Analysis of Impact of the Visibility of Satellites of GNSS Systems on the Process of Digital Signals Processing SIS in the GNSS Receiver

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***Abstract*—**The subject of this article is to conduct selected research in the field of analyzing the impact of visibility of GNSS satellites systems on the digital processing of SIS signals in the navigation system receiver. In the context of considering this problem, special attention has been paid to the main advantages of GNSS systems, where their functionality in applications requiring the best accuracy of the end user's position using several available satellite navigation systems brings a number of benefits. First of all, a larger number of satellites allows continuous and more reliable observation, which will translate into benefits for potential users. This is especially important in areas related to air navigation (e.g. during aircraft approach to landing). In addition, the signals additionally make it possible to increase the reliability of measurements, due to the greater number of observations available. The use of two or more satellite navigation systems also enables measurement control by comparing the autonomous solutions of each system separately. The article presents the results obtained from simulations assessing the availability of satellites in the area of the globe. A larger number of satellites also makes it possible to conduct observations in areas where due to the large obscuration of the horizon, GNSS satellite techniques have not been used so far, as exemplified by urbanized and mountainous areas. Based on the conducted analysis, performed simulations and obtained results, practical conclusions presented in the final part of the article were formulated.

***Keywords*—**analysis, visibility of system satellites, digital SIS signal processing, GNSS receiver

I. Introduction

In the standard receiver of the global navigation satellite system GPS *(Global Positioning System)*, the signals received by the antenna are subjected to a band pass filtration process and are appropriately amplified.

Usually this process takes place in the active antenna itself, consisting of a low noise amplifier and filters that extract the signal transmission band of one or more GNSS *(Global Navigation Satellite Systems)* systems [1], [2].

Subsequently, the signal in question is imported into the frequency intermediate band or into the baseband by mixing this signal with the local oscillator output signal.

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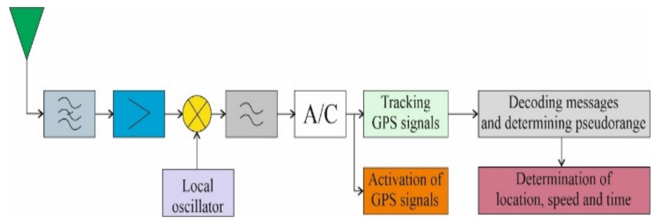

Fig. 1. Processing of signals SIS GNSS in a navigation receiver

The obtained result signal in the SIS *(Signal in Space)* air space, in the next stage subjected to low-pass filtration, has the possibility of further processing in the analog form, or it can be converted into a digital signal.

For the purpose of determining the position of the navigation receiver it is necessary to know the so-called pseudoranges from individual satellites. Also required are the parameter values characterizing the movement of these satellites in their orbits, transmitted in the form of a navigational message.

In addition, it should be noted that in order to be able to reproduce the navigation data placed in the signal of a particular satellite, it is necessary to focus the spectrum of the signal obtained as a result of the operation of multiplication of the input signal by the local replica.

The replica is defined as the product of the course of the pseudo-random sequence C/A *(Coarse Acquisition)* and the frequency of the possibly closest central frequency of the received GPS signal. In order to be able to create a replica correspondingly synchronized with a signal coming from a satellite, it is required to determine the parameters of this signal, obtained through the implementation of subsequent stages of the processing.

It should be noted that in order to make full use of the signal transmission process in all frequency bands, their full use is only possible if they are available to many users at the same time. For this purpose, methods developed in the form of so-called spectrum spreading technique *(spread spectrum)*, implemented in several ways.

The key methods of this technique are:

1. FHSS *(Frequency Hopping Spread Spectrum)* - spectrum spreading with carrier frequency hopping.
2. DSSS *(Direct Sequence Spread Spectrum)* - defining the so-called direct spectrum spreading with a pseudorandom sequence.