ADVANCED ACQUISITION OF GPS AND GALILEO SIGNAL USING FFT

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Abstract
Signal acquisition is vital process in a GNSS receiver. To observe which satellite is transmitting a signal acquisition is carried out. There should be acquire the signal in very less time. Our work is to reduce the signal acquisition time at GNSS receiver to speed up the navigation process. This is achieved through Advanced FFT techniques by using Radix 2, Radix 4,Radix 2 with zero padding, Radix 4 with zero padding. The proposed work done on both GPS and GALILEO signals. This work gives best result with advanced acquisition of GPS and Galileo signal with very less delay.
Keyword: Advanced FFT techniques, GNSS receiver, GPS (global positioning system), GALILEO.

I. INTRODUCTION

Global Navigational Satellite System made up of GPS and GALILEO is a tool for positioning an object on earth. The GPS is proposed by united states and managed by US air force .it has been used for both military and civilian for different application such as location, navigation and timing. GALILEO is developed by European Space Agency. GALILEO composing of 24 operational satellite in three medium earth orbit.it provides six services freely and payable use. Software GPS receiver capture the RF modulated signal at the L1 or E1 frequency ,down conversion is done to an intermediate frequency ,after that digitization and signal processing is performed to extract the position information from navigation message by comparing with conventional hardware GPS receiver, software GPS receiver offer flexibility and less cost for algorithm redesign[3]. This work represents the Acquisition schemes by using advanced FFT schemes to improve the time required by analyzing spectrum C/A code and observing effect of reducing delay.

Segment II describes the acquisition schemes in GPS and GALILEO which consists of Serial search, FFT based approach for acquisition of GNSS signal and comparison both the acquisition schemes the result show the reduction in time.

II. ACQUISITION SCHEMES IN GPS AND GALILEO

These are various techniques used in acquisition there are serial search acquisition, FFT based acquisition.

A.Serial search Algorithm: The serial search algorithm is the basic acquisition schemes for GNSS receiver.

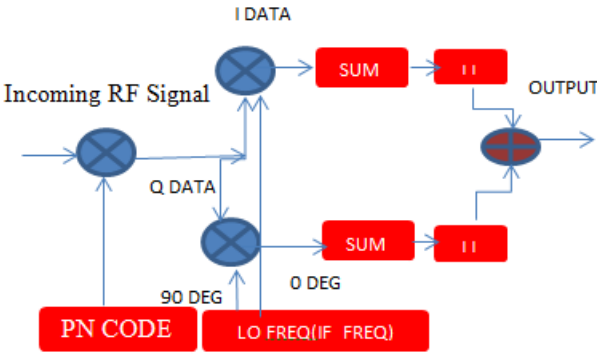

Fig 1: Serial search design

Figure 1 represents the diagram of serial search acquisition scheme.

Serial search is by multiplying the locally generated PRN code sequence and carrier signal. Firstly the incoming GNSS IF signal is multiplied with a carrier replica which is generated by the PRN generator and corresponds to a specific satellite to wipe off the carrier wave from the signal [1].the signal is multiplied by a code replica in phase I and multiplied with 90 degrees phase shifted version Q both I & Q signal are integrated over a time of 1ms separately then the output of integrator is given to comparator and then the output is summed up.

B.FFT based Acquisition

The serial search algorithm takes more time for acquisition because the search is done serially combining frequency and code phase if any one of the parameter could be eliminated or done parallel then we can save a time for acquisition .parallel search technique uses FFT and inverted FFT. FFT based acquisition transforms the signal from time domain into frequency domain and one parameter is eliminated to shorten the acquisition time.

The incoming GPS signal can be expressed by equation 1 and locally generated carrier sequence can be expressed as equation 2

$$Y_{IN}(t_s)=B.c(t_s-\check{T}).d(t_s-\check{T}).\cos(2\prod(f_{IN}-f_d)t_k-\emptyset(t_k))+p_k \quad \textbf{-(1)}$$

$$Y_C(t_S)=c(t_s-\check{T}).e^{j2\prod(f_{in}-f_d)t_k} \quad \textbf{-(2)}$$

Where Y_{IN} is incoming GPS signal digitized at sample rate t_s and $Y_C(t_S)$ is the locally generated carrier signal. B is the magnitude of a signal which tells the power of signal. The diagram of FFT based acquisition is shown in fig 2.

