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SIMULATION ALGORITHM OF RADIO HOLOGRAMS FORMATION IN A REMOTE EARTH SENSING SYSTEM

SEMEN CHEHOVICH, VIKTOR YANUSHKEVICH
Polotsk State University, Belarus

The article considers radio holograms formation in a remote earth sensing system. The linear-frequency-modulated signal is selected as the probe signal. Calculations of the basic signals parameters to form radio holograms are made. Construction of radio holograms is produced by multiplying the maximum and minimum aperture values of the reflected signal at the array of data.

Introduction. Relevance considered in this article is concerned with challenges in improving algorithms of radio holograms forming in a remote earth sensing system.

Radar systems of space-based land review are an effective means of obtaining operational and long-term information about the state and dynamics of objects and regions scale, regardless of weather conditions and time of the day.

Satellite radiolocation is by far one of the major and most dynamically developing directions of remote sensing today.

The basis of satellite radiolocation is made by development of methods and equipment to ensure the formation of radar images of the Earth surface with high spatial resolution which serves as information support for a wide range of scientific, economic and defensive tasks.

The purpose of this operation consists in development of an image generation algorithm in digital radars with the synthesized aperture (RSA) by creating radio holograms in the environment of Matlab.

Main part. Let us consider the use of the algorithm based on the formation of radio hologram pulse radar method with respect to the X-band frequencies of the carrier wave 9.5-9.8 GHz. A transmitting device generates radar pulses with the same repetitive pauses as received by radio receiver at the station. Measuring range to the object is based on determining the time interval between the sending and receiving signals. For high resolution we need to generate short pulses of no more than 0.1 microseconds. However, such pulses have a low energy level. A transmitting device provides a short range of such pulses. To increase the range of pulses they should transmitted in tens of microseconds in length. Sufficient resolution is provided by pulse duration at the receiver due to internal modulation.

The most widely used form of probing cosmic signals in digital imaging radar is packs linearly frequency-modulated pulses, which have a number of advantages as compared to PSK signals.

Probe signal is determined by the formula:

$$U_t(t) = \sum_{k=0}^{N-1} A\left(t-kT_p\right) exp\left\{j2\pi f_0\left(t-kT_p\right)+j\Phi_k\right\}, \quad (1)$$

where A(t) – pulse envelope;

Φ_k – phase of the transmitted pulse

N – number of the transmitted pulses

$$U_r(m,n) = U_{max} rect\left(\frac{m-m_T-\frac{N_t}{2}}{N_t}\right)\cdot exp\left[j\pi\Delta F\tau\left(\frac{m-m_T-\frac{N_t}{2}}{N_t}\right)^2 - j2\pi\cdot\frac{2R_T(n)}{\lambda}\right] \quad (2)$$

m_T range reference number for the leading edge of the goal aported by the recoil momentum

$N\tau$ – number of samples in the duration of the probe pulse

R_{min} – range of the first reference in the gate receiving radio hologram

Receiving radio hologram multiplication occurs at the maximum and minimum values of the reflected signal data of the aperture array.

Array data synthetic aperture

$$u = du\cdot(-m/2{:}m/2-1), \quad (3)$$

du – upper half of the frequency of the wavelength;

m – number of samples in azimuth.

