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ALGORITHMS FOR COMBINED PROCESSING OF STOCHASTIC SIGNALS IN MILTICHANNEL SCATTER-MEASURING SYSTEMS WITH SYNTHESIS OF APERTURE

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Several new algorithms have been synthesized for optimal processing of signals scattered by random nonuniformities of the relief at active remote sounding. A feature of these algorithms is the consideration of interchannel statistical relations between the signals received, and of statistical relations between the measured parameters set by a priori distributions of probability densities of these values.

One of the pressing problems of remote sounding of natural media is their exploration by a multichannel radar with synthesized aperture (RSA). It permits improvement of the accuracy of multiparameter measurements and the quality of experimental data interpretation by using several radar shots of the same areas (obtained, for instance, at different frequency ranges, different polarization, different observation angles, etc.). Often the measurement data obtained in different channels are utilized without strict account for statistical relations between them, and, the processing is partitioned into primary (production of radar shots) and secondary (interpretation and measurement of image parameters).

This work is devoted to synthesis of full (comprehensive) algorithms for processing of the fields received, including the whole complex of operations, beginning from the field recording and ending by generation of the measured parameter estimates. The main attention is concentrated on the field processing peculiarities, which provide for maximum measurement accuracy. These algorithms can be successfully categorized as the primary and secondary processing of signals.

The parameters and statistical characteristics of the surfaces (moisture content in the soil, permittivity, mean-square height of sea waves, the fields of driving wind velocities etc.) in this work are considered as functions of coordinates of the surface D (map), which is mean about the relief roughness, i.e., $\lambda = [\lambda_k(r)]$, $r = (x, y) \in D$. In a particular case, for the estimated statistical characteristics of a surface we consider the elements of the covariance matrix of scattering [1] and its diagonal elements, i.e., specific equivalent scattering areas (ESA), which represent the surface image in the scatter-measuring RSA [2].

The optimal processing algorithms will be sought based on the maximum of the likelihood functional. Since the parameters to be estimated and statistical characteristics are functions of the coordinates r, the problem is of the variational type. The optimal estimates will be determined as a solution to the system of likelihood equations

$$\frac{\delta \ln P[u(t)/\lambda]}{\delta \lambda_{\mu}(r)} = -\frac{1}{2}\mathbf{S}\mathrm{pur}\int_0^T\int_0^T \frac{\delta R_u(t_1,t_2,\lambda)}{\delta \lambda_{\mu}(r)} W(t_1,t_2,\lambda)\mathrm{d}t_1\mathrm{d}t_2 -$$

$$-\frac{1}{2}\int_0^T\int_0^T u^T(t_1)\frac{\delta W(t_1,t_2)}{\delta \lambda_{\mu}(\vec{r})}u(t_2)\mathrm{d}t_1\mathrm{d}t_2 = 0. \qquad (1)$$

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