

REFERENCE SYSTEM EXERCISE: RECENT ADVANCES IN MOBILE GPS/GIS MAPPING TECHNOLOGY

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Introduction

GPS/GIS Field data collection is a perennial problem for cartographers, surveyors, engineers and researchers. Until recently, the tools available for mapping applications have been bulky in size and weight, expensive, and difficult to learn. During the past year, tremendous advances have taken place in GPS technology (receivers), data collection hardware, and field data collection software. Not only has the autonomous GPS accuracy improved, but the data collectors have become smaller, lighter, and less expensive. The software has become cheaper and easier to learn. In addition, for applications involving offsets, lower priced laser range finders have been become available. All of these advances have made the GPS/GIS data collection tasks easier, more economical and faster to complete.

Advancements

GPS Receivers

With the elimination of Selective Availability (SA), autonomous accuracy is much better. Today, a single stand alone receiver can provide an accuracy of between 10–15 meters. These receivers are so small that they can easily fit in your shirt pocket and one can get these receivers for approximately \$100. It is also now possible with the use of DGPS service to obtain sub meter accuracy in real time. (This eliminates the need for post processing). This DGPS service is available through the use of coast guard beacon receivers and satellite based DGPS service. The coast guard service is limited to the coastal areas of the country or around 50–200 miles radius of the station itself. For areas where the coast guard beacon service is not available, real time satellite based DGPS service is available almost throughout the world at reasonable cost.

Data Collectors

The traditional units for GPS data collection use either an onboard storage memory or an external data logger. In most cases, the software on these units is extremely complicated and difficult to learn. The data collectors are vendor specific to GPS engines only and cannot be used

for any other applications. The units come with a proprietary operating system which makes modifications or difficult to incorporate. These units have slower processors thus making the manipulation and processing of data and maps impossible or very slow. Also, the small screen size limits the display of data without scrolling down or panning often. The units have very low battery life and are expensive to replace.

With the introduction of Palm Pilots followed by Microsoft's launch of a pocket PC operating system, a new generation of handheld Personal Digital Assistants (PDA's) have flooded the market. It is now possible to use these lightweight handheld PDA's, with GPS/GIS data collection software, for field applications.

In addition, regular windows based laptop PC's are now available in ruggedized waterproof versions. One can use these PC's for mapping applications in tough outdoor environments.

Some of the new units available are manufactured by Casio, Hewlett Packard, Sharp, Compaq, Fujitsu, Panasonic, and Walkabout Computers.

The new data collectors are economically priced between \$300–\$6000. Widespread familiarity with the Palm, Pocket PC, and Windows operating systems has resulted in a quick and easy GPS/GIS integration with these devices. As these units can be used with or without GPS, other field data collection applications can be handled. They have a longer battery life, 14–16 hours, and are lightweight, thus making it easier for the user to carry the units all day in the field. In addition, most data collectors have touch screens and come with a color display. Almost all have voice activated systems which comes in handy if one wants to dictate notes. Most devices have 2 serial ports, USB ports, and infrared ports. Some of them have built-in modems, and offer extended memory and Compactflash card options.

Software

The traditional Data Collection software is difficult to learn and is vendor specific to their GPS engine only. Also the software available operates only on a Windows operating system and is expensive.

Some of the new software introduced during the past year or so are: Fieldworker, Solo, ArcPad, Sitemate, Patchworks, and Composer.

Today, the new generation of software offers the user various options that can be used for his or her applications. The software is very economically priced, between \$50–\$3000, and has the capability to add background maps or digital orthophotos. Most of the new generation software allows the user flexibility to use any type of GPS engine beginning from a low priced recreational type unit to a high accuracy survey grade unit. The software has the capability of reading from 2 serial ports allowing the user to use a GPS receiver as well as an additional sensor, such as a laser range finder. The software can also accept digital camera input allowing the user to capture not only the location data but also the actual picture of the feature. Once the location, features and attribute data have been collected, all of the data can be exported in different GIS formats, such as ArcView shape files. Most of the new generation of software has a version available for Windows as well as a Pocket PC operating system. This results in a much shorter learning curve.

Selection Considerations

GPS Receiver Selection Consideration

The most important criteria in selecting a GPS receiver is identifying the accuracy that the application requires. The receivers generally fall into 4 categories. Autonomous – 10–15 meters, 1–3 meters, submeter, and survey grade. For the 1–3 meters, submeter, and survey grade, you will need some way to correct the readings. The corrections can be – Post processing, Coast Guard Beacon, and Satellite based.

In the post processing option, you need to ensure that base station data is available from a nearby base station. If the Coast Guard Beacon method is chosen, one needs to identify if a beacon station is available near the site. In the satellite based option, one needs to make sure that the service is available in the area and the subscription paid for.

Data Collector Selection Consideration

The weight and size of the unit is an important factor when using these units in the field for a long time. The type of operating system (Palm O/S, Pocket PC, WIN-

DOWS) to be used needs to be considered if integrating with other application platforms. If you require a display of a background map, it will be preferable to have a unit with a larger screen and color display. However, the color display may reduce your battery life. If the application involves use in a rough environment, the data collector selected must be ruggedized for outdoor use. Battery life is also an important factor in the selection of the data collector. The unit selected has to be compatible with the type of GPS receiver to be used.

Software Selection Consideration

As certain versions of field data collection software have limited features, several factors need to be considered in selecting the right software.

The selected software should be compatible with the GPS receiver and the operating system chosen for the data collector. Some software packages do not allow you to create and edit features in the field. This restriction implies that for any changes and or additions to the data dictionary, you will have to stop the project in the field and access a PC to edit the dictionary, reload the new version of the dictionary, and restart the field project. This is a very time consuming process which can be avoided by simply selecting the software with field editing of the data dictionary capability.

Often field data projects are handled in different datums and projections, and as a result, one should choose software with capability to select various datums/projections. If laser range finders or any other external devices besides GPS are to be used, make sure that the software is compatible and raw data is converted into the proper units. It is good practice to view the quality of GPS data collected by viewing the DOP number. Hence, one should pick a software package which displays DOP values. If you need to go back to a previously located or known point, you will need the navigation capability in the software. Most often the collected data needs to be imported into a GIS. The software chosen should be able to provide a conversion routine to allow an import of GPS and Feature data into various types of GIS software, such as, ARCVIEW, MAPINFO, and AUTOCAD.