РАДІОЕЛЕКТРОНІКА ТА ТЕЛЕКОМУНІКАЦІЇ

РАДИОЕЛЕКТРОНИКА И ТЕЛЕКОММУНИКАЦИИ

RADIO ELECTRONICS AND TELECOMMUNICATIONS

УДК : 621.396 + 629.7

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КОРРЕКЦИЯ ПОГРЕШНОСТИ МНОГОЛУЧЕВОСТИ В ПОКАЗАНИЯХ СПУТНИКОВЫХ НАВИГАЦИОННЫХ СИСТЕМ НА ОСНОВЕ ВЕЙВЛЕТ-ПРЕОБРАЗОВАНИЯ ИХ СИГНАЛОВ

Актуальность. . – , , , , (,). ,).

Цель. , , ( ), .

Метод. - – .

Результаты. , . MATLAB.

Выводы. , , , - , , .

Ключевые слова: , , - , .

НОМЕНКЛАТУРА

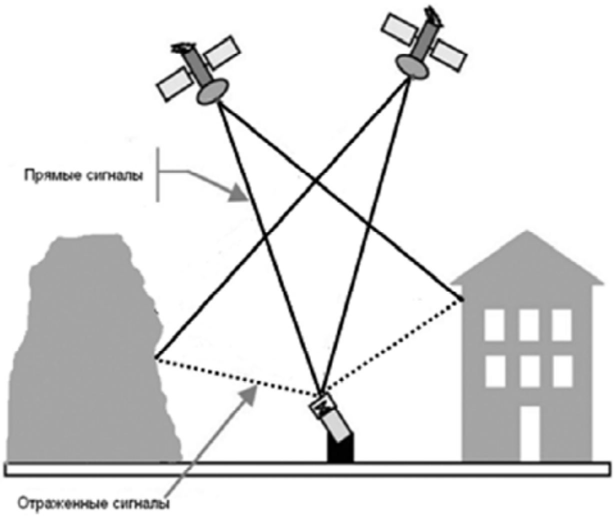
– - ;
– - ;
– ;
– ;
– ;
a – ( );
$B^{s}_{r,i}$ – (-);
b – ( );
c – ( );
dT^{s} –);
dt_{r} –);
$d\Phi^{s}_{r,i}$ – - (-);
$I^{s}_{r,i}$ – ;

DOI 10.15588/1607-3274-2018-1-1

M_P –
;
M_Φ – ;
P – ;
T_r^s – ;
$\overline{t}_r$ – ;
$\overline{t}^s$ – ;
ρ_r^s –
;
ε_p – ;
ε_ϕ – ;
λ_i – ;
$\Phi_{r,i}^s$ – ;
$\psi(t)$ – ( ) .

ВВЕДЕНИЕ

[1].



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[2].

[1].

1 ПОСТАНОВКА ЗАДАЧИ

2 ОБЗОР ЛИТЕРАТУРЫ

[1]. (choke-ring)

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( ), « - » (SNR)

[3].

[4]

( ) [5]:

$$P^s_{r,i} = \rho^s_r + c\left(dt_r\left(\overline{t_r}\right) - dT^s\left(\overline{t^s}\right)\right) + I^s_{r,i} + T^s_r + M_P + \varepsilon_p .$$

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:

$$\Phi^s_{r,i} = \rho^s_r + c\left(dt_r\left(\overline{t_r}\right) - dT^s\left(\overline{t^s}\right)\right) -$$

$$- I^s_{r,i} + T^s_r + d\Phi^s_{r,i} + \lambda_i B^s_{r,i} + M_{\phi} + \varepsilon_{\phi} . \quad (2)$$

($\Phi^s_{r,I}$):

$$P^s_{r,i} - \Phi^s_{r,i} = 2 I^s_{r,i} - \lambda_i B^s_{r,i} + M_P + M_{\phi} + \varepsilon_p + \varepsilon_{\phi} . \quad (3)$$

$I^s_{r,i}$

[3], $B^s_{r,i}$ [5], [6]. M,

M_p,

(3)

ε_p ε_0 (« ») M_p.

