ISSN 0735-2727, Radioelectronics and Communications Systems, 2014, Vol. 57, No. 11, pp. 506–515. © Allerton Press, Inc., 2014.
Original Russian Text © A.R. Bestugin, A.F. Kryachko, M.A. Kryachko, 2014, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2014, Vol. 57, No. 11, pp. 38–50.

Methods of Raising Telecommunication System Effectiveness by Using Atomic Function Envelope Approximation

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Received in final form September 22, 2014

Abstract—Cellular and satellite data transmission systems are the most perspective directions of telecommunications development. Solution of the available spectral band effective usage problem with minimal energy costs is pracically important for these systems. This article describes the best practices of space-frequency signal filtering by antenna technology methods, applying a multiple spatial channels for information transmitting and methods of generating spectrally efficient signals based on finite differential equations solutions with offset argument. Methods of construction both direct and quadrature receive information systems with interference were proposed.

DOI: 10.3103/S0735272714110053

Last time due to intensive development of radio engineering devices for discrete information transmission amount of transmitted information increases, hence requirements to quality of information transmission increases that leads to lack of spectral resources. In this connection it is actual to obtain the solution of generation of the signals with high rate of energy spectrum fall in case of provision of necessary received data integrity. It is important to obtain efficient solution of this problem in developed satellite and cellular multichannel radio engineering systems for broadcasting a great volume of information in case of transmission of video images in digital television of high definition, video conference as the most promising facilities of telecommunication.

The purpose of the paper is research of the methods of increase of spectral efficiency of discrete messages transmission by means of multi-position signals with compact spectrum on a basis of atomic functions at different stages of the signals processing.

There are several main methods of increase of spectral efficiency of wireless systems. The first way is based on application of wireless communication systems of space-frequency signals filtering by antennas technology for radio communication, including application of directive phased antennas and adaptive antenna arrays. The realization of such method allows to increase the energy of wireless systems and according to C. Shannon relation to increase spectral efficiency of such systems.

Since radiolocation signals, appearing at the inputs of antennas devices of radio engineering systems (RES), and carrying the information are space-time processes by their nature [1], then it is necessary to synthesize optimal and quasi-optimal algorithm for their space-time processing. There are known drawbacks of the systems, realizing space-time processing, which are high level of minor lobes (LML) of the radiation pattern (RP) and responses of matched filters of optimal time processing of single signals of radar systems (RS), and also trajectory signals of the radar systems with synthesized antenna aperture (RSA).

In case where the processes registered are characterized by space-time band narrowity, then synthesis of such systems is possible to be carried out independently, i.e. in factored form with preserving all advantages of space-time analysis [2]. Optimization of spatial algorithms in this case is reduced to selection of amplitude distribution (AD) of the field in antenna array, providing required characteristics of RP (maximal LML, a rate of minor lobes fall, required value of minor lobes at some distance from main beam, main beam width, etc.).

In real onboard antennas Hamming and Dolf–Chebyshev functions are more frequently used as weighting functions. Application of the first one is related to necessity of suppression of the first minor lobe, whose influence on estimation angular coordinates in case where there is an object with great efficient scattering surface (ESS) near the target. Distribution of Dolf–Chebyshev is optimal regarding the criterion