THE STATISTICAL RELATIONSHIP BETWEEN THE SCATTERED AND PROPER RADIATION FOR UNDERLYING SURFACE REMOTE SENSING

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In the remote sensing problem solving by active and passive radiolocation complex methods it is necessary to investigate the connection characteristics between the scattered and proper radiation. It can be obtained either by solving direct difraction problems on given electrodynamical surface models or by carrying out special experiments.

The investigation of the reverse scattering (on energy) coefficient and radiobrightness temperature correlation relationship with taking into account their functional dependences on random electrophysical and geometrical surface parameters formed on electrodynamical models is presented in this paper.

We are using such characteristics as scattering bistatistical coefficient $\gamma^{k\ell}$ [I] and radiobrightness temperature

$$T_B^{\ell}(\vec{\alpha}) = T_0\left[1 - \sum_{k=(v,h)} \int_{\Omega_0} \gamma^{k\ell}(\vec{\alpha},\Omega)\, d\Omega\right], \qquad (I)$$

where $\vec{\alpha}$ ($\vec{r}$) is the electrophisical and geometrical parameter vector, including unductivity, conductivity, rough scale and its slope angle and other components.
Situated near by, inddxes $k,\ell=(Vh, hV, hh, VV)$ denote received field polarization on given falling field polarization.

The mutual correlation coefficient has been chosen as a measure of statistical relationship of the scattered and heat radiation [I,2]

$$\rho^{k\ell} = (\sigma_\gamma \sigma_{T_B})^{-1} \langle \mathring{\gamma}^{k\ell}(\vec{\alpha})\, \mathring{T}_B^{\ell}(\vec{\alpha})\rangle . \qquad (2)$$

The mutual correlation coefficient depends on mutual relation ship of radiobrightness temperature with scattering coefficient which can be found from the expression (I), random parameters $\vec{\alpha}$ ($\vec{r}$) statistical characteristics and T_0 ($\vec{r}$). The values $\gamma^{k\ell}$ and T_B^{ℓ} can be found from the conventional second moment of the field strength created by the element ΔS in the observation point [2]

$$\gamma^{k\ell} = 4\pi R^2 M[\mathcal{J}^{k\ell}(\vec{\alpha},\Omega)/\vec{\alpha}]\,/\,|\dot{E}^{\ell}|\,\Delta S\cos\theta, \qquad (3)$$

where $M[\cdot/\cdot]$ denotes a conventional mean value;
$\dot{E}^{\ell}$ -is a falling field strength near surface; $\mathcal{J} = |\Delta\dot{E}|^2$;
θ -is a location angle (of the wave falling).

The mutual correlation coefficient has been calculated for such electrodynamical models in this paper.

A phenomenalogical model. It is supposed that the scatter red field is created by a great number of elementary independent scatters. The bistatical scattering coefficient is re - presented as a product [2]

$$\gamma_d^{kl} = \gamma_d^{kl}(\vec{\alpha})\,\Psi^{kl}(\Omega), \qquad (4)$$

where $\gamma_d^{kl}(\vec{\alpha})$ is a reverse scattering coefficient; $\Psi^{kl}(\Omega)$ -is a standardized indicatrix of the scattered field.

It has been shown in the results of the phenomenalogi - cal model investigation, the indicatrix in the form of determinated functions is independent on random parameters $\vec{\alpha}$; the correlation coefficient is negative and approach to I on absolute value. If the indicatrixes are