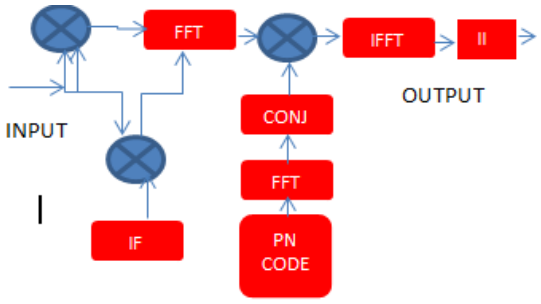

Fig 2:Block diagram of FFT based acquisition

III .RESULTS AND ANALYSIS

Now, consider the acquisition result of different acquisition schemes the serial search algorithm takes 10.1020 seconds and 9.2034 ms for GPS and GALILEO respectively the serial search acquisition result is shown in fig 3 and fig 4.The Radix2 takes 4.756 ms and 2.1689 ms for GPS and GALILEO respectively which is lesser than serial search it is as shown in fig 5 and fig 6 .The Radix 4 acquisition takes 5.0799 ms and 4.6863 ms for GPS and GALILEO respectively but it saves the hardware when it is implemented on circuit in fig 7 and fig 8 .the Radix 2 with padding takes much lesser time than all the acquisition schemes 3.3743ms and 3.2882 ms for GPS and GALILEO respectively but has disadvantage of false detection in fig 9 and fig 10. The radix 4 with padding takes 3.8786 ms and 4.2025 ms for GPS and GALILEO respectively in fig 11 and fig 12.