« »

(3) .

3 МАТЕРИАЛЫ И МЕТОДЫ

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$$\Psi_{ab}(t) = |a|^{-1/2}\Psi\left(\frac{t-b}{a}\right), \quad (4)$$

a – ( ), b –
( ), $\Psi(t)$ –
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[9–11]
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$$\psi(r) = \frac{1+\sqrt{3}}{4}\varphi(2r-1) + \frac{3+\sqrt{3}}{4}\varphi(2r) - \frac{3-\sqrt{3}}{4}\varphi(2r+1) + \frac{1-\sqrt{3}}{4}\varphi(2r+2), \quad (5)$$

$$\varphi(r) = \frac{1+\sqrt{3}}{4}\varphi(2r) + \frac{3+\sqrt{3}}{4}\varphi(2r-1) + \frac{3-\sqrt{3}}{4}\varphi(2r-2) + \frac{1-\sqrt{3}}{4}\varphi(2r-3). \quad (6)$$

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$$\hat{\psi} = (2\pi)^{-\frac{1}{2}} e^{i\omega} \sin\left(\frac{\pi}{2}v\left(\frac{3}{2\pi}|\omega| - 1\right)\right), \frac{2\pi}{3} \le |\omega| \le \frac{2\pi}{3}$$

$$\hat{\psi} = (2\pi)^{-\frac{1}{2}} e^{i\omega} \sin\left(\frac{\pi}{2}v\left(\frac{3}{2\pi}|\omega| - 1\right)\right), \frac{4\pi}{3} \le |\omega| \le \frac{8\pi}{3}$$

$$\hat{\psi}(\omega) = 0, \omega \in \left[\frac{2\pi}{3}; \frac{8\pi}{3}\right]. \quad (7)$$

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, - (. 1) - - 4- ; , – - - . , , - , , , - ; - – GPS, - , , . , - «1» . 3 , - 4- ; , - – , «2», - , , . - , - - - - . . 2.

4 РЕЗУЛЬТАТЫ

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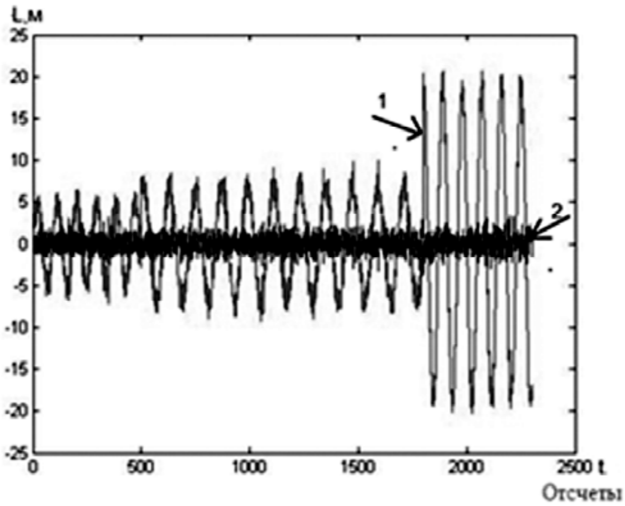
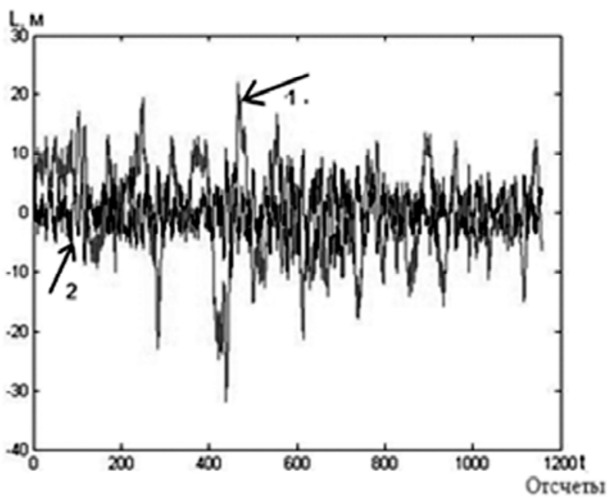
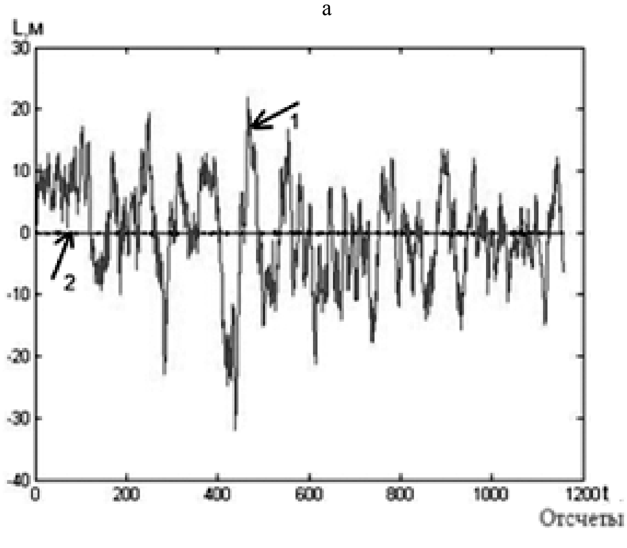
- , . , 500 ( ) 5 90 , 501 1800 – 7 120 , 1801 2300 – - 19 120 π/2, - 1 . - [4], - - . «1» . 2 – , , «2» – - . , , 0,5



