WILDGOOSE GPS and Navigation Service, www.gps-vietnam.net

Understanding Navigation with GPS Receiver

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Introduction

Navigation is the process of determining positions, finding ways and setting courses to the destination with or without using tools. Furthermore navigation includes techniques of controlling the movement and other special tasks.

Depending where you are doing navigation you differentiate between three kinds of navigational work:

- Land or terrestrial navigation
- Sea or nautical navigation
- Air or aeronautical navigation

All of these kinds of navigation have the same purpose and do the same issues but using different techniques under different circumstances.

Land Navigation

There are different tasks for land navigation but only 3 of them are the base tasks:

- Determining the current position
- Determining the destination
- Determining the way to the destination

For doing land navigation we usually use three different tools. A map, a compass and a GPS receiver. All these three tools can be used separately but have the biggest benefit when using together. The GPS receiver does NOT replace a map and a compass. The GPS receiver is doing about 50% of the map work and 80% of the compass work but cannot do all of the map and compass work.

You should not use a GPS receiver alone in unknown terrain for full navigational work because - as said above - the GPS receiver has its limitation in the mapwork. Furthermore the GPS receiver can get lost or useless if the batteries are emtpy or it gets broken; in this case map and compass have a backup function.

Generally the GPS receiver do the same navigational work like with map and compass. The navigational work with GPS is not invented new, it is just done more faster and much more accurate. And a GPS receiver offers additional functions for navigational work.

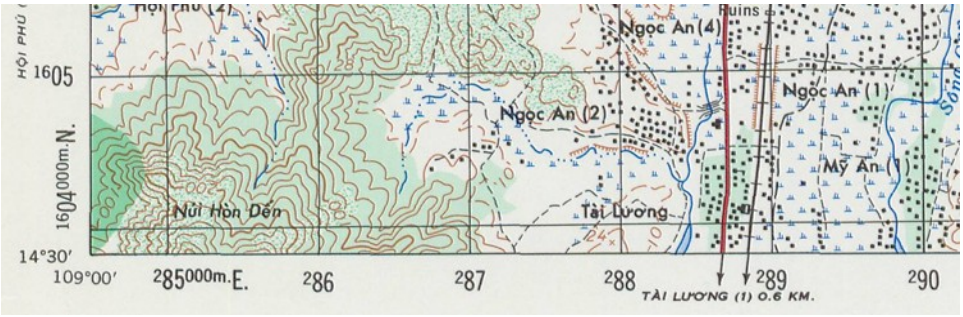
Determining the current position

One of the simpliest way is determining the own position by comparing the map with the environment. This is called terrain association. If this is not possible, other techniques are intersection, resection or modified resection with map and compass.

The GPS receiver always show the position in realtime. This is one of the main features of a GPS receiver. Usually the position is shown by coordinates and also on a map plotter (depending on the unit). Because the display of the GPS unit is quite small it may be necessary sometimes to transfer the position to a bigger papermap to get an overview of the entire situation.

For handling with coordinates for land navigation we usually use grids. Grids are more easy to handle and easy to calculate with. The preferred grid is the so-called UTM-Grid. This grid can be used worldwide while national grids have only a local usage. DMS coordinates (DMS stands for degree,

minutes, second coordinates) are prefered for nautical and areanautical navigation, not for land navigation.



UTM coordinates on a topographic papermap of Vietnam

For the quick and accurate determining of coordinates in the field a protractor is used. Instead of the protractor you can also use a ruler. After some tries you will see how easy it is to handle with grids.

Determining the way and courses

Ways can easily determined by following a trail or the shoreline of a river. Just compare the map with the nature and follow the way. This is called moving by terrain association.

If there are no such terrain features to use you have to use map and compass to specify the correct direction. This is called moving by dead reckoning. In other words, it begins with the determination of a polar coordinate (azimuth and distance) on a map and ends with the act of finding it on the ground.

When navigating with a GPS receiver, the unit is doing exactly the same. Once stored the destination point in the GPS unit, the navigation mode can be started. Navigation can be done in a bearing or course mode.

Advanced features of a GPS receiver

Near the basic features mentioned above a GPS receiver offers a lot of more advanced features, depending on the model.

Some of these features are:

- Convert one coordinate to another coordinate system
- Convert one map datum to another map datum
- Measure azimuth and distance between 2 points
- Displays maps on a map plotter page
- Project points from current location
- Shows trip and movment data
- Offers a Point-of-Interest database (location database)
- Offers automatic-route-calculation (on streets and roads only)

Accuracy of position

A GPS receiver does not calculate a position exactly, it is doing this by convergence correlation using a special code transmitted from each GPS satellite. Due to physical circumstances there are some error sources which can affect seriously the accuracy of position.

These error sources are:

- Runtime errors in the ionosphere and troposphere

- Heavy rain and extremely cloudy weather conditions
- Bad satellite constellation
- Multipath errors, especially asymetric multipath in urban areas
- Electromagnetic fields caused by extensive cabling above ground level
- Almanac errors

Also very important for receiving satellite signal is the used GPS-chipset and the style of the antenna.

Street routing device versus GPS navigator

There are a lot of street routing devices like Tom-Tom, IGO, VIGO etc. on the market which call themselves navigation devices but only have very limited navigation functions. These devices are designed to work on streets doing automatic route calculation on steets and roads only. They also dont offer navigational functions and the majority of these devices cannot even handle with coordinates.

If you leave the road with such device - for doing a walk in the nature, mountainbiking or driving a boat on the river - it is completely unuseful for its owner. Limited battery capacity and not being water- and dustproof are additional disadvantages.

A GPS navigator offers all navigational functions needed on and off the road, in urban and rural areas, on the land, on the water or in the air.