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Real time Processing of Global Positioning System Data Using Digital Signal Processing Techniques

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Abstract: The Global positioning system (GPS) accuracy can also be affected by a variety of inherent error sources such as satellite TV for pc errors, receiver clock blunders and orbital mistakes etc. In this paper digital signal processing methods such as awful statistics identification and change (BDIM) approach and Kalman filter has been used to beautify the accuracy of GPS altitude. In this paper, the Kalman filter after BDIM substantially decreased the blunders in GPS measurements

Keywords: Global positioning device (GPS), Kalman filter, Recursive filter, terrible records identification and modification approach (BDIM).

1. Introduction

The NAVSTAR Global positioning gadget (GPS) used in global presents function records at any point at any time, somewhere on earth in the form of longitude, latitude, and altitude. It was first designed and operated via the U.S. Department of Defense [1]. Twenty-nine satellites revolve round the earth each 12 hours at 12 miles away from the earth, consequently overlaying the higher location of the earth. To evaluate the user's role via the usage of the distance, the receiver wished at least 4 satellites. It requires very clear environment for appropriate accuracy. Each satellite TV for pc revolves around the earth by means of one time in 12 hours. The GPS gadget precisely measures the unknown place of a user on earth the use of the integral principle of trilateration [2]. The GPS satellites are placed in such a way that at least 5 to eight satellites are accessible at any factor on earth at any time. Basically, GPS works in three segments- space segment, the control segment, and user segment. The space segment consists of satellites which broadcast signals, user phase consists of special GPS receivers and manipulate segments consists of the grasp manipulate station, base manage station, and floor antennas.

While 5 base station in the manage segment sends facts to the grasp manipulate station, the place grasp manage station corrects the information and send it back to satellites through floor antennas [3]. The accuracy of GPS receiver is affected due to a range of inherent error sources. These error

sources are multipath interference, person mistakes, satellite TV for pc and receiver clock errors, orbit errors, satellite TV for pc geometry, atmospheric interference [4]. Sometimes atmospheric phenomena, clouds and other barriers like mountains or buildings also produce errors. These blunders can be reduced to arrive at a extra correct estimate of coordinates of the person [5]. In the paper, BDIM and Kalman filter DSP techniques have been used to system GPS altitude, the handheld GPS receiver has been used at ground level gives altitude above sea level.

2. DSP Techniques:

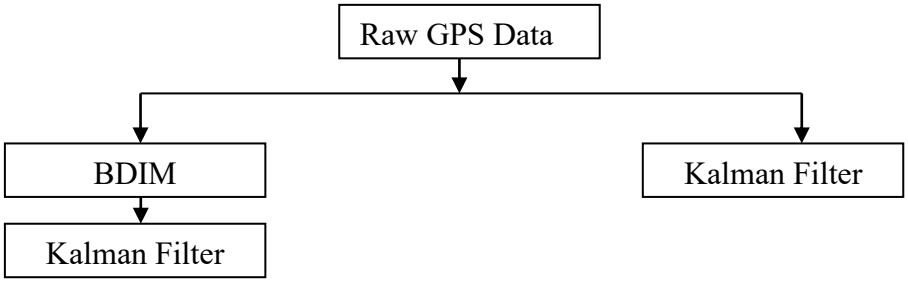

Fig. 1: DSP Techniques used to Process GPS Raw Data

The a number of techniques that have been used are BDIM and Kalman Filter. Figure 1 suggests DSP methods used to manner GPS statistics in real time.

2.1 BDIM:

The presence of terrible facts might be due to temporary loss of satellites, sign reflections ambient noise might also degrade GPS accuracy. Thus in order to improve accuracy, it is vital to do away with the awful data. Bad data is identified via figuring out information which differ suggest price of altitude via preset tolerance price (k*σ) [5][12]. Where σ: general deviation values of z as measured in a shifting window of width T. The awful information has been both changed through the window mean. In present utility value of okay is taken as 1 to acquire proper rejection rate. The fee of T has been chosen using quite a few trials to obtain great results.