2 – - ( )



а



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	0,51	0,53	0,58	0,48

2 – -

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	3,51	1,53	1,58	0,13

. , - . - , [4], , - 1 . , - - (- [4]). - - .

ВЫВОДЫ

- - . - - - . , - (-) (2), - - .

БЛАГОДАРНОСТИ

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1. , - « – »;
2. , – - « – »;
3. , - .

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27.04.2017.
20.09.2017.

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[2] , , , - , - , , ,
[3] , , , - , - , ,
[4] , , , , - . ,

КОРЕКЦІЯ ПОХИБКИ БАГАТОПРОМЕНЕВИМИ У ПОКАЗАННЯХ СУПУТНИКОВИХ НАВІГАЦІЙНИХ СИСТЕМ НА ОСНОВІ ВЕЙВЛЕТ-ПЕРЕТВОРЕННЯ ЇХ СИГНАЛІВ

Актуальність. - .

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Мета. , , ( ),
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Метод. - -
– .
Результати. ,
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MATLAB.
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Висновки. , , ,
- , ,
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Ключові слова: , , - ,
.

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THE MULTIPATH ERRORS CORRECTION IN THE TESTIMONY OF SATELLITE NAVIGATION SYSTEMS BASED ON THEIR SIGNALS WAVELET TRANSFORMS

Context. This research aims to improve the satellite navigation systems accuracy due to the correction of satellite signals multipath propagation errors. The multipath effect errors reducing problem on the navigation solutions accuracy is one of the most pressing problems in modern satellite navigation, because the error introduced by the satellite signals reflections can be up to tens of meters, which greatly complicates the precise positioning task in difficult terrain. For example, in dense urban development conditions, with using satellite navigation technologies in design and construction.

Objective. The main objective is to reduce multipath error signal at least one order, which will significantly increase the accuracy of the navigation task solution.

Method. When solving the relative positioning tasks, it is often difficult, basically from a financial point of view, to provide the entire receivers set with the same antennas using hardware methods. Including because of the effective use of funds, it was decided to consider the software methods. In this article, is considered a method for correcting the multipath error by using the wavelet transform of incoming navigation signals.

Results. The efficiency the proposed method is demonstrated on real satellite navigation data. Software implementation and all experiments are made by the computer mathematics package MATLAB. The results showed the multipath correction method efficiency and confirmed the expected accuracy after processing by the proposed technique.

Conclusions. Based on the results obtained in this paper, we can conclude that the use of wavelet transformation improves the measurements quality used to obtain a navigation solution, thereby increasing its accuracy, regardless of terrain.

Keywords: Global navigation satellite systems, Multipath of navigation signal, Wavelet-transformation, Precise positioning.

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