**SIMON BOLIYEH DION**

**CIVIL ENGINEERING**

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**CVE 310: ENGINEERING SURVEYING II**

# GLOBAL POSITIONING SYSTEM (GPS)

GPS is a satellite navigation system used to determine the ground position of an object. It is a satellite-based radio-navigation system owned by the United States government and operated by the United States Space Force. It is one of the global navigation satellite systems (GNSS) that provides the geographical location and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals.

# BENEFITS OF GLOBAL POSITIONING SYSTEM (GPS)

## NAVIGATION

Perhaps the most common use for GPS is in navigation systems. Combined with map technology, it becomes a powerful tool for road vehicles and boats. GPS can pinpoint a device's location with accuracy and by comparing coordinates; the statistics can be used to calculate a device’s direction of movement and speed. This information can be used to provide step-by-step directions from Point A to Point B in real time.

## LOW COST

The satellites behind GPS are paid for, maintained and upgraded by the US Department of Defence. That means that the system is essentially free, although you may have to pay for a device and software to utilize it. Smartphone apps, such as Google Maps, that use GPS are also usually free.

## CRIME AND SECURITY

GPS can be used as a valuable tool by law enforcement to track criminals or terrorists, using devices they attach to vehicles, or through tracking the criminal's smartphone. GPS tracking devices can also be used to deter theft by employers or ordinary people.

## EASY TO USE

Navigation using GPS is generally very easy and requires minimal skill or effort, certainly when compared to traditional methods and technologies, such as map-reading. In most cases, the user just has to input the destination and the device will do the rest. GPS is also an easier and more efficient technology to use for tasks like surveying and the study of the movement of tectonic plates (see below).

## EMPLOYER MONITORING

Employers can use GPS tracking to make sure that their drivers are behaving responsibly, such as following the quickest route, and not wasting time or fuel by going off track, as well as following speed restrictions. Businesses can also provide better customer service if they know where delivery or service vehicles are at any one time. A fleet of vehicles can be used more efficiently using GPS.

## SAFETY

GPS tracking can be used by parents to keep tabs on their children. Spouses can also use similar technology to keep track of their partners. Workers and others can also use GPS tracking for personal safety, so that their whereabouts are known if there is an emergency.

## NEIGHBOURHOOD SEARCH

As well as navigation, GPS can also be used to provide information on the local area. For instance, finding out where the nearest hotel or gas station is, or discovering nearby restaurants that are open for business. This is convenient when you are on a long road trip and need to find a place to stop for food, gas, sleep, and so on.

## TRAFFIC AND WEATHER ALERTS

One of the nice things about GPS is that it is all happening in real time. That means that you can be notified if there is a traffic accident or other hold-up ahead, or if you are approaching an area where there is a severe weather event occurring. Not only can this shorten your journey time, but also improve safety.

## AVAILABLE ANYWHERE

One of the best features of GPS is that because it essentially works through satellite technology, it is available across the entire globe. There is no need to be caught out not knowing your own location, or get lost.

## UPDATED AND MAINTAINED

The GPS system is paid for, updated, and maintained by the US Department of Defence, so that it is always accurate. Most software, apps, and devices that use GPS are also regularly updated, normally for free. So unlike a traditional printed map which goes out of date after a while, GPS and related technology normally stays very accurate.

## EXERCISE MONITORING

GPS can be used for exercise monitoring and can help amateurs to improve their health and fitness, as well as professional sports men and women. It can be used to calculate speed, distance travelled, and even uses the information to estimate calories burned.

## FLEXIBLE ROUTE OPTIONS

GPS give you route choices in live time, enabling flexibility. You can choose a route according to your particular needs or desires. If you take a wrong turn, a new route can be calculated using GPS. If your route becomes blocked by an incident, GPS can be used to calculate a new pathway.

## MILLITARY USAGE

As well as being useful for navigation and other general uses, the military employs GPS when setting targets for guided missiles. GPS improves accuracy through giving the missile a specific set of coordinates, and reduces collateral damage through increased accuracy.

## SURVEYING

Land surveying takes place before construction or development. Over time, GPS has gradually replaced traditional land surveying techniques, mainly because it is cheaper, quicker, and usually more accurate. It often takes hours with GPS, rather than days.

## BUILDINGS AND EARTHQUAKES

There are many scientific applications of GPS beyond just navigational matters. It can be used to help detect structural problems in roads and buildings, as well as predict natural disasters like earthquakes through the monitoring of tectonic plate movement.

# TYPES OF ERRORS ASSOCIATED WITH GPS

## RECEIVER NOISE

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

## SIGNAL MULTIPATH

Multipath describes an error affecting positioning that occurs when the signal arrives at the receiver from more than one path. This occurs when the GPS receiver is positioned close to a large reflecting surface such as a lake, a big rock or building.

## SATELLITE AND RECEIVER CLOCK ERRORS

Even though the clocks in the satellite are very accurate to about 3 nanoseconds, they do sometimes drift slightly and cause small errors, affecting the accuracy of the position. The satellite clocks are independent of each other.

## SELECTIVE AVAILABILITY (S/A)

Selective availability is a process applied by the U.S department of defence to the GPS signal. This is intended to deny civilian and hostile foreign powers from getting full accuracy of GPS by subjecting the satellite clocks to a process known as dithering, which alters their time slightly.

## ANTI-SPOOFING (A/S)

Anti-spoofing is similar to S/A and is intended to deny civilian access to the P-code part of the GPS signal, thereby forcing the user to use the C/A code which has selected availability applied to it

## CLOCK STABILITY

GPS depends on accurate time measurements. 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 using an equation.

## IONOSPHERIC DELAYS

GPS signals are electromagnetic signals and such are non-linearly dispersed and refracted when transmitted through a highly charged environment like the ionosphere. Dispersion and refraction of the GPS signal is referred to as the ionosphere range effect because it results in an error in the GPS range calculation as the velocity of the radio signals from the satellite is affected.

## TROPOSPHERIC DELAYS

The troposphere is that part of the atmosphere which is closest to the earth . it extends from the surface of the earth to about 9km over the poles and 16km over the equator. But as far as GPS signal is concerned, the troposphere is combined with the stratosphere and taken to be at a height of 50km above the surface of the earth. The tropospheric delays add a slight distance to range of the receiver measures between itself and the satellite. The troposphere is an electrically neutral layer of the earth’s atmosphere. Hence, it is neither ionized nor dispersive.

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