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RESEARCHING SPATIAL SELECTION METHODS
OF EXTREME COUNTS GROUPS
OF ANTENNA ARRAY(AA)

The main trend in the development of modern telecommunication radioelectronic systems is multichannel principle of their construction. The usage of this principle provides a solution of such tasks as the capacity increasing, the possibility of effective operation under the circumstances of signal fading and multipath propagation, the effective operation under the conditions of uneven frequency and spatial allocation of noise and interference, the possibility to adap to the electromagnetic environment changes, the reduction of the reaction time, the operation effectiveness improvingin general.

Such major types of channels as frequency, time, spatial, polarization and code are typically used in multichannel telecommunication radioelectronic systems. An example of such systems is the mobile space-communication system that uses the digital antenna array (DAA) of 128-elements with multilobed directional pattern (MDP), which consists of 250 receivers, at the base space station. The main problem to be solved with a set of system channels is the signals and interference separation into the acceptable mixture with their further processing, selection and combination. To separate signals and interference the given range of possible values of the selection parameters is divided into a set of spots – the receiving channels within which the selective reception with the help of applicable selective devices – filters, is simultaneously or alternately carried out.

The prospective trend of the modern telecommunication systems and networks construction is the use of spatial multichannel reception and selection on the basis of DAA with MDP that provides effective implementation of many stations access. The main problem of constructing DAA with MDP is to provide a set of requirements for resolution capability, selectivity in the sidelobes of dynamic range and sensitivity.

Fulfilling the current requirements of the proposed trends DAA with MDP (Fig. 1, a) is used. In such DAA the radiation patterns of main partial lobes are significantly overlapped. This leads to the fact that the signal from a certain source of radio emission is received simultaneously by the group of space-selective channels, forming accordingly a group of signaling responses in the DAA at their outputs (Fig. 1, b).
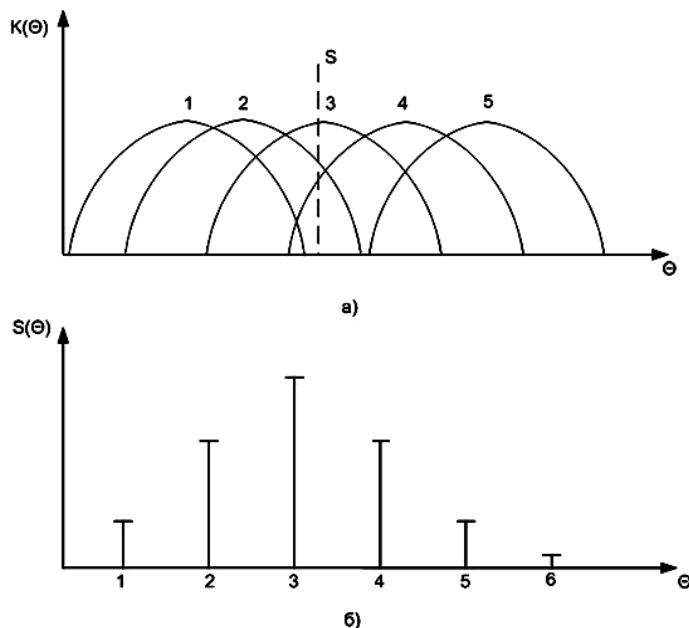

Fig. 1. The formation of the signal group at the output
of DAA with MDP

In the conditions of a priori uncertainty about of the spatial location of subscribers' signals sources, the urgent task of their effective reception is the searching for and identification of the corresponding signal groups within the controlled space sector and the corresponding aperture in DAA with MDP. Unlike the existing energetic methods we have researched the methods of searching, detection and analysis of signal groups based on the complex directional pattern of DAA with MDP in the conditions of intensive spatial noises and interference.

That's why it is advisable to synthesize DAA with MDP using the fast Fourier transform algorithm in the time or frequency domain space according to the equation:

$$X(j\Omega_p) = \sum_{n=0}^{z-1} U(jn) \cdot \exp(-j2\pi\Omega_p n) \cdot W(n)$$

,

where $X(j\Omega_p) - \rho$ complex partial directional pattern of MDP;

$U(jn)$ – the count of emission mixture that is received with the $n-1$ element of DAA;

p0,1, … (z-1);

$\Omega_p - p$ equivalent spatial frequency;

W(n) – weight function.

The principles and implementation methods of searching, detection and analysis of DAA signal groups are substantiated. Besides, the information parameter that corresponds to signal group location is the shift of the main lobe of extreme directional pattern relative to the zero element of DAA:

$$S_m(j\Omega_p) = E_s \cdot X_m(j\Omega_0 + \Delta\Omega).$$

Two basic variants of algorithms are proposed for determining the shift $\Delta\Omega$ – of extreme directional pattern using complex correlation processing and digital filtering, respectively. The research results show that it is reasonable to solve the problem of searching, identifying and analyzing of signal groups as the problem of searching and identifying of extreme partial directional pattern of MDP within the DAA aperture.