

## Semester Final Project

### Introduction and Objectives

Differential GPS have a wide variable range of accuracy to plus or minus three meters. This can be a problem when mapping two distances which are very close but not exactly the same. Using an RTK receiver, which has accuracy of centimeters,



can efficiently eliminate the possibility of such an error created by the DGPS, but at a much greater cost because the RTK is much more expensive.

This objective of this project was to compare the readings from two differential GPS, the Garmin map60CSx and the Garmin Oregon 300, to using the Draw tool in HGIS to determine if the Draw tool can be more accurate in taking distance measurements.

The location used to demonstrate the objectives of this project was the track directly north of Green Acres Elementary school at 1900 North in North Ogden. This was used because the inside and the outside of the track could be measured easily by walking. The distance from one side of the track to the other is about 10 feet.



### Materials and Methods

The materials used:

- Garmin GPSmap 60CSx
- Garmin Oregon 300
- HP iPAQ with HGIS
- Desktop computer with internet access

Using both the Garmin GPSmap 60CSx and the Garmin Oregon 300, the area calculation was used to plot a trail marking the inside and a trail marking the outside of the track.

Using the iPAQ HGIS draw tool to draw and measure lines following the outside and inside of the track:

- Download the image and world file for just the image of the track area from MSRmaps.com
- Open up the image in HGIS
- A continuous line can be drawn by zooming in to one area of the track, selecting Draw, drawing a portion of the line, select Pan, Pan to the next area, select Draw, click on the existing line, selecting the line button, and continue drawing the rest of the line where the existing line left off. Continuing this process, a single line can be drawn while zoomed into an area to get a more accurate measurement.

Using DNR Garmin, upload the tracks and save as shape files:

- Open DNR Garmin
- Connect to GPS device
- Track > Download
- Highlight which tracks to upload and save
- File > Save to > File . . . > save as a (Projected) (\*.shp) > Output shape > line

Putting the tracks into a format which can be transferred to a word document:

- Open HGIS on the computer
  - When it is done on the computer rather than on the iPAQ, the file can then be saved as a .jpg or take a screen shot which can't be done on just the iPAQ
- Open the image and overlay the imported tracks
- File > Print > Print to JPG file > Next > Name it > Open
- This saves the picture as a .jpg which can then be opened in a word document

## Results and Discussion

The following are the measurements from the three devices:

Garmin GPSmap 60CSx

Inside track: 2336.4 ft, 0.4425 mi

Outside track: 2402.3 ft, 0.4549 mi

Garmin Oregon 300

Inside track: 2312.7 ft, 0.4380 mi

Outside track: 2382.7 ft, 0.4512 mi

HP iPAQ

Inside track: 2379.4 ft, 0.4506 mi

Outside track: 2419.9 ft, 0.4583 mi

(ft)	Garmin GPSmap 60	Diff – 60/Oregon	Garmin Oregon	Diff – Oregon/iPAQ	HP iPAQ	Diff – iPAQ/60
Inside Track	2336.4	23.7	2312.7	66.7	2379.4	43
Outside Track	2402.3	19.6	2382.7	37.2	2419.9	17.6
Difference between inside and outside	65.9		70		40.5	

Table 1.1: The differences between the track measurements.

The comparison of the measurements from each of the devices showed that they were somewhat close to each other to within 67 feet at the greatest difference. Without knowing the exact measurement, being able to see which measurement is closest is very difficult. Although, the following web site <http://northogdenrecreation.com/Parks/GreenAcre.htm> and the faculty at Green Acres Elementary say that two times around the track is 1 mile. From the GPS measurements, the track is less than one half mile by about 0.01 miles. A contact from Ogden City Parks and Recreation said that it was 0.3 miles which is also different from both the web site and the GPS readings. Because of the discrepancies from all the sources, using the RTK unit would provide a much more accurate measurement which to compare the measurements which were taken for this project as well as the additional sources of information.

