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AEGPS (Accuracy Enhanced Global Positioning System) -Based on case study of Chopper-down of AP, CM Y.S.R.

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Abstract. Science has been saying 'jai-ho' all the times yet it fails to nature sometimes. One such case is the chopper down of Andhra Pradesh, chief minister, Y.S.Rajasekara reddy (2/09/2009).It took 16 hours before they could track down the chopper's along with the dead bodies after the crash in the deep forests of nallamala district. The question that arises is: In this world of Technology, what took these security officials 16 hours to track down a chopper? Couldn't they trace down the last appeared location via tracking device like GPS etc?? We would like to convey the answer in terms of the failure of the older GPS system which lacks in tracking dense forested areas, bad weather & other external disturbances. Who knows CM and others might have been injured for long time and died due to the delay in search? We are dealing this paper with a highly efficient global positioning system with accuracy enhancement named AEGPS. Certainly in cases like tracking dense forested areas, locating in a very bad weather circumstances, situations in which tracking made impossible by natural & artificial disturbances. We are also dealing with ineffectiveness of older system of GPS, AEGPS a challenger for atmospheric & multi path effects, ephermis & clock errors, man-made natural sources of interferences. AEGPS is having a better carrier phase tracking & advanced position calculation.

Keywords: AEGPS, GPS.

1. Introduction

Today's world is well known for its 'cutting-edge technology', improvisation has done almost all human & natural aspects. Mankind fails in analyzing the Mother Nature's volatility. We begin with the case study on what exactly happened on 02/09/2009 chopper down of Andhra Pradesh, chief minister, Y.S.Rajasekhar reddy. The helicopter (bell-430) for C.M is equipped with ELT (emergency locating transmitter), PRB (personal recovery beacon) & GPS. However, it took 16 hours before they could track down the chopper. They couldn't trace down the last appeared location even via tracking with GPS. We begin with the incidence then proceed with a overview on bell-430 helicopter then failure of older GPS system & well advanced AEGPS for better tracking in bad weather & other external disturbances.

2. Facts that Puzzle

Every helicopter, as per aviation sources, is equipped with High Frequency as well as Very High Frequency sets. When Crash happens, these sets might not function if the external antenna gets destroyed due to the impact of crash. But what puzzles me is that every helicopter is expected to have an Emergency Locating Transmitter (ELT) fixed to the body of aircraft, while the pilot is expected to carry a Personal Recovery Beacon (PRB). In the event of a Crash, Emergency Locating Transmitter (ELT) starts giving distress signals and the PRB, once activated, would start beaming the Global Positioning System (GPS) 'latlong' (latitude and longitude) details. However, it took 16 hours before they could track down the

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chopper. The question that arises is: In this world of Technology, what took these security officials 16 hours to track down a chopper? Couldn't they trace down the last appeared location via tracking device like GPS etc?? Leave aside that how about escort choppers, weren't they along with the CM's chopper? Of course searching a missing helicopter in the forest of Nallamala which is roughly 300 sq. km. was surely a daunting task indeed for the police and other search teams, who have scanned through the thick forest area. 16 hours in jungle? Even a healthy person can give up struggling to survive, leave aside the injured. Who knows CM and others might have been injured for long time and died due to the delay in search?? It is still unclear how the official machinery in the state remained clueless about the CM's whereabouts despite multiple communication methods, including satellite phones, mobiles, GPS and other sophisticated technology being available with the pilots

3. Ineffective Older GPS

3.1. Basic concept of GPS

The **Global Positioning System** (**GPS**) is a U.S. space-based global navigation satellite system. It provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth.

A GPS receiver calculates its position by precisely timing the signals sent by the GPS satellites high above the Earth. Each satellite continually transmits messages which include

- the time the message was sent
- precise orbital information (the ephemeris)
- The general system health and rough orbits of all GPS satellites (the almanac).

The receiver measures the transit time of each message and computes the distance to each satellite. Geometric trialateration is used to combine these distances with the satellites' locations to obtain the position of the receiver. This position is then displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units also show derived information such as direction and speed, calculated from position changes.

Three satellites might seem enough to solve for position, since space has three dimensions. However, even a very small clock error multiplied by the very large speed of light—the speed at which satellite signals propagate—results in a large positional error.

3.2. Challenges for basic GPS

Humidity & bad weather. Humidity also causes a variable delay, resulting in errors similar to ionospheric delay, but occurring in the troposphere. This effect both are more localized and changes more quickly than ionospheric effects, and is not frequency dependent. These traits make precise measurement and compensation of humidity errors more difficult than ionospheric effects.

Multi path effects. GPS signals can also be affected by multi path issues, where the radio signals reflect off surrounding terrain; buildings, canyon walls, hard ground, etc. These delayed signals can cause inaccuracy. A variety of techniques, most notably narrow correlater spacing, have been developed to mitigate multi path errors. For long delay multi path, the receiver itself can recognize the wayward signal and discard it.

Ephermis & clock errors. While the ephemeris data is transmitted every 30 seconds, the information itself may be up to two hours old. If a fast time to first fix (TTFF) is needed, it is possible to upload a valid ephemeris to a receiver, and in addition to setting the time, a position fix can be obtained in under ten seconds. It is feasible to put such ephemeris data on the web so it can be loaded into mobile GPS devices.

Natural & artificial sources of interferences. Since GPS signals at terrestrial receivers tend to be relatively weak, natural radio signals or scattering of the GPS signals can desensitize the receiver, making acquiring and tracking the satellite signals difficult or impossible. Space weather degrades GPS operation in two ways, direct interference by solar radio burst noise in the same frequency band or by scattering of the GPS radio signal in ionospheric irregularities referred to as scintillation**.**

4. AEGPS an Introduction

Based upon the investigation of above mentioned case, something keeps on telling me that there is something wrong in the older system of GPS. One specific reason behind this is U.S.A brought the GPS system to the world. The environmental & weather factors existing in America are completely different conditions prevailing in other parts of the world. USA designed GPS as America-user-friendly. So it might not work as effectively as it works USA. So, we propose AEGPS a newer system which is a debugged older system.

4.1. Characterics of AEGPS

The special characteristics of AEGPS includes (i) dense forest tracking, (ii) interfering bad weather for effective locating, (iii) advance position calculation, (iv) correction of a GPS's receiver clock ,(v) carrier phase tracking, (vi)selective ability, (vii)precise monitoring & augmentation.

4.2. System of AEGPS in Detail

The AEGPS consists of three major segments. These are the space segment (SS), a control segment (CS), and a user segment (US).

System segmentation of AEGPS.

(1) Space segmentation:

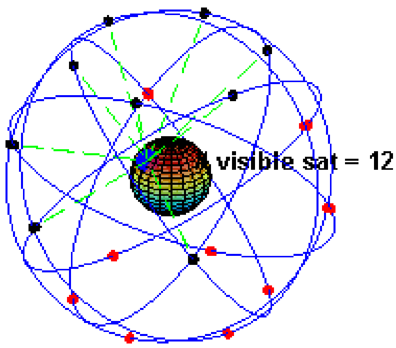

Fig. 1: Example

The space segment (SS) comprises the orbiting AEGPS satellites or Space Vehicles (SV) in GPS parlance. The GPS design originally called for 24 SVs, eight each in three circular orbital planes, but this was modified to six planes with four satellites each. The orbital planes are centered on the Earth, not rotating with respect to the distant stars.

(2) Control segment:

The tracking information is sent to the Air Force Space Command's master control station at Schriever Air Force Base in Colorado Springs, which is operated by the 2nd Space Operations Squadron (2 SOPS) of the United States Air Force (USAF).

(3) User segment:

GPS receivers come in a variety of formats, from devices integrated into cars, phones, and watches. In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly-stable clock (often a crystal oscillator).

5. Navigation Signals AEGPS

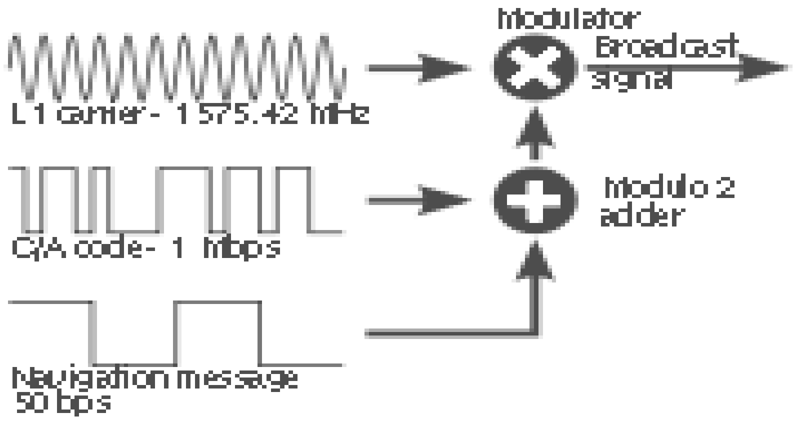

Fig. 2: Example

Each AEGPS satellite continuously broadcasts a *Navigation Message* at 50 bit/s giving the time-of-week, AEGPS week number and satellite health information (all transmitted in the first part of the message), an *ephemeris* (transmitted in the second part of the message) and an *almanac* (later part of the message). The messages are sent in frames, each taking 30 seconds to transmit 1500 bits.

Demodulation & decoding AEGPS. Demodulating and Decoding AEGPS Satellite Signals using the Coarse/Acquisition Gold code.

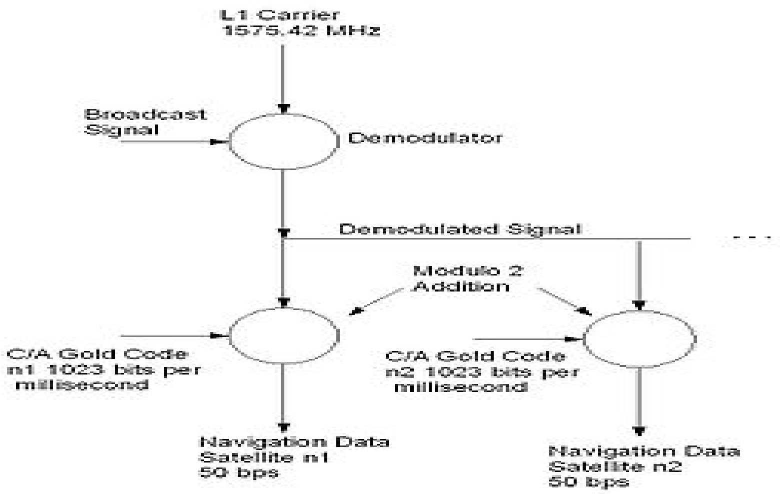

Fig. 3: Example

Position calculation introduction in AEGPS. Using messages received from a minimum of four visible satellites, a GPS receiver is able to determine the times sent and then the satellite positions corresponding to these times sent whatever the weather condition may be!. The x, y, and z components of position, and the time sent, are designated as $[x_i, y_i, z_i, t_i]$where the subscript *i* is the satellite number and has the value 1, 2, 3, or 4. Knowing the indicated time the message was receivedtr, the AEGPS receiver can compute the transit time of the message as $(tr-t_i)$. Assuming the message traveled at the speed of light, c, the distance traveled, p_i can be computed as $(tr-t_i)c$.

Position calculation advanced. Before providing a more mathematical description of position calculation, the introductory material on these topics is reviewed. To describe the basic concept of how a AEGPS receiver works, the errors are at first ignored. This should make it clear to the reader that the surfaces of the two spheres actually do intersect in a circle. Two sphere surfaces intersecting in a circle. The article, trilateration, shows mathematically how the equation for this circle of intersection is determined. A circle and sphere surface in most cases of practical interest intersects at two points, although it is conceivable that they could intersect in 0 or 1 point.

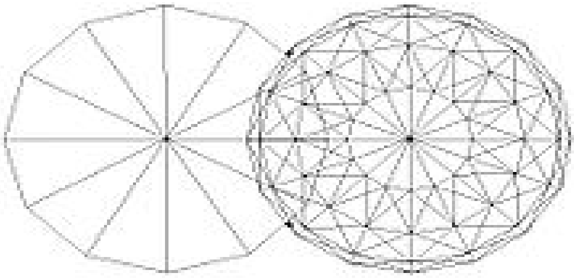

Fig. 4: Surface of a sphere intersecting a circle (i.e., the edge of a disk) at two points

This shows how position calculation is advanced in AEGPS using the concept spheres despite of the location (cases like dense forest).

Selective ability. AEGPS includes a (currently disabled) feature called *Selective Availability* (*SA*) that adds intentional, time varying errors of up to 100 meters (328 ft) to the publicly available navigation signals. This was intended to deny an enemy the use of civilian GPS receivers for precision weapon guidance. this system can handle the artificial and man-made disturbances and interferences to send the signals to the station at time.

Accuracy enhancement in AEGPS.

(1) Augmentation:

Augmentation methods of improving accuracy rely on external information being integrated into the calculation process. There are many such systems in place and they are generally named or described based on how the AEGPS sensor receives the information. Some systems transmit additional information about sources of error (such as clock drift, ephemeris, or ionospheric delay), others provide direct measurements of how much the signal was off in the past, while a third group provide additional navigational or vehicle information to be integrated in the calculation process.

(2) Precise monitoring:

The accuracy of a calculation can also be improved through precise monitoring and measuring of the existing AEGPS signals in additional or alternate ways.

A second form of precise monitoring is called *Carrier-Phase Enhancement* (CPGPS). By eliminating this source of error, CPGPS coupled with DGPS normally realizes between 20 and 30 centimeters (8 to 12 inches) of absolute accuracy.

6. Conclusion

Thus the newer AEGPS (accuracy enhanced global positioning system) is discussed with its all functions & its meritorious performance versus the older model of availing GPS system. These advancements can be checked with feasibility by the concerned authority and can be implemented as soon as possible in order to make sure that incidents like the above mentioned won't happen again. Not only for that particular purpose but also for ensuring an effective defense system to stay strong amidst of other countries.

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