# USING TECHNOLOGY OF THE DIFFERENTIAL CORRECTION TO IMPROVE NAVIGATION SUPPORT MICRO / NANO-SATELLITE

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The possibility of using differential correction technology to improve flight navigation support micro/nano-satellite.

The problem as urgent as now due to the advent of modern equipment for remote sensing of increasingly stringent security requirements of navigation spacecraft remote sensing (ERS satellites). In this refinement of navigation equipment to the required parameters leads to increased costs and a significant increase in mass, as well as refinement of navigation equipment may be technically impossible. It is therefore advisable to use ground-based means to solve the problem.

We studied the methods of differential correction, motion model navigation satellites (NS) GLONASS, motion model of low-altitude small spacecraft (LSS) model radio navigation measurement model of navigation model ionospheric delay signal.

In this paper, we considered two methods of differential correction using an amendment to the navigation solution and the amendments to the pseudorange. An analysis of the effectiveness of these two techniques for the implementation was chosen dfferentsialnoy correction technique that uses pseudo-range corrections.

Methods and algorithms joint processing on board navigation solutions on LSS and correcting station (CS) during the flyby over her LSS.

Differential correction algorithm:

1. Input data:

coordinates of CS ($x_{CS}, y_{CS}, z_{CS}$), pseudoranges $\{D^{msr}_{CS(i)}\},\{D^{msr}_{LSS(i)}\}$

coordinates of NS ($x_i, y_i, z_i$) ;

2. Calculation of the navigation solution to the CS:

$$D^{*}_{CS(i)} = \sqrt{(x_{CS}-x_i)^2+(y_{CS}-y_i)^2+(z_{CS}-z_i)^2}\ ; \qquad (1)$$

3. Calculation of the navigation solution for the LSS: $x_{LSS}, y_{LSS}, z_{LSS}$ ;

4. Calculation of ionospheric error model for CS:

$$\begin{cases} \delta D_{ion(CS)i} = D^{msr}_{CS(i)} - D^{*}_{CS(i)} \\ K_i = \dfrac{\delta D_{ion(CS)i}}{D_{ion(CS)i}} \end{cases} ; \qquad (2)$$

5. Calculation of ionospheric error model for LSS:

$$\delta D_{ion(LSS)i} = K_i \cdot D_{ion(LSS)i}\ ; \qquad (3)$$

6. Calculation of refined ranges for LSS:

$$D^{*}_{LSS(i)} = D^{msr}_{LSS(i)} - \delta D_{ion(LSS)i}\ ; \qquad (4)$$

7. Calculation of refined navigation solution for LSS: $x^{*}_{LSS}, y^{*}_{LSS}, z^{*}_{LSS}$ ;

8. Evaluation improve the quality of the navigation support:

$$\delta r_{LSS} = \sqrt{(x^{*}_{LSS}-x_{LSS})^2+(y^{*}_{LSS}-y_{LSS})^2+(z^{*}_{LSS}-z_{LSS})^2}\ . \qquad (5)$$

A numerical study of the effectiveness of differential correction was performed using the model of LSS traffic "AIST" and NS GLONASS. When applying differential correction algorithm results were obtained, which are displayed in Fig. 1

When the method of differential correction has been revealed that the deviation calculated using differential correction ranges from the true values of distances "LSS - NS" does not exceed 7 m, whereas the deviation from the true measurement of distance up to 40 m

In result of the navigation solution according to updated to distances revealed that refined navigation solution rejected by the radius vector is not more than 5 m from the navigation solution obtained by the true range. The results of comparison of the errors displayed in Fig. 2

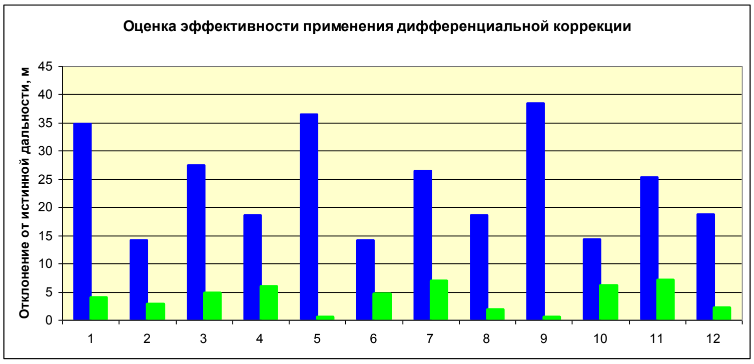


Fig. 1 – Histogram comparison result of deviations and refined pseudo-ranges from the true


Fig. 2 - Histogram comparison result of the measured deviations of navigation solutions and refined navigation solution from the true

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