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A Study on SOFTWARE RECEIVER FOR GPS SIGNAL

[1] Madhu Dilip Potadar, [2] Dr. P C Srikanth
[1] PG Scholar, [2] Professor
Dept. of ECE, Malnad college of Engineering Hassan, India

Abstract: **- Today Navigation depends on the Satellite Navigation Systems which covers the entire globe there are so many Global Navigation Satellite System (GNSS), United States has GPS, Russia has GLONASS, European has Galileo, China uses Bei-Dou navigation System, and India uses IRNSS. In this paper, we would like to discuss Universal receiver which supports different satellite Navigation system here signal from the satellite is RF signal convert to digital and further processing will be done in digital domain which permits the true software receiver for a navigation satellite system.**

Keywords: **- GNSS, GPS, GLONASS, IRNSS.**

I. INTRODUCTION

In the mid-1970s, a few U.S. government associations, including the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and the Department of Transportation (DOT) [4], interested in creating satellite system for three-dimensional position assurance. Global navigation satellite systems (GNSSs) are the most recent of the fully operational radio navigation systems. The two primary systems currently in operation are the United States' Global Positioning System (GPS) and the Russian Global Orbiting Navigation Satellite System (GLONASS) [4]. Albeit both are generally new, GPS is the more well known of the two and it played the role of determining relative and absolute position, speed, and time for both regular citizen and military fields.

GPS configuration involves three segments are known as the Space Segment and the Control Segment and user segment. GPS is a satellite-based system that uses a constellation of 24 satellites and they are arranged on six orbital planes and each plane contains four satellites. The inclination of the angles of the planes towards the equator is 55° and these planes are turned by 60° against each other [2] .The GPS signals is a blend of three principle parts namely the carrier frequency, navigation data and the spreading sequence. GPS signals are modulated signals, which contain two frequencies components, i.e. L1=1575.42 MHz, L2 = 1227.60 MHz and driven by a common atomic clock of 10.23MHz [2]. Software GPS receiver is flexible, easily reconfigurable and the new algorithm can be easily implemented no need to replace the hardware components again and again.

II. SOFTWARE GPS RECEIVER

Software Receiver comprises of Hardware and programming parts. Hardware used in software GPS receiver is Antenna, RF- front-end and ADC. Samples from the ADC are processing in the software and find out the necessary parameter like distance, time, satellite position and user position. Basics Software GPS Receiver is shown in figure1 [1]. ADC is placed as near as to the antenna [3]. GPS satellites transmit a signal is received by the antenna. An antenna is followed by RF front-end in RF-Front-end the input signal is converted to the desired frequency and amplified to suitable amplitude. An ADC is utilized to digitize the input signal. Digitized samples are further used in software to process it. A signal of the specific satellite and frequency is finding in acquisition[3]. The tracking program is used to find the phase transition of the navigation data. Navigation data phase transition is obtained from tracking which helps to obtain the sub-frames and navigation data. Ephemeris data and pseudo range can be obtained from the navigation data. The ephemeris data are used to obtain the satellite positions. Finally, the user position can be calculated. Minimum three satellite are required to calculate the User position and it can be calculated by the distance formula between GPS satellite and the unknown position [1].The basic distance equation

$$\boldsymbol{\rho_i = \sqrt{(x_i - x_u)^2 + (y_i - y_u)^2 + (z_i - z_u)^2}} \quad \text{.....(1)}$$

Where is the distance of different satellite, ( ) are the known position of the different satellite, ( ) are the unknow position

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.These equation can be solved by using linearization and an iterative approach.

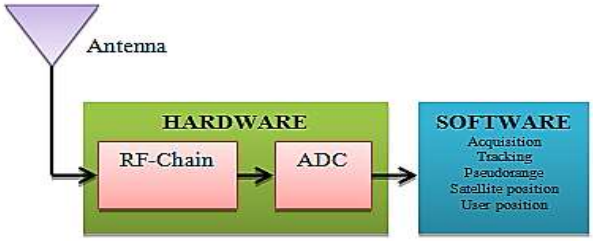

Fig1: Fundamental Gps Recevier

III. GPS SIGNAL ACQUISITION

3.1GPS SIGNAL

GPS signal is a bi-phase modulated signal. This consists of Navigation data, carrier frequency, and spreading sequence. Spreading sequence are the Coarse/acquisition (C/A) code, and precision code (P-code) and navigation data contains information about the satellite orbits, almanac data, and ephemeris data [1].GPS signal broadcast two carrier frequencies L1 and L2 these are the primary frequency which is derived from the fundamental atomic clock. L1 contains two codes C/A Code and P-Code and L2 contains P-code [2]. C/A code and P-code used for the civilian and military propose respectively. Course/Acquisition code belongs to Gold codes family. It contains 1023 Chip with a chip rate of 1.023MHz and each chip is 977.5ns (1/1.023MHz) long and itself repeats every one millisecond and each satellite contains distinctive C/A code[4]. Satellites not directly send the P-code, yet it is modified by a Y-Code hence it also referred to as P(Y) code. It contains two pseudorandom noise (PRN) codes with the chip rate of 10.23MHz and code is 38-week long code and it is reset by every week. GPS Signal is generation is shown in figure2 [1], it is obtained from the products of two 1023 bits PRN sequences.It contains 10 stage maximal length linear shift register ,which are indicated by generator polynomials.

