Ogbonna Wisdom

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Survey Assignment 1

1. Benefits if GPS over other forms of equipment for measuring:
* Higher positioning accuracies, from tens of meters to millimetre level;

With GPS, one could get way more accurate positional data than with any other measuring equipment. This makes GPS a better option when dealing with operations very sensitive to position. E.g Military Grade Operations.

* It is an all-weather system available 24 hours a day;

The fact that GPS could provide information even during the most intense weather conditions makes it way better than other competitors because everyone needs uninterrupted access to data at all times.

* It is a positioning system with no user charges and uses relatively low cost hardware;

Not everyone who needs access to positional data has the money required by other data sources. This makes GPS a better option to this large number of people as they have access to the data they need at a very low cost with the simplest of gadgets.

* Capability of determining velocity and time, to an accuracy commensurate with position;

GPS has an added advantage over other measuring equipment as it can measure both velocity and time.

* Signal availability to users anywhere on the globe: in air, on the ground, or at sea;

With GPS, data transmission is not limited by distance. People on the opposite side of the globe receive signals in less than milliseconds. This is a very huge advantage as GPS would be more useful when one needs timely access to data.

* The positional information is in 3d, that is, vertical as well as horizontal information is provided; This means that GPS is very accurate with positions on all three planes making sure that all positions within the globe are covered.
1. Discuss the types of errors associated with absolute GPS positioning mode:
* Tropospheric delays: Troposphere is the atmospheric layer placed between earth's surface and an altitude of about 60 kilometres.

The effect of the troposphere on the GNSS signals appears as an extra delay in the measurement of the signal traveling from the satellite to receiver. This delay depends on the temperature, pressure, humidity as well as the transmitter and receiver antennas location and, according to

Δ=∫straight line(n−1)dl(1)

it can be written as:

T=∫(n−1)dl=10−6∫Ndl(2)

where n is the refractive index of air and N=10−6(n−1) is the refractivity. The refractivity can be divided in hydrostatic, i.e., Dry gases (mainly N2 and O2), and wet, i.e., Water vapour, components N=Nhydr+Nwet.

* Ephemeris’s errors and orbit perturbations: Satellite ephemeris errors are errors in the prediction of a satellite position which may then be transmitted to the user in the satellite data message. Ephemeris errors are satellite dependent and very difficult to correct and compensate while modeling the orbit of a satellite because many forces acting on the predicted orbit of a satellite are difficult to measure directly. Ephemeris errors produce equal error shifts in the calculated absolute point positions.
* Clock Stability: GPS depends on accurate time measurements. GPS satellites cary rubidium and cesium time standards that are usually accurate to 1 part in 10^12 and 1 part in 10^13, respectively, while most receiver clocks are accurate by quartz standard accuracy of 1 part in 10^8. A time offset is the difference between the time recorded by the satellite clock and that recorded by the receiver range errors observed by the user as a result of the time offset between the satellite and receiver clock have a linear relationship and can be approximated.
* Ionospheric delays: One of the largest errors in GPS positioning is attributable to the atmosphere. The long, relatively unhindered travel of the GPS signal through the virtual vacuum of space changes as it passes through the earth’s atmosphere. Through both refraction and diffraction, the atmosphere alters the apparent speed and, to a lesser extent, the direction of the signal. This causes an apparent delay in the signal's transit from the satellite to the receiver.
* Signal Multi-path: The whole concept of GPS relies on the idea that a GPS signal flies straight from the satellite to the receiver.

Unfortunately, in the real world the signal will also bounce around on just about everything in the local environment and get to the receiver that way too.

The result is a barrage of signals arriving at the receiver: first the direct one, then a bunch of delayed reflected ones. This creates a messy signal.

If the bounced signals are strong enough they can confuse the receiver and cause erroneous measurements.

Sophisticated receivers use a variety of signal processing tricks to make sure that they only consider the earliest arriving signals (which are the direct ones).

* Receiver Noise: This includes variety of errors associated with the ability of the GPS receiver to measure a finite time difference. These include signal processing, clock/signal synchronisation and correlation methods, receiver resolution, signal to noise ratio, etc.