2. 2 Kalman filter:

Kalman filter is a mathematical toolbox which solves the hassle by the use of mathematical equations. Its primary intention is to produce outcomes that tend to be nearer to the real values taken from the discovered dimension that includes noise. It is an choicest recursive filter, ultimate in a experience it minimizes the estimated error covariance and is recursive as it does no longer require to keep all the previous values to estimate the next stage, but it wishes just preceding value at (k-1) time instantaneous to estimate the present day fee at okay time instantaneous in contrast to different estimation methods [5-6]. Kalman filter is a studying tool. [7]. Kalman filter can be taught using a easy derivation involving scalar mathematics, simple algebraic manipulations and handy to follow to thought experiment [8]. Kalman filter solves the problem with the aid of using a stochastic difference equation:

$$X_k = AX_{k-1} + Bu_k + W_{k-1} \quad \text{……..} \ (1)$$

Kalman filter works in a cycle of two awesome phases: additionally known as prediction step is accountable for projecting forward the previous prior estimation price to acquire an estimation of prior modern-day country and dimension replace also known as correction step is responsible to gain a posterior estimate. In dimension replace phase, the modern-day prior prediction is blended

with present day commentary data to refine the state estimate. This multiplied estimate is termed as a posterior nation estimate. This segment works in three steps the first task is to compute Kalman gain, secondly replace the nation estimated value and then compute the posterior estimated price of the state. At the completion of every cycle, the new posterior cost is taken as the previous estimated prior cost for estimation of contemporary prior cost in the subsequent cycle [9-11]. The manner is repeated once more and again with the nation estimated at the previous time instant. It affords an estimation of nation error covariance recursively. Kalman filter is a minimum mean square error evaluator. The posterior nation estimator error price is evaluated by:

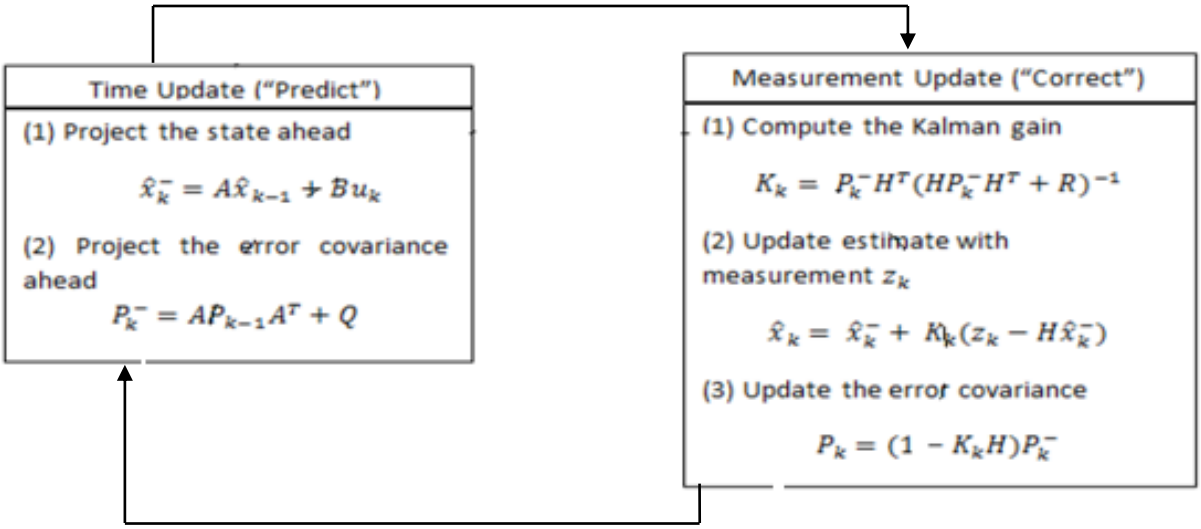

Fig. 2: Time and Measurement Update Equations

Where $\hat{x}_k^-$, prior estimated state at k time instant; A = Matrix that relates the nation at the preceding time step to the state at the cutting-edge step in the absence of method noise; B = Optional manage input „u" to the country x; U = Control input; P = Error covariance; Q = Process noise covariance; K = Kalman filter; R = Measurement noise covariance; H = Matrix that relates kingdom to the measurement; Both the estimation error covariance and the Kalman reap will stabilize shortly and then remain constant. In the existing application, the following parameters are viewed to acquire better results. As kingdom does not change from step to step so A is taken as 1. U is taken as zero as there is no manage input [6]; Q has been assumed as 0.00001 as assuming a small however non-zero price offers us extra flexibility in "tuning" the filter as we will [10]. In this work, the value of P is chosen such that error covariance converges. Thus P =1 is considered.