$$G_1: X^{10} + X^3 + 1$$

$$G_2: X^{10} + X^9 + X^8 + X^6 + X^3 + X^2 + 1 \qquad \ldots\ldots (2)$$

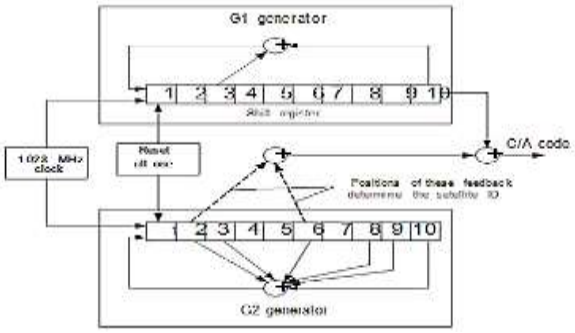

Fig 2: GPS C/A Signal Generation

3.2 GPS SIGNAL ACQUSITION

Acquisition is the procedure used to detect the presence of the signal and fundamental parameters are acquired and passed through the tracking program. From the tracking program navigation data is obtained [3].The basic idea of acquisition is to despread the input signal and find the carrier frequency. If the C/A code with the correct phase is multiplied on the input signal, the input signal will become a continuous wave signal [1].It is utilized to recognize the satellites for the users and determine the coarse values of the carrier frequency and the code phase of the signal.

There are three standard methods of acquisition: Serial Search Acquisition, parallel frequency space acquisition, parallel code phase search acquisition [3] and algorithm are used for acquisition are conventional, Fast Fourier transform (FFT), and Delay and Multiplication [1]. The FFT method and the conventional method generate the similar outputs, but FFT method can be considered due to it reduced computational version of the conventional method. The objective of the acquisition is to perform a correlation with the incoming signal and a PRN code to obtain the beginning of the C/A Code and carrier frequency

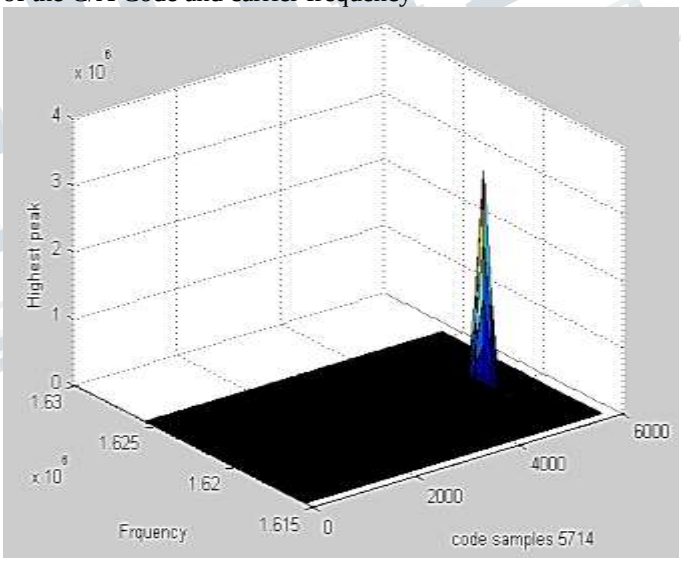

Fig 3: Acquisition result using FFT approach (satellite 8)

Fig 3 illustrates the result of acquisition using FFT methodology. C/A code is locally generated is sampling at 5.714MHz with center frequency 1.6205MHz and Doppler frequency range searched over acquisition is ±10KHz, which contains 21 frequencies of the FFT output covering the desired 20 KHz and C/A code has the 5714 samples it is multiply point by point with the input data .FFT is performed on the product to find the frequency. Highest amplitude of among these outputs is the result and it also crosses the threshold it is considered as the beginning of the code and there corresponding carrier frequency.

IV. CONCLUSION

In this paper, I have studied GPS signal acquisition using software GPS receiver. The FFT acquisition approach has been studied. This receiver is based on a PC and samples of GPS signals at IF. The local C/A code and carrier replica signals are pre-generated, stored in memory, and can be used repetitively during signal acquisition.The scope of this paper is implementing the universal software receiver for all the GNSS signal.

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