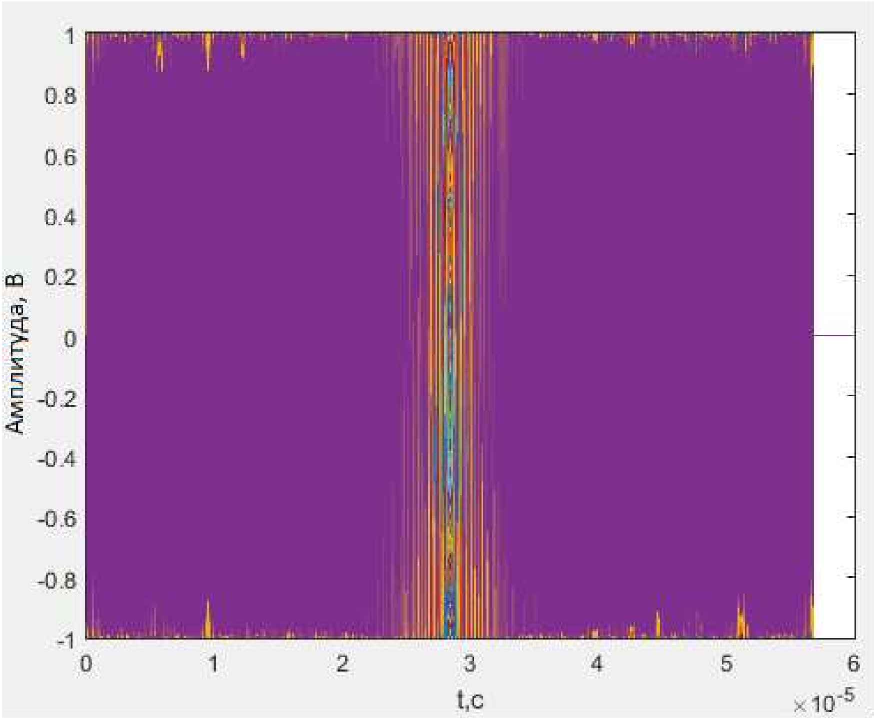

Fig. 1. Target complex video signal received from a single point at the output of the phase detector in the receiver for receiving the sensing gate will look as follows:

Radio holograms are graphical representation of the digitized analog input signal which reflect and carry information about aperture change, time and number of samples for further processing and the construction of the radar picture.

Bystry time is characterized by temporal counting on ranges, slow time temporal counting on an azimuth. Using other approach, it is possible to define slow time as time of movement of the radar, and bystry – as the propagation time of a signal on range coordinate i.e. bearing information on the researched Earth's surface.

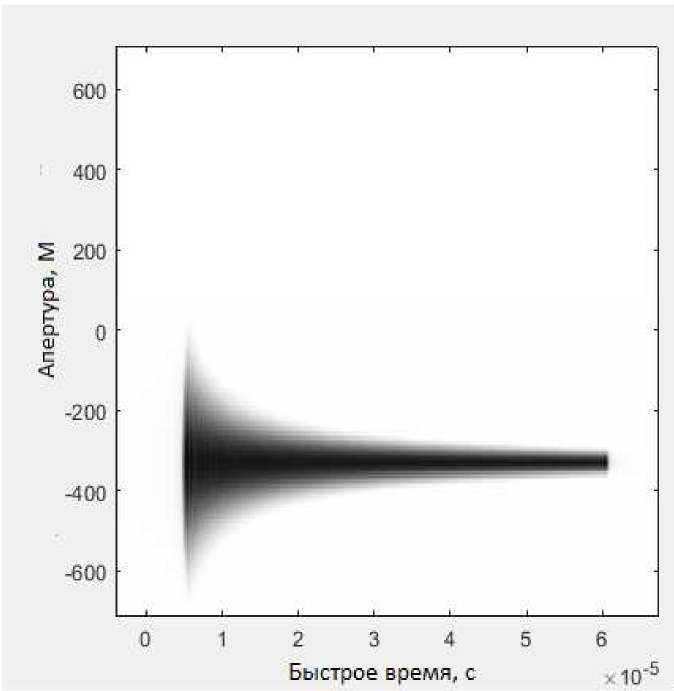

Fig. 2. Radio hollogram routing mode

Conclusion. Thus, carried out analysis has shown that application of different operation modes will allow to carry out surface shooting of sections of the Earth surface with high resolution, determined by requirements to the sizes, definition of delimitation of objects, necessary structure and quality of an observed surface, assignment of the obtained information. The formation algorithm of radio holograms is considered on the basis of the impulse method of radiolocation in relation to X – the range with frequencies of bearing oscillations of 9, 5 - 9,8 GHz. The research results can be applied in remote Earth sensing systems.

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