3. Data collection:

GPS records has been collected at the floor level of Hostel-I, Dhanalakshmi Srinivasan Institute of Technology (India) for 250 seconds. Also, the proper altitude of the given location has been taken in accordance to the survey of India [13] which is used as the standard reference for the estimation of error in raw GPS altitude, measurements. GPS receiver BT359 relays statistics to a laptop computer by using a Bluetooth hyperlink the use of NMEA 0183 protocol [14]. GPS information logger software technique output of GPS receiver to provide 3-d role in shape of longitude, latitude, and altitude as shown in Figure 3

Fig. 3: Logging of GPS Data

4. Results and Discussion:

4.1 Observed GPS measurement:

The figure 4 shows the actual altitude and observed GPS altitude measurement:

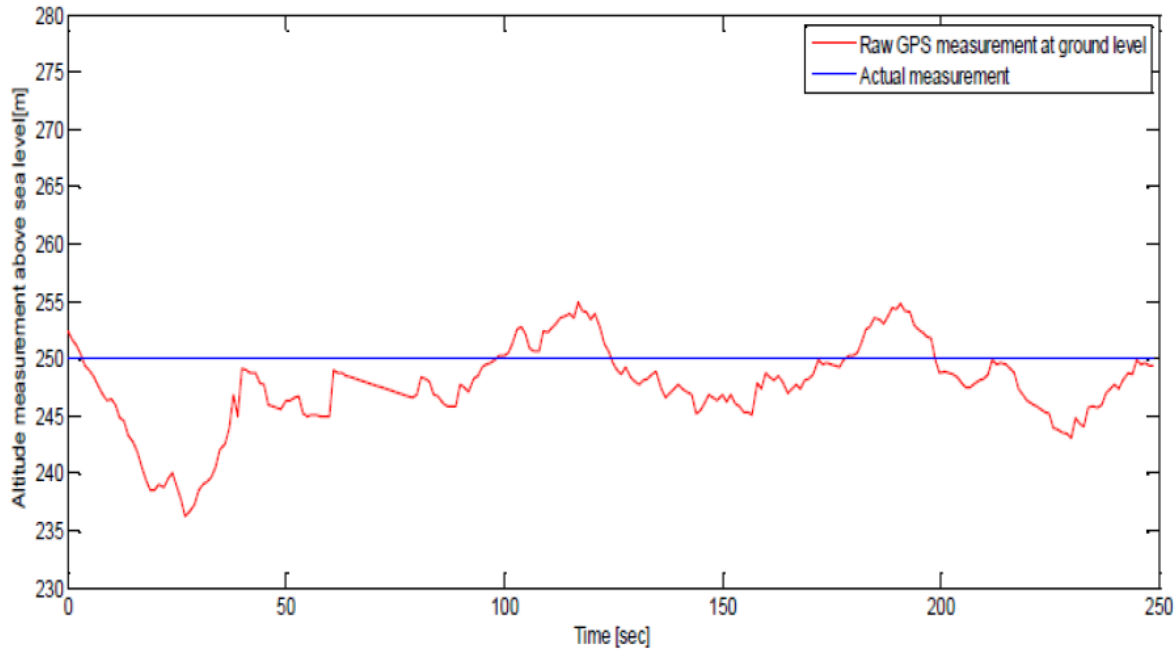

Fig. 4: Comparison of raw and actual GPS height

It has been observed that the GPS altitude size suggests an error of 13.8m, which is now not shut to the true altitude. It is due to the fact of some inherent sources of error in GPS measurements. These error sources are likely to be affected by a range of elements such as satellite geometry in the course of the time of the test, changing ambient weather prerequisites etc. Inaccuracies in GPS altitude measurements for the duration of subject take a look at can also be due to uncooked GPS altitude size has been processed the use of the combination of Kalman filter and Kalman filter after BDIM.

