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Entity Tracking and Surveillance using the Modified Biometric System, GPS-3

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Abstract

Identification of exact enemy location is extremely necessary in modern military systems. The variants of enemy target are either fixed location like building or training site etc. or a moving vehicle carrying ammunition or persons. In either case, locating the initial position becomes mandatory. Global Positioning System (GPS) is a system comprising of satellites, computers and receivers that is able to determine the latitude and longitude of a target on earth. This paper describes the use of GPS-3 for accurate location identification of enemy targets (fixed or moving) enabling improved command and control of military operations.

Keywords: Triangulation, AEL system, GPS, Electromagnetic spectrum, Wireless communication, GPS-3.

1. Introduction

A system of satellites, computers, and receivers is incorporated that determines the latitude and longitude of an object which can be done by calculating the time difference between the signals from the Global Positioning different satellites to reach the receiver. GPS System is a worldwide radio-navigation system formed from a constellation of 24 satellites and their ground stations. GPS uses these "man-made stars" as reference points to calculate positions accurate to a matter of centimetres. In fact, with advanced forms of GPS it is possible to make measurements to better than a centimetre. In a sense it's like giving every square metre on the planet a unique

address. Though the GPS is used in many applications, it is extensively used in military operations for Automatic Entity Location (AEL) of enemy targets, moving or stationary.

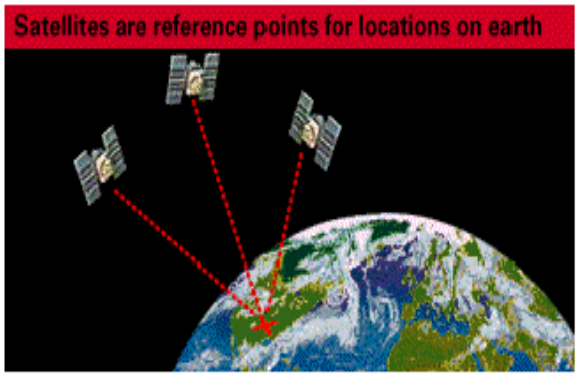
2. Technology Requirements

The system consists of a "constellation" of at least 24 satellites in 6 orbital planes. Each satellite circles the Earth twice every day at an altitude of 20,200 kilometers (12,600 miles). The satellites carry atomic clocks and constantly broadcast the precise time according to their own clock, along with administrative information including the Orbital elements of their own motion, as determined by a set of ground-based observatories.

The receiver does not need a precise clock, but does need to have a clock with good short-term stability and receive signals from four satellites in order to find its own latitude, longitude, elevation, and the precise time. The receiver computes the distance to each of the four satellites from the difference between local time and the time the satellite signals were sent (this distance is called a pseudo range). It then decodes the satellites' locations from their radio signals and an internal database. The receiver should now be located at the intersection of four spheres, one around each satellite, with a radius equal to the time delay between the satellite and the receiver multiplied by the speed of the radio signals. The receiver does not have a very precise clock and thus cannot know the time delays. However, it can measure with high precision the differences between the times when the various messages were received. This yields 3 hyperboloids of revolution of two sheets, whose intersection point gives the precise location of the receiver. This is why at least four satellites are needed: fewer than 4 satellites yield 2 hyperboloids, whose intersection is a curve; it is impossible to know where the receiver is located along the curve without supplemental information, such as elevation. If elevation information is already known, only signals from three satellites are needed (the point is then defined as the intersection of two hyperboloids and an ellipsoid representing the Earth at this altitude). The receiver contains a mathematical model to account for these influences, and the satellites also broadcast some related information, which helps the receiver in estimating the correct speed of propagation. High-end receiver /antenna systems make use of both L1 and L2 frequencies to aid in the determination of atmospheric delays.

3. The Theory of Triangularity

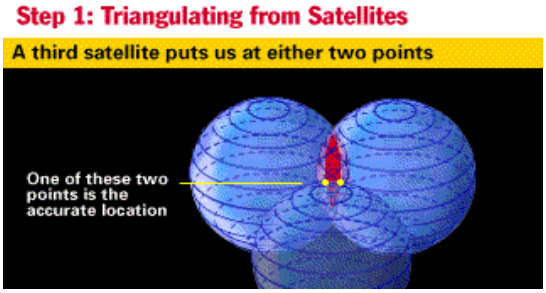
GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location.



Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. This delay is calculated, and the length of the delay tells the signal's travel time. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map. A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset.

4. Working of a GPS system:

1. The basis of GPS is "triangulation" from satellites.
2. To "triangulate," a GPS receiver measures distance using the travel time of radio signals.
3. To measure travel time, GPS needs very accurate timing, which it achieves with some tricks.
4. Along with distance, you need to know exactly where the satellites are in space. High orbits and careful monitoring are the secret.
5. Finally you must correct for any delays the signal experiences as it travels through the atmosphere.



Improbable as it may seem, the whole idea behind GPS is to use satellites in space as reference points for location here on earth.

That's right by very, very accurately measuring our distance from the satellites we can "triangulate" our position anywhere on the earth. Forget for a moment how our receiver measures this distance. We'll get to that later. First consider how distance measurements from three satellites can pinpoint you in space.

