



A COMPARATIVE ANALYSIS OF GLOBAL POSITIONING SYSTEM SCHEMES BASED ON BLOCK CODES

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Abstract:

Global Positioning System (GPS) is a satellite based positioning system based on radio ranging technique. The GPS will provide very accurate three-dimensional position, velocity and timing information to users anywhere in the world. GPS can also be used in other applications such as vehicle monitoring for traffic management in urban areas, Geographical Information System (GIS), 4G Communications, marine navigation, search and rescue and military applications. As GPS accuracy is limited by ionospheric effects, this course also covers the basics of ionosphere and its effects on GPS. Navigation is the art of directing a vehicle such as aircraft or a person from one point to another point. Some of the prominent advantages of the GPS are: Land based system problems like ground reflections, electromagnetic interference, reflections from physical systems are avoided in GPS since it is space constellation, Intentional interference like jamming, unintentional interference will not affect GPS since spread spectrum techniques are used in it, System accuracy can be improved to the order of centimeters using differential techniques, Smaller size and reduced cost of the GPS receiver enable it to be used in 3G Communication. In this paper, a literature review of existing GPS schemes based on block codes that mainly targets towards finding out the tolerance to signals from other GPS satellites sharing the same frequency band (multiple access capability), analyzing the tolerance to some level of multipath interference, there are many potential sources of multipath reflection (example man-made or natural object) and finding out the tolerance to reasonable levels of unintentional or intentional interference, jamming or spoofing by signal designed to mimic a GPS signal.

Key Words: Global Positioning System, Geographical Information System & Block codes and Frequency bands

1. Introduction:

In early days navigation was accomplished based on the movement of stars and the sun. As time progressed various instruments like the compass, the clock, the theodolite, the chronometer etc. came to the aid of the navigation. The radio navigation which makes use of electromagnetic waves in fixing the position of an aircraft has an accuracy far superior compared to the earlier navigational methods such as Navigation by pilotage, Celestial navigation, Navigation by dead reckoning etc. VOR, ILS, MLS, LORAN, OMEGA and DECCA are some of the radio navigation system used (Nagaraja, 1982). Transit is the first satellite based navigation system. It has six low orbiting satellites and works on Doppler principles. Some of the limitations of this system are: a fix can only be made in two dimensional interval between fixing positions is very long and about 1.5 hours on an average. However, this system was discontinued in 1996. In the tenth air Navigation Conference that was held in 1991, International Civil Aviation Organization (ICAO) established a special committee on future Air Navigation System (FANS) to look after the development of satellite Aided Communication Navigation and Surveillance (SACNS) system.

The present CNS system suffers from propagation limitations of current line of sight system and /or accuracy and reliability limitations imposed by the variability of propagation characteristics of other system, compatibility between CNS system in different parts of the world, lack of digital air ground data interchange. The new system should be such that; it will have universal accessibility to air navigation safety communications from harmful interference to realize these objectives effectively Global Positioning System (GPS) is needed. Currently, only two satellite navigation systems are operating worldwide [1]. In 1973, the US Dept. of Defence decided to establish, develop, test, acquire and deploy a space borne Global Positioning System (GPS), The result of this decision is the present NAVSTAR GPS (Navigation Satellite Timing And Ranging Global Positioning System) (Hoffman, 1992). The GPS is proved to be all- weather, space-based navigation system. The primary goal for developing the GPS was of military nature. The multipurpose usage of NAVSTAR GPS has developed enormously within the last three decades. With the elimination of SA (Selective Availability) on May 2nd, 2000, the usefulness of the system for civilian users was even more pronounced. The GPS satellites provide a platform for radio transmitter, atomic clocks, computers and various equipment used for positioning and for a series of other military projects (e.g., atomic flash detection) (Parkinson, 1996). Today a full constellation of at least 24 satellites is available (30 satellites in July, 2009).