4.2 Processing of GPS measurement:

Use of Kalman filter appreciably reduces the GPS receiver error from 13.8 m to 5.2788 m. Thus enhance the GPS accuracy by way of 8.5212 m.

Using Kalman filter

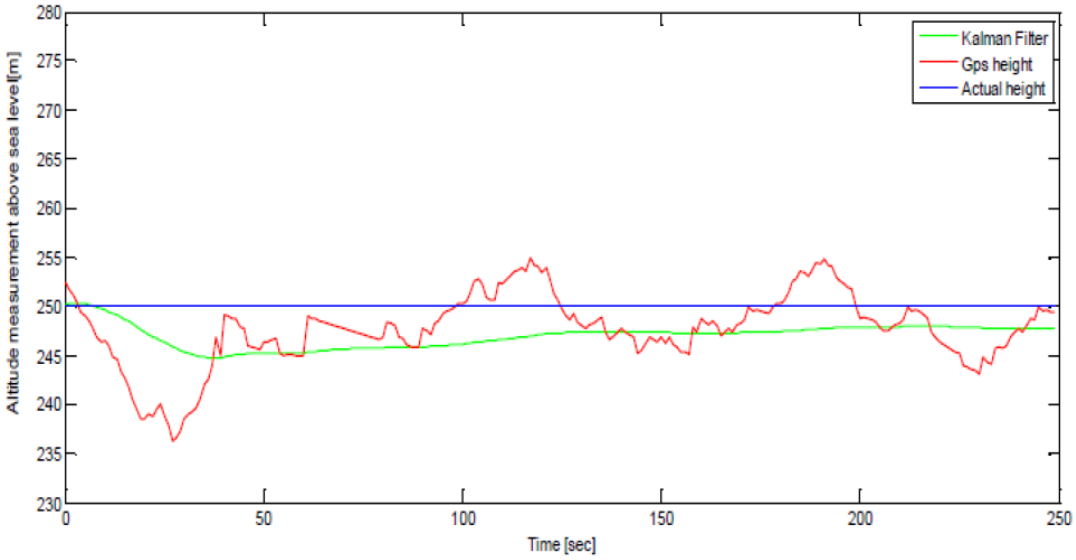

Fig. 5: Estimate of GPS measurements by Kalman Filter

Using Kalman filter after BDIM

Kalman filter after BDIM has been proven to remove the GPS error up to large extent.

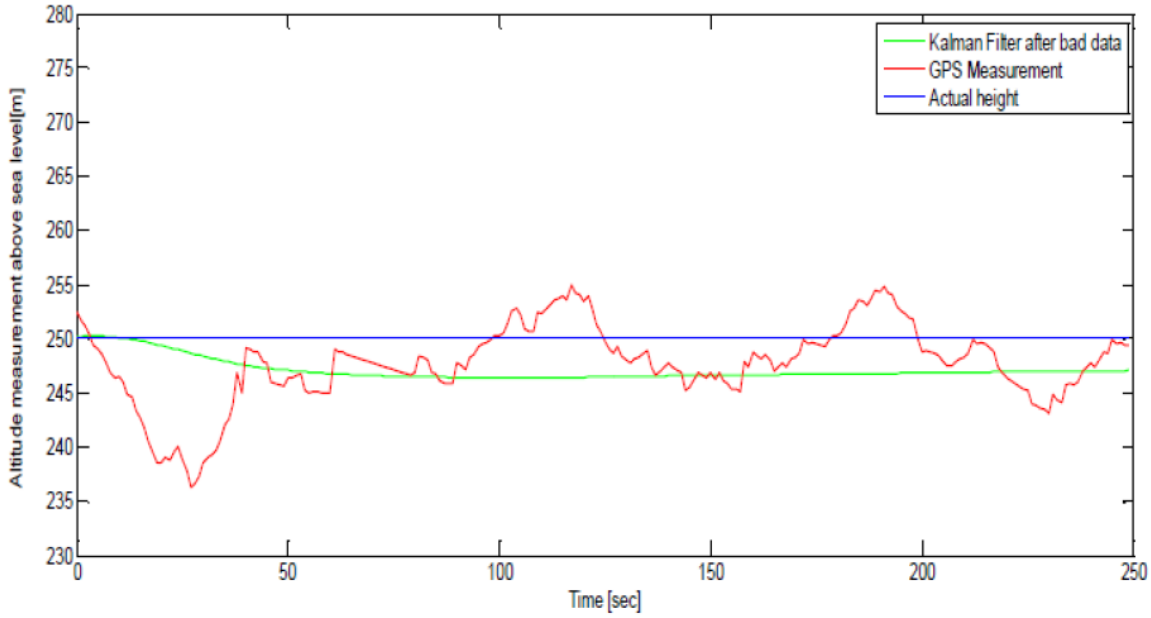

Fig. 6: Estimate of GPS measurements by Kalman filter after BDIM

5. Conclusion:

GPS receiver BT359 has been used for facts collection at the floor stage of the Hostel-I, Dhanalakshmi Srinivasan Institute of Technology (India). It has been concluded that Kalman filter after BDIM gives higher consequences as in contrast to Kalman filter. Thus Kalman after BDIM drastically reduces error from 13.8m to 3.6420m. The GPS receiver may also be the least expensive device for overhead conductor sag measurement in power transmission lines.

References

[1] Farid, Zahid, Rosdiadee Nordin, and Mahamod Ismail. "Recent advances in wireless indoor localization techniques and system." Journal of Computer Networks and Communications 2013 (2013).
[2] Li, Huan, et al. "A novel algorithm for the weak GPS signals acquisition." the 2nd International Conference on Computer Application and System Modeling. 2012.
[3] Heng, Liang, et al. "Reliable GPS-based timing for power systems: A multi-layered multi-receiver architecture." Power and Energy Conference at Illinois (PECI), 2014. IEEE, 2014.
[4] Zheng, Sophia. Signal acquisition and tracking for a software GPS receiver. Diss. Virginia Tech, 2005.
[5] Komaragiri, Shalini Sushmitha, and Satish M. Mahajan. "A sag monitoring device based on a cluster of code based GPS receivers." Power & Energy Society General Meeting, 2009. PES'09. IEEE. IEEE, 2009.
[6] Gotzig, Heinrich, and Georg Geduld. "Automotive LIDAR." Handbook of Driver Assistance Systems: Basic Information, Components and Systems for Active Safety and Comfort (2014): 1-20.
[7] Kalman, Rudolph Emil. "A new approach to linear filtering and prediction problems." Journal of basic Engineering 82.1 (1960): 35-45.
[8] Faragher, Ramsey. "Understanding the basis of the Kalman filter via a simple and intuitive derivation." IEEE Signal processing magazine 29.5 (2012): 128-132.
[9] Wu, Jian-feng, et al. "The study of GPS Time Transfer based on extended Kalman filter." European Frequency and Time Forum & International Frequency Control Symposium (EFTF/IFC), 2013 Joint. IEEE, 2013.
[10] Bishop, Gary, and Greg Welch. "An introduction to the Kalman filter." Proc of SIGGRAPH, Course 8.27599-3175 (2001): 59.
[11] Kleinbauer, Rachel. "Kalman filtering implementation with Matlab." (2004).
[12] Mensah-Bonsu, Chris. "Instrumentation and measurement of overhead conductor sag using the differential global positioning satellite system." (2001): 3209-3209.
[13] Choudhury, Pranab Ranjan, Marcello De Maria, and Laura Meggiolaro. "Strengthening GIS standards to improve monitoring of land indicators for SDGs: Using India as a use case." World Bank Land and Poverrt Conference, Washington DC. 2018.
[14] Pei, Ling, et al. "Indoor/outdoor seamless positioning technologies integrated on smart phone." Advances in Satellite and Space Communications, 2009. SPACOMM 2009. First International Conference on. IEEE, 2009.