ACQUISITION OF GALILEO SIGNALS IN MATLAB

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Abstract

The deployment of Galileo constellation leads to the need of the algorithms for Galileo signals' acquisition and tracking. These signals are different from the GPS signals and this difference is sufficient to take into consideration in the program code. This paper deals with the acquisition of Galileo signals in Matlab. The code is developed on the basis of the free code developed by Kai Borre for GPS Software defined radio [1].

Proposed program code was initially intended for GPS real signals, so we had totwo main modifications: firstly, the Matlab code was changed to process complex GPS signals and secondly – to process Galileo signals.

Galileo satellites transmit two signals in the frequency band E5a (1176.45 MHz), two signals in the frequency band E5b (1207.14 MHz) and one signal with central frequency 1191.795 MHz. Galileo signals use AltBOC modulation [2].

Alternate BOC modulation is based on standard BOC modulation that represents a quadrature carrier modulation where the signal is multiplied by carrier.

The aim of using AltBOC modulation is to generate coherent bands E5a and E5b. Resulting signal may be received as a wide-band BOC signal. Both bands have in-phase (I) and quadrature (Q) parts. The E5a code is shifted into the lower frequency band and E5b is shifted into the upper frequency band. Quadrature E5a and E5b signals are modulated by pilot signals without data, in-phase E5a and E5b signals are modulated by PRN codes and data signals.

The advantage of AltBOC modulation is the following: E5a and E5b signals may be processed separately as usual BPSK signals or together, which leads to higher accuracy and better noise filtration in multipath conditions.

During the modification of the original code [1] it was taken into consideration that the length of Galileo code is four times more than the one of GPS code (4092 samples instead of 1023). Besides, there are different coding principles for GPS and Galileo signals, this fact also required substantial changes in the code.

Acquisition part of the code was also modified, since the first step in receiving data from the satellite is to acquire the satellite, mitigate noise and determine Doppler shift.

The results of data processing may be seen in figures 1 and 2. Figure 1 shows the acquired signal on the output of the receiver. Figure 2 shows the results of the simulation: calculated frequency of the signal in Hz and determined Doppler shift in Hz.

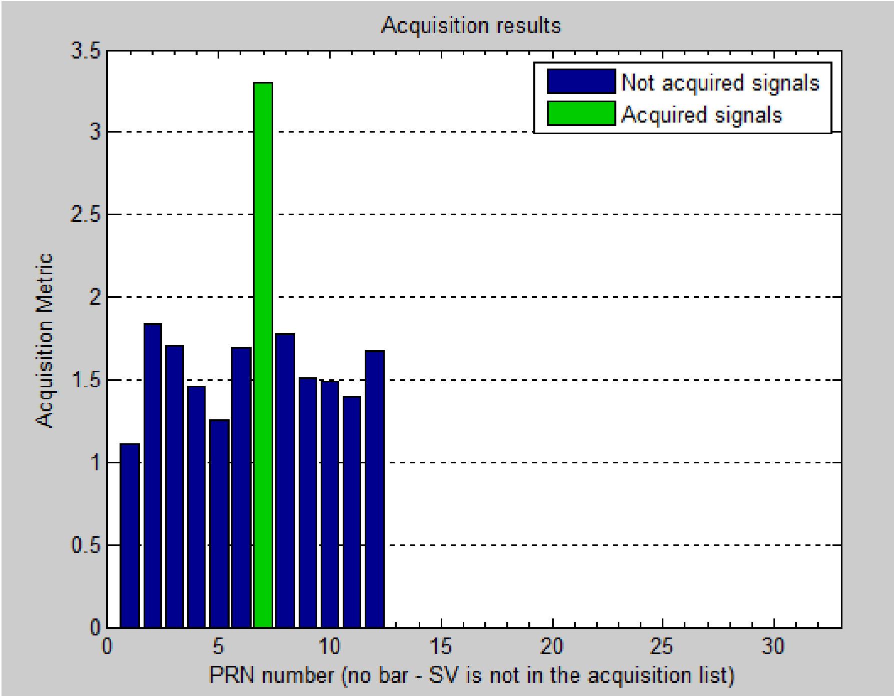

Fig. 1 - Acquisition results

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  Acquiring satellites...
(. . . . . . 07 . . . . . . )

*=========*=====*===============*===========*
| Channel | PRN |   Frequency   |  Doppler  |
*=========*=====*===============*===========*
|       1 |   7 |  1.14441e+02 |     114    |
```

Fig. 2 - Simulation results

The simulation shows, that the approach, realized in [1], is perfectly fit for the acquisition of Galileo signals after some improvements, reflecting new features of Galileo signals.

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References

1. *Kai Borre, Dennis M. Akos, Nicolaj Bertelsen, Peter Rinder, Soren Holdt Jensen, A Software-Defined GPS and Galileo Receiver, Birkhauser Basel, 2007*

2. *European GNSS (Galileo) Open Service. Signal In Space Interface Control Document, OS SIS ICD Issue 1.1, September 2010*