5. Triangulating principles

- Position is calculated from distance measurements (ranges) to satellites.
- Mathematically we need four satellite ranges to determine exact position.
- Three ranges are enough if we reject ridiculous answers or use other tricks.
- Another range is required for technical reasons to be discussed later

Several frequencies make up the GPS Electromagnetic spectrum:

- L1 (1575.42MHz): Caries a publicly usable coarse acquisition C/A) code as well as an encrypted position P (Y) code.
- L2 (1227.60MHz): Usually carries only the P(Y) code. The encryption keys required to directly use the P(Y) code are tightly controlled by the U.S. Government and are generally provided only for military use. The keys are changed on a daily basis. In spite of not having the P (Y) code encryption key, several high-end GPS receiver manufacturers have developed techniques for utilizing this signal (in a round-about manner) to increase accuracy and remove error caused by the ionosphere.
- L3 (1381.05MHz): Carries the signal for the GPS constellation's alternative role of detecting missile/rocket launches (supplementing Defense Support Program satellites), nuclear detonations, and other high-energy infrared events.
- L4 (1841.40MHz): Being studied for additional ionospheric correction.
- L5 (1176.45MHz): Proposed for use as a civilian safety-of-life signal.

6.1 GPS - 3

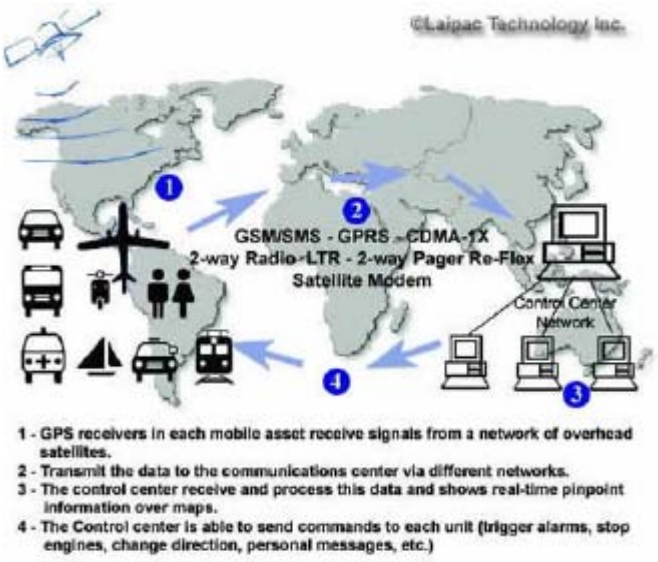
A GPS-3 gets its name as such because not only does this material do the work of a conventional GPS it consists of a microphone with a spy cam on it which helps in transmitting the surrounding or the target's voice (human) continuously to the receiving monitoring system. Also this GPS-3 has a camera which relays live coverage to the receiving system. The total control is placed only with the base station. The future of GPS-3 could be a part of THE NEW WORLD ORDER project, which involves a biometric chip.

6. Automatic Entity Location (AEL) System

The AEL tracking system consists of a GPS receiver inside the vehicle and a communications link between the entity and the control center as well as PC-based tracking software for dispatch. The AEL now continuously tracks the position of the target. In addition to the position identification the data received is now fed to a map which helps in the tracking of the target from the base station. The communication system is usually a cellular network similar to the one used by a cellular phone. Currently all kind of communications networks permit Real-Time Tracking for mobile assets. This AEL system not only provides tracking and route finder to target, a spy cam is provided which gives us live visuals which are studied from the base station. Also a microphone is embeded to it which helps us to make out what the target (human) is communicating.

7.1 GPS Segments

The GPS system is divided into three segments: space, control, and user. The space segment comprises the GPS satellite constellation. The control segment comprises ground stations around the world that are responsible for monitoring the flight paths of the GPS satellites, synchronizing the satellites' onboard atomic clocks, and uploading data for transmission by the satellites. The user segment consists of GPS receivers used for both military and civilian applications.



7. Conclusion

The AEL system is an advantage over the traditional Biometric system because in such a biometric system foreign material is injected inside the body which may cause harm. Added advantages like live relay and ability to hear the entity’s voice this system has a

remarkable edge over the latter system. Nowadays GPS receivers are becoming very economical. And that makes the technology accessible to virtually everyone. The GPS location data is stored on board of the GPS receiver. A receiving station can be a stationary receiver or a moving one. The monitoring system could be small mobile gadgets like laptops, handsets etc.

References

[1] http://www.gisdevelopment.net/technology/gps/techgp0048.ht
[2] Kelly J, Bogensberger E, Heitz S, Beckman K, Emery J, Rambo J, 2001, Development of the first Military GPS Handheld Survey System: Initial Report. Rockwell Collins Government Systems USA..
[3] Dennis Roddy, , “Satellite Communications”,McGraw Hill, Jan. 2006.
[4] http://www.landairsea.com/gps-tracking-blog/gps-tracking-military-applications/
[5] http://forums.military.com/eve/forums/a/tpc/f/65819558/m/3330059461001