The following images are from Google Earth and MSRmaps. The image from Google Earth shows a much clearer line indicating the edges of the track than the image from MSR maps. This may be one reason why using the Draw tool in HGIS was hard to be very accurate. Another reason why using the Draw tool was difficult was because of the trees along the north side of the track covering up the lines and so an estimate was used as to exactly where the edges of the track were.



Google Earth Image



(Lower Left Corner)

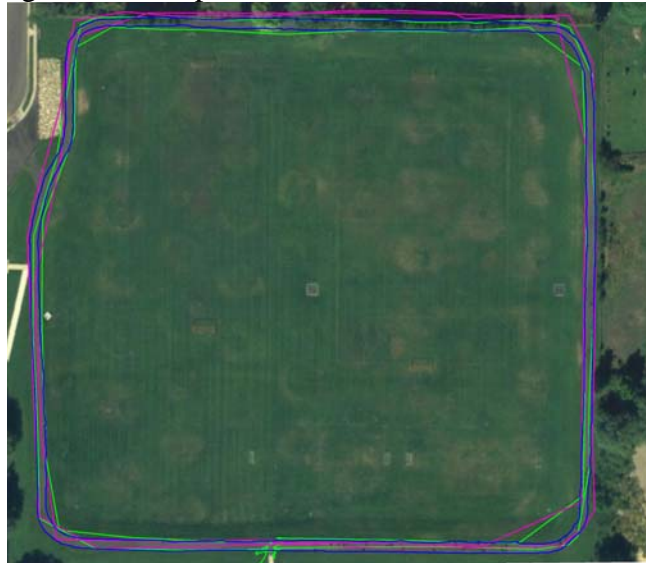


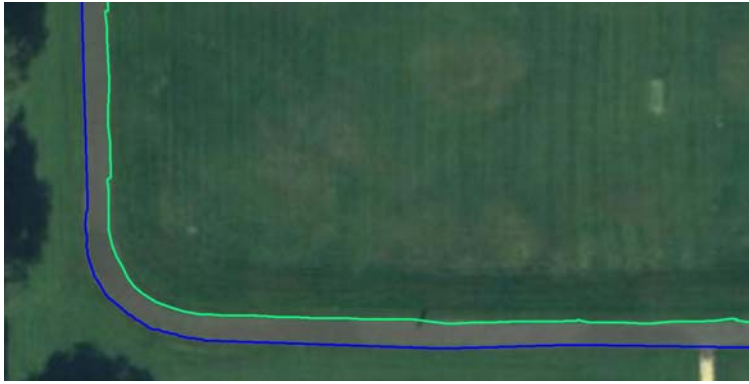
MSR maps Image



(Lower Left Corner)

The following images show the paths that the GPS and HGIS Draw tool calculated:





Using the HP iPAQ Draw tool



Using the Garmin GPSmap 60CSx



Using the Garmin Oregon 300



Using HGIS to add all map layers

Green = Garmin Oregon 300  
Blue = HP iPAQ  
Pink = Garmin GPSmap 60CSx

## Conclusion

From the data presented, the three measurement methods used were close enough together that when measuring a distance where an error of 20 to 60 feet is acceptable than they are comparable to each other. Often, GPS devices have an increased variance because of tree cover, but because these measurements were taken when the trees didn't have any leaves, there shouldn't be any error due to that factor. For the purposes of measuring the distance around the track for people who use it only for recreation, a very expensive piece of equipment like the RTK is not necessary for the application. But if an accuracy of inches is needed for the application of measuring an Olympic track for racing, for example, an RTK system should be used. Also, the distance measurements were consistent in that they showed the inside of the track to be less than the outside of the track. Based on the inside measurement compared to the outside measurement, logically the iPAQ seems to be more accurate because the two numbers are close enough together whereas the other devices showed that the difference was closer to 70 feet than 40 feet. In future projects, using images with sharper lines, walking slower with the GPS devices and also using an RTK system to compare for accuracy would be advisable.

Here are some additional interesting pictures of the area:

<http://gis.co.weber.ut.us/website/gizmo/viewer.htm>



InfraRed/NAIP 2006(1m)



DOQ 1990's (1m)



2009 HRO (1ft)



NAIP2004 Color (1m)