of measuring coordinates is DGPS , followed by the navigator GPS, followed by the measurements of the Google earth (pro.) and then followed by the measurements of the phone. The reasons of the different accurate in the measurements of each method are:

1-DGPS: It belongs to the measuring principle of the (Static Method), and the correction post processing that done to the data so the most errors will be corrected to gain a closer value of the real position of the points with rate of errors ranging in millimeters

2-Navigator GPS hand held:

The received data directly from the satellites are uncorrectable, so the range of the error in this method is ranging between (3 meters) and (30 meters) relative to the type of the instrument.

3-Google earth (pro.): here we measure the coordinates of the point on a satellite image that its pixel resolution in meters, so the coordinates are shifted some meter about the real position on the ground.

4-GPS phone application:

The application in the phone doesn't has all the details of the navigation massages that is in the previous methods to solve and compute the exact position, and has no the ability to correct the errors in the received signals.

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