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REDUCTION OF RADAR IMAGE REDUNDANCY BASED ON KALMAN FILTERING

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The paper is devoted to synthesis of a new quasioptimal algorithm for reduction of radar image redundancy. The results of computer-aided statistical simulation of the algorithm are presented.

In remote sounding of the Earth's surface by a radar with a synthesized antenna aperture (RSA), we have to transmit, in real time, large data flows (images in particular) to a ground-based deciphering station, which may present considerable difficulties because of low traffic capacity of the radio channel. The wide field of view of the Earth's surface and high resolving capacity of contemporary RSA will make this problem intractable if we do not perform some preliminary processing of the radar image (RI) aboard the flight vehicle to reduce the image redundancy (i.e., to compress the data).

Among numerous methods for RI reduction, of particular interest is the method of classification of underlying surface shown in a picture in [1]. Here we must remember that the surface irradiated by RSA usually represents some totality of homogeneous segments (HS) similar to each other within the totality (forest, field, arable land, etc.), and characterized by their own mean specific effective scattering surface (MSESS) ($\sigma_0^{(j)}$). The use of this method assumes putting every image element (IE) into one-to-one correspondence with the ordinal number *j* of MSESS (the class of the underlying surface). Easing of requirements to data transmission rate is attained due to transmission, over the radio channel, of information corresponding not to brightness of each IE but to the number of the class *j* and to the size of each homogeneous segment.

Synthesis of the algorithm for reduction of RI redundancy by the method of classification has been performed in [2] with the use of the generalized homomorphic transform and of its application to Kalman filtering. A disadvantage of this algorithm is inaccuracy of determination of boundaries between homogeneous segments at a small number of noncoherent accumulations and small number of their MSESS. Improvement of accuracy at determination of the borders between adjacent HS can be attained if in this algorithm we consider the statistical properties of the underlying surface, irradiated by RSA, along two coordinates.

The purpose of this work is synthesis of the algorithm for reduction of RI redundancy based on Kalman filtering, with regard for statistical properties of the terrain along two coordinates. Another purpose is the analysis of properties of the new algorithm.

The synthesis. The image of the underlying surface irradiated by RSA will be represented by a set of Gaussian fields with arbitrary boundaries corresponding to HS. Every line of the generated RI looks like a discrete sequence of IE brightness values mapping the system with a random structure [3]. The process of generation of the IE brightness value is described by the observation equation

$$z_{k,r} = H_{k,r}^{(j)} \cdot \Lambda_{k,r} + n_{k,r}^{(j)} \qquad (1)$$

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