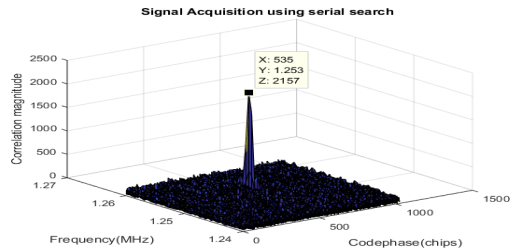

Fig 3 Signal acquisition using Serial Search of GPS

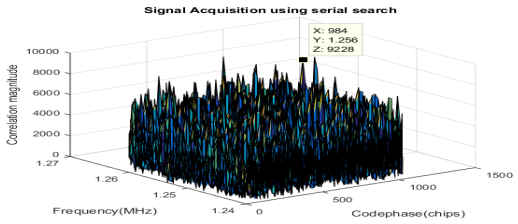

Fig 4 Signal acquisition using Serial Search of GALILEO

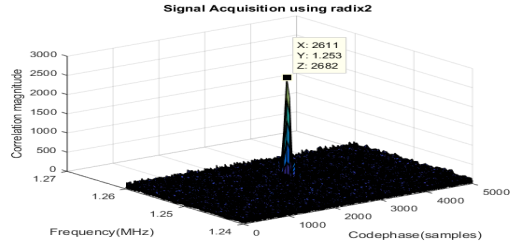

Fig 5 Signal acquisition using Radix 2 FFT of GPS

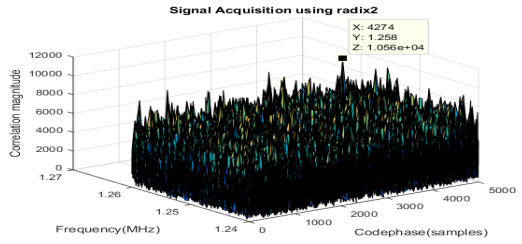

Fig 6 Signal acquisition using Radix 2 FFT of GALILEO

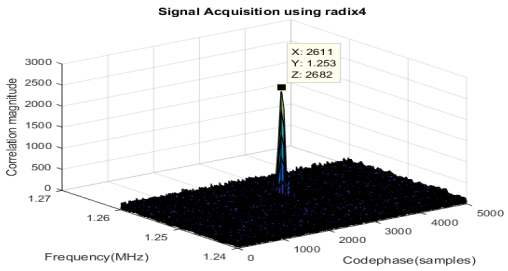

Fig 7 Signal acquisition using Radix 4 FFT of GPS

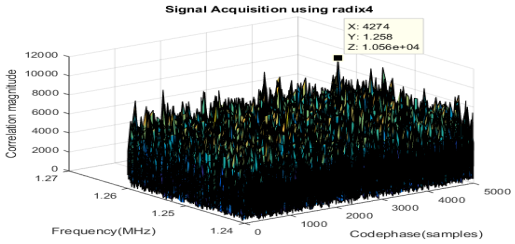

Fig 8 Signal acquisition using Radix 4 FFT of GPS

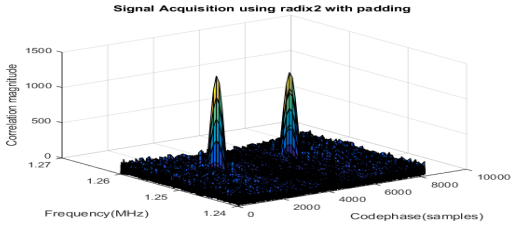

Fig 9 Signal acquisition using Radix 2 with padding FFT of GPS

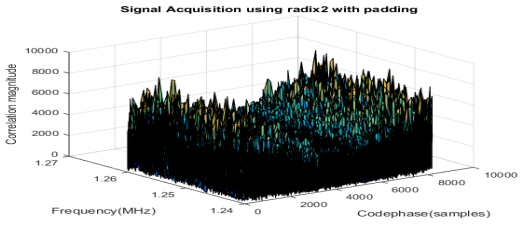

Fig 10 Signal acquisition using Radix 2 FFT with padding of GALILEO

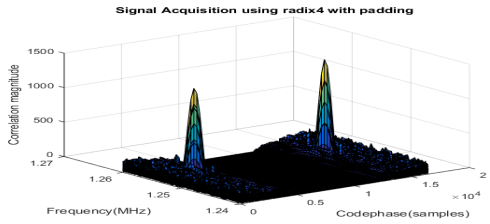

Fig 11 Signal acquisition using Radix 4 FFT with padding of GPS

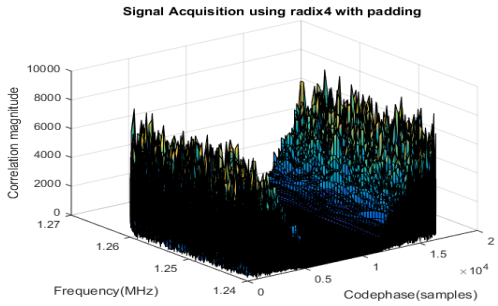

Fig 12 Signal acquisition using Radix 4 FFT with padding of GALILEO

The Table provides the comparison of different acquisition schemes for both GPS and GALILEO.
The Table 1 describes for GPS and Table 2 for Galileo.

Table1: Processing time, magnitude of GPS

Acquisition algorithm	**Observed code phase**	**Observed frequency bin**	**Max peak magnitude**	**41 Doppler bins (s)**
Radix 2 FFT of GPS	2611 samples	27 (1.253 MHz)	2682	4.756
Radix 4 FFT of GPS	2611 samples	27 (1.253 MHz)	2682	5.0799
Serial search of GPS	535 chips	27 (1.253 MHz)	2157	10.1020

Radix 2 with padding FFT	2381 samples	27 (1.253 MHz)	1430	3.3743
Radix 4 with padding FFT	2611 samples	27 (1.253 MHz)	1312	3.8786

Table2: Processing time, magnitude of GALILEO

Acquisition algorithm	**Observed code phase**	**Observed frequency bin**	**Max peak magnitude**	**41 Doppler bins (s)**
Radix 2 FFT of GALILEO	4274 samples	36 (1.258 MHz)	1.05e+04	2.1689
Radix 4 FFT of GALILEO	4274 samples	36 (1.258MHz)	1.056e+04	4.6863
Serial search of GALILEO	984 chips	36 (1.258MHz)	9228	9.2034
Radix2 with padding FFT	8047 samples	36 (1.258MHz)	8991	3.2882
Radix 4 with padding FFT	10566 samples	36 (1.258MHz)	9267	4.2025

IV.CONCLUSION

In the FFT based Acquisition scheme time is reduced by using Different Radix Algorithm. In this paper we have compared different acquisition schemes such as Radix 2, Radix 4, Radix 2 with zero padding and Radix 4 with zero padding from the analysis point of view serial search Acquisition takes more time compared to other acquisition schemes. The Radix 2 with zero padding takes less time but has a difficulty of fault diagnosis and similar with Radix 4 with padding .The result of the experiment are for all the acquisition schemes.

V. REFERENCES

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