GPS 미약신호 처리 알고리즘

*우제르, *최완식

*한국전자통신연구원, 융합기술연구부문, 위치정보기술연구팀, 대전, 대한민국

Acquisition Algorithm for GPS C/A Coded Weak Signals

*Uzair Ahmad, *Choi Wan Sik

*IT Convergence Technology Research Lab, Positioning Information Technology Research Team, ETRI, Daejeon, Republic of Korea

ABSTRACT : This paper concerns to the acquisition of Global Positioning System L1 C/A coded signals. It specifically addresses the issues of acquiring very low power signals which are attenuated due to special circumstances such as indoor environment or forest canopy etc. The proposed post-processing algorithm applies modified signal folding coherent integration scheme on weak signal record. It dynamically compensates the doppler effect on the length of C/A code before integrating the signal power. Experimental results show effectiveness of the algorithm on weak GPS signals recorded in a real environment.

KEY WORDS : Doppler Effect, Post Processing, Signal Folding

1. INTRODUCTION

The GPS signal strength in Line Of Sight conditions is expected to be around 44 dB. Under normal conditions, this signal can be easily processed by coherently integrating the signal power for one period of C/A coded GPS signal. However, in challenging environment, such as indoors, the signal power may degrade to 20 dB or even lower. Such signals require extraordinarily long time to perform in/coherent integrations.

2. SIGNAL FOLDING

Baseband signal folding is an efficient method for longer coherent integrations. A schematic diagram of this method is shown in Figure 1. The LO generates Doppler shifted replica carrier signals I and Q. The input signal is multiplied to each replica carrier signal. Resulting I and Q signals are combined to make complex baseband signal. The baseband signal is folded and all folds are added to form a n_r points summed baseband signal. As the number of code periods to be coherently integrated grow, the f_n grows larger making the correlation process computationally intensive. Moreover, the navigation data bit sign may change every 20 millisecond.

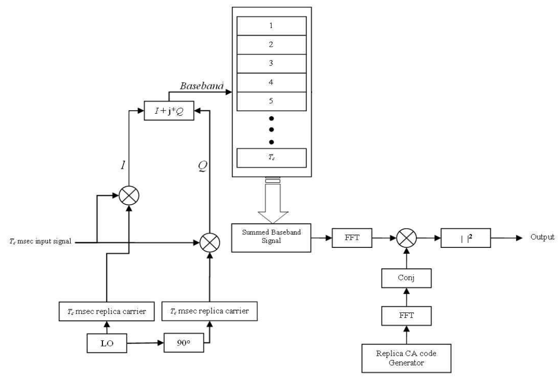

Figure 1 Signal Folding Coherent Integration

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3. THE DOPPLER EFFECT

The Doppler Effect on code length is shown in Figure 2. This problem is addressed by adjusting the replica code length in terms of code rate. A new technique is proposed here that compensates Doppler Effect on code length without adjusting the replica code length.

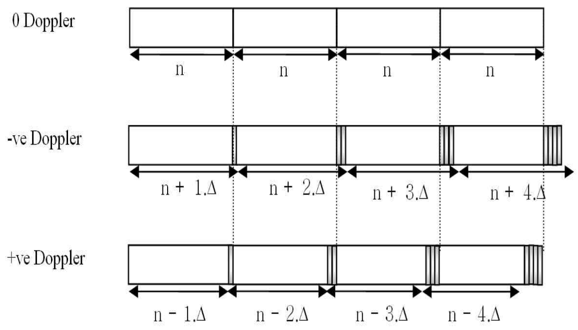


Figure 2 The conceptual Doppler Effect on code length.

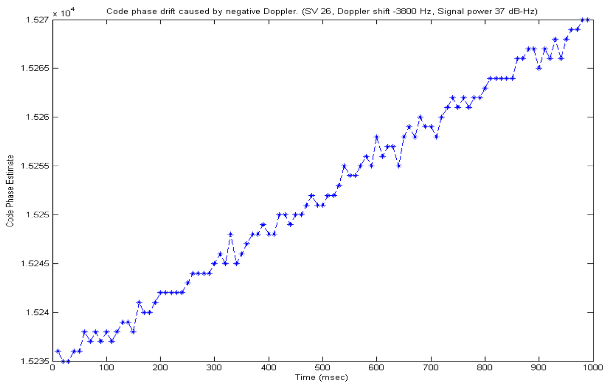
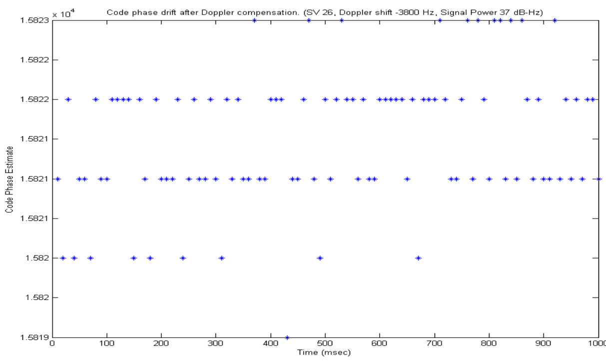


Figure 3 Code Phase drift caused by Doppler; Negative Doppler Case.

Over a long period of integration, the compounded △ values cause the code phase estimate to drift towards the sign of Doppler value. It means that for positive Doppler values the code phase estimates will render a downward slope if drawn on a two dimensional plane. Likewise, for the negative Doppler values the slope of the estimates will be upwards. After applying the proposed technique the dopple shift is compensated as shown in Figure 4.

Figure 4 Doppler compensa



ted code phase estimates

CONCLUSIONS

Long coherent integrations are required for weak signal acquisition. The length of such integrations is limited in practice due to factors such as data sign reversal and extended Doppler search are discussed and analyzed in this paper. Results show the sampling rate of the ADC component and Doppler Effect play an important role in acquisition performance of coherent integration algorithms. The performance of the proposed algorithm is demonstrated with real signal records. The experimental results verify successful acquisition of weak L1 C/A coded GPS signals.

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