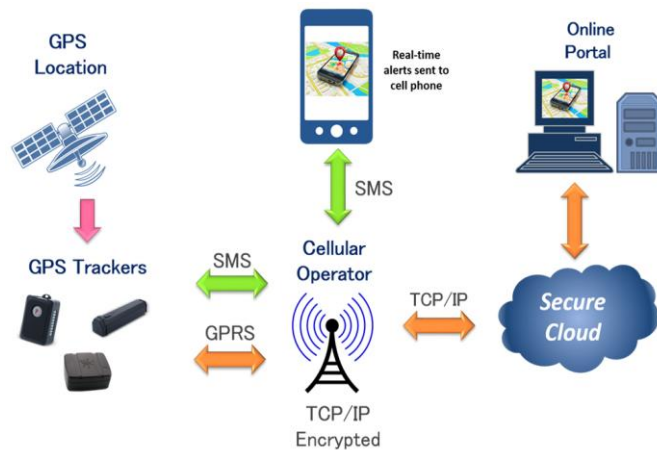


Figure 1: Illustration of application of a Global Positioning System

2. Literature Review and Analysis:

In this section, a literature review of existing GPS schemes based on block codes that mainly targets towards finding out the tolerance to signals from other GPS satellites sharing the same frequency band (multiple access capability), analyzing the tolerance to some level of multipath interference, there are many potential sources of multipath reflection (example man-made or natural object) and finding out the tolerance to reasonable levels of unintentional or intentional interference, jamming, etc., [5-9].

2.1 Background:

2.1.1 Visual Attention:

Tens of millions of years of organic evolution have made our vision system both difficult and powerful. The number one purpose at the back of this effectiveness is that human beings pay near interest best to areas of pastimes in their discipline of view. Deploying targeted analysis to a small place one at a time and swiftly switching to other areas offers the experience of rich scene expertise and consequences in a slow update of the knowledge approximately one's environment [10]. Whilst human beings perform their normal sports inclusive of on foot, using, or playing, they do no longer need to understand or see the whole lot. Best the items which can be related to their modern-day sports are most vital. Getting to them one-by using-one and decoding their family members to the scene subsequently gives sufficient data approximately the surroundings. Visible interest is widely categorized as backside-Up and top-Down [11] interests that are mentioned in subsequent sections. Consistent with [12], unbiased and interacting mind areas exist which are chargeable for those two types of attention mechanisms.

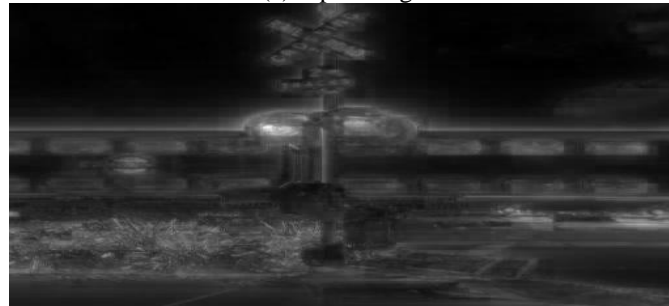
2.1.2 Bottom-Up Attention:

The elements of bottom-up interest are directly associated with scene contents and impartial of the observer's internal mental country. The bottom-up elements seek advice from photo conspicuity, and encompass image functions consisting of robust brightness or shade comparison. Photograph conspicuities may be notion of as regions with conspicuously extraordinary residences than their respective surroundings, this is, regions that put themselves in evidence. Photograph regions having such properties are going to attract an observer's attention obviously and are called salient areas. For instance, if there is massive tree inside the middle of a desert then the tree is salient and has high ability of attracting the observer's attention. Further, the overall moon over a clean night sky is also fantastically salient. There exists one of a kind computational tactics that try to mimic such biological behavior so that it will rank the level of conspicuousness of different areas in a scene.

The most conspicuous vicinity is thought to be at the point of interest of attention and a mechanism referred to as selective attention guides the order wherein the conspicuous areas are attended. One thrilling trouble approximately bottom-up interest is that a highly salient area cannot be suppressed voluntarily [13] even if the observer is driven by using a few different desires. This effect is known as attention capture. As an instance, if an observer is looking for the Andromeda galaxy on a clear night time sky with a complete moon, it isn't always feasible for the observer to completely ignore the moon. The lowest-up factors which are taken into consideration on this work can be discussed in later sections. Parent 1 indicates an example of bottom-up map computed by Firetrap's machine [4]. Figure 2(a) shows an enter photo that carries few substantial items consisting of the visitors lighting and gate, signs and symptoms pronouncing Railroad Crossing, and teach windows. All exciting gadgets found with the aid of Frintrop's system are shown in figure 2(b) in which the extent of brightness corresponds to the extent of saliency. It can be discovered that elements of the site visitors lighting fixtures and the traffic signs that are laid on a simple light-blue location (sky), the train windows, the monogram of Caltrain, and the pink sections of the traffic gate get hold of better saliency. Then again, the obvious sky and other uniformly textured regions get hold of decrease saliency (depicted via darker sun shades). Something that's substantially different from its surroundings has been diagnosed by way of Firetrap's system.



(a) Input image



(b) Bottom-up saliency map

Figure 2(a): An input image and 2(b) bottom-up saliency map computed by Frintrop's system

2.1.3 Top-Down Attention:

Unlike bottom-up interest that is derived from scene contents, pinnacle-down attention is motivated through the current intellectual nation of the observer. The mental country encompasses elements consisting of contemporary goal, context of the modern state of affairs, and expectation. The results of these factors come from better mind areas and are encouraged by means of the observer's knowledge [12]. As an example, an observer driving an automobile is better prepared to identify prevent signs and symptoms or site visitors lighting than different passengers who generally don't pay that a great deal attention to the road. There could be other salient areas within the driver's discipline of view but the areas containing traffic symptoms will attract greater attention and similarly analysis can be deployed on the ones areas, to be able to cause eventual cognizance of secure car navigation. The complexity of the using forces of top-down attention consisting of expectation, expertise, and context continue to be the principle limitations to a higher understanding of top-down attention; on account that very little is understood about those aforementioned elements. Consequently it's far difficult to version these using elements and their interactions, which could be beneficial in practical packages. In [4], a top-down version is defined that allows you to be verified. In this model, Frintrop combines the lowest-up functions to compute a pinnacle-down interest map.

Specific weights are assigned to each bottom-up functions; wherein the weights are subjected to a getting to know mechanism. The subsequent subsections present diverse metrics, which includes moments, invariants, and texture classifiers, that have been proposed within the literature as potential manner to encode the observer's knowledge and to guide top-down interest. Those metrics are defined right here as they'll assist the experimental investigation conducted within the following chapters.

2.1.3.1 Definitions:

Picture moments play an essential role in classical image processing strategies. They discover programs as shape or texture descriptors, and for individual popularity, among others. A comprehensive remedy in this concern can be discovered in [14]. Moments are typically defined well for continuous features but their respective discrete variations exist as nicely. Geometric moments are probably the maximum famous moments. Calculating extraordinary photograph properties together with center of mass of a shape or the feel of a picture the use of geometric moments is trivial. As an instance, m_{00} is the mass and $(m_{10}/m_{00}, m_{01}/m_{00})$ represents the middle of gravity or centroid.

2.1.3.2 Moment Invariance:

Minute invariants are an arrangement of numerical formulae which stay consistent for a specific example regardless of the possibility that the example experiences a few changes to which it is invariant. The change can be any essential change (interpretation, revolution and uniform scaling) or a blend of such fundamental changes, uniform difference change or relative change contingent upon the invariants being utilized. For instance, the greatness of complex minutes are revolution invariant which implies that for a specific example, the estimation existing apart from everything else invariants are the same regardless of the possibility that the example goes under rotational change. Translational invariance can be acquired by making an interpretation of the premise capacity to

the centroid and such minutes are known as focal minutes. To acquire scaling invariance, focal minutes must be partitioned by a normalizing component which is generally energy of another comparable snapshot of low request (e.g. (0, 0)). Also, invariance to uniform differentiation change can be accomplished yet the standardization figure must be of various requests than the one utilized for scale invariance.

2.1.3.3 Hu Invariants:

In 1962, Hu determined seven minute invariants in view of geometric minutes that are invariant under Euclidean change (interpretation, pivot, uniform scaling) [15]. The last one among them switches sign under mirror change and consequently can be abused to decide whether a build is mirror 10 reflected. Hu invariants utilize minutes up to the third request and his unique work does not give headings on the most proficient method to get invariants from higher request minutes. It can be seen that the invariants rely on standardized focal minutes; in this way making them effectively invariant to interpretation and uniform scaling. Rotational invariance is accomplished by the particular numerical operations as delineated in the conditions. Hu invariants have been effectively utilized as a part of numerous pragmatic applications since they can fill in as a shape descriptor. In this work, Hu invariants are additionally utilized as a shape descriptor. A Hu shape descriptor is a seven dimensional vector that depicts a discretionary shape where the segments of the vector originated from the seven invariants.

2.1.3.4 Legendre Moments:

Minutes when all is said in done are numerically insecure because of huge examples and various increase, division and summation operations including genuine numbers. Thus, utilizing minute based methodologies can be dubious and one must be extremely watchful at how it is actualized in programming. Legendre minutes in this regard (in any event) are more attractive since they are figured utilizing Legendre polynomials which are numerically all around acted. Legendre polynomials are orthogonal to each other on [-1, +1] and subsequently considered to hold ideal grouping capacities. Rotational invariance utilizing Legendre minutes is however hard to accomplish yet the likelihood is exhibited in [16]; which likewise proposes a system to figure relative invariant Legendre minutes. In spite of the fact that picture minutes are principally utilized on pictures, they can likewise be connected on any self-assertive capacity to uncover its inward structure and shape properties and along these lines help in speaking to discretionary capacities minimally. Such minimal portrayals help in accomplishing productive execution also. In this regard abusing one dimensional Legendre minutes can be favorable. P(x) is the Legendre polynomial which is characterized in equation below.

$$L(n) = \int_{-1}^{+1} P_n(x) f(x) dx$$

$$L(m, n) = \int_{-1}^{+1} \int_{-1}^{+1} P_n(x) P_m(y) f(x, y) dx dy$$

$$P_n(x) = \frac{1}{2^n n!} \frac{d^n}{dx^n} (x^2 - 1)^n$$

$$(n + 1)P_{n+1}(x) = (2n + 1)xP_n(x) - nP_{n-1}(x)$$

The capacity on which Legendre minutes are being registered can be subjective and it can be spoken to minimalistically by taking a modest number (e.g., for n having a place with the range [0, 15]) of minute qualities. This is especially valuable to speak to histograms which can be substantial in size (normally 256 for 8-bit dark scale pictures and 768 for three-channel shading pictures).

2.1.4 Local Binary Pattern:

Neighborhood double examples (LBP) were appeared to be powerful for surface arrangement in [17]. The calculation of LBP is basic and quick. A 3x3 window is considered which slides over the information picture and registers an esteem related with the inside pixel of the window. The neighbors of the inside pixels (there are 8 such neighbors) are doled out, in view of their individual position, to a whole number weight number which is energy of two. Note that the allotted weights must be indistinguishable for every single conceivable position of the sliding window. Figure 3(a) demonstrates a conceivable task of weights. It can be watched that the weights frame a 8-bit number and their aggregate is 255. As indicated by number hypothesis, any number in the range [0, 255] can be shaped utilizing different blends of the weights. Next, the power of the middle pixel is contrasted with that of each of its neighbors. In the event that any neighbor's power is higher than that of the inside pixel, then the related weight of that neighbor is added to the LBP estimation of the middle pixel (which is zero at first). Figure 3(b and c) demonstrate two specimen windows where the inside pixels have forces of 20 and 23 individually. Their comparing LBP esteem is appeared in the inscription.

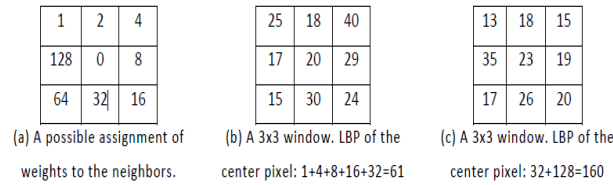


Figure 3(a): Weight assignment of neighbors, (b) and (c) example windows and their respective LBP value according to the weight assignment

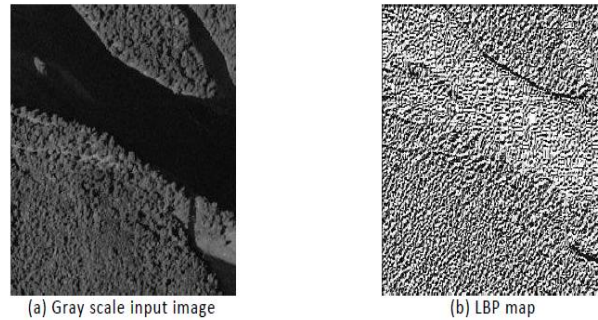


Figure 4: Local Binary Pattern (LBP) map of a gray scale image

Pixels whose individual neighbors have comparable power setup will have indistinguishable LBP values. At the point when calculation for all pixels is finished, a few systems can be connected to separate surfaces. Outwardly comparable surface will tend to have comparable LBP values and their factual properties will be equivalent. For instance, two comparative however unique surfaces will have comparative LBP histogram. Figure 4 demonstrates a shading picture and its dark scale form on which the comparing LBP guide is registered. In the first picture the woodland and the waterway are prevailing. The comparing neighborhood parallel examples are additionally recognizable.

2.1.5 Early Age of Attention Models:

Mankind has for some time been endeavoring to better clarify and comprehend itself, beginning from human science to human brain science. A wide assortment of psychophysical models on visual consideration in this way exists in the writing. A depiction of Treisman and Gelade's model [1] which is called "highlight reconciliation hypothesis" is exhibited in the following subsection which is trailed by a concise review of the advancement incline in the territory of visual consideration, alongside other outstanding works applicable to this endeavor.

2.1.5.1 Feature Integration Theory:

Treisman's Feature Integration Theory (FIT) is a standout amongst the most well-known and broadly utilized visual consideration models. It initially showed up in 1980 [1] and has been subjected to adjustment. A large number of the methodologies archived in the field of visual consideration are really subordinates of this model. In Treisman's work it was guaranteed that in an early phase of human visual discernment, distinctive elements are naturally enlisted in parallel and acknowledgment happens at a later stage with centered consideration. The components are joined in a guide that shows where the articles are found. This guide is known as the saliency outline. The last highlights distinctive locales of a scene as indicated by their level of conspicuity.

2.1.5.2 Development Trend of Computational Attention Systems:

Treisman's FIT was for the most part of hypothetical intrigue however filled in as the reason for more propelled research. Koch and Ullman first presented computational approach of visual consideration in their work [2]. In spite of the fact that it was not actualized around then, their system roused some consideration models. One of the soonest usage of computational consideration frameworks was created by Milanese [8]. This execution depended on the model of Koch and Ullman and utilizations traditional picture preparing devices, for example, channel operations and edge discovery for highlight outline. The framework depends on elements, for example, rival hues, arranged edges, and force varieties.

The Neuromorphic Vision Toolkit (NVT) [3], which was later concocted by Itti et al., is a standout amongst the most well-known consideration frameworks and depends on Koch-Ullman's model [2]. Itti's framework was at first created as a base up consideration framework however was later reached out to fuse best down consideration too. The underlying framework utilizes power, introduction and shading as the base up components to figure the last saliency delineate. It produces comes about that are cognizant with human consideration. Afterward, Frintrop contrived another visual consideration framework, VOCUS, [4] that conveyed a few changes to Itti's approach. VOCUS considers both the base up and the top-down consideration alongside a learning instrument. This structure assumes a noteworthy part in the work depicted in this proposition.

2.1.5.3 Data Complexity and Testing Scenarios:

The vast majority of the proposed computational arrangements found in the writing have been tried principally on indoor scenes or for a predetermined number of pictures. In addition, by and large-tried pictures are shortsighted in nature with their substance restricted to a solitary protest appeared over a basic uniform foundation. It is just in the current years that consideration based computational frameworks begun to be contemplated in viable applications which presented the requirement for managing genuine information. In this unique situation, Frintrop and Jensfelt utilize a meager arrangement of historic points in light of a naturally consideration based component choice system and dynamic look control to accomplish synchronous limitation and mapping of a robot flowing in an office domain and in a chamber zone. In a comparable way, Siagian and Itti utilize remarkable elements gotten from consideration together with setting data to construct a framework for portable automated applications that can separate outside scenes from different destinations on grounds and for confinement of a robot. Rasolzadeh et al., proposed a stereoscopic vision framework structure that distinguishes consideration based components that are then used for automated question getting a handle on. Rotenstein et al., proposed the utilization of components of visual regard for be incorporated in a keen wheelchair for handicapped youngsters and to help with visual hunt undertakings.

2.2 Frintrop's Bottom-Up Saliency:

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2.2.1 Feature Selection:

Among a few base up components proposed in the writing, force, introduction and shading are the most mainstream, to a great extent because of the impact of natural and mental research works. There are likewise various base up components, aside from previously mentioned ones, which are investigated and detailed in the writing, these incorporate entropy, unpredictability, ovals, symmetry, ebb and flow, and optical stream. When all is said in done the bigger the quantity of considered elements, the more exact the framework should be. A few elements are inalienably muddled to manage, for example, movement which includes protest elements. Then again, power, introduction and shading stay more straightforward and productive to register, which additionally clarifies their notoriety. The force highlight includes the calculation of differentiation in various areas of the picture. There are two variations motivated by science, in particular on-focus and off kilter. On-focus retinal Ganglion cells fire when a cell gets brighter light than its environment, and the other way around for the unbalanced situation. The higher the light complexity the more grounded the terminating reaction. The introduction includes, then again, is committed to introduction of edges present in a scene. Certain introductions of edges, for example, vertical and flat edges, are known to react more grounded than others in the human vision framework. The shading highlight likewise assumes a vital part in base up consideration. In the visual field, shading is spoken to as far as redness-greenness and yellowness-blueness. Subtle elements on the calculation of each component utilized as a part of Frintrop's framework are given in resulting areas.

3. Conclusion:

The GPS system does not require the user to transmit any data, and it operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. The GPS system provides critical positioning capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver. In this paper, a literature review of existing GPS schemes based on block codes that mainly targets towards finding out the tolerance to signals from other GPS satellites sharing the same frequency band, analyzing the tolerance to some level of multipath interference, there are many potential sources of multipath reflection and finding out the tolerance to reasonable levels of unintentional or intentional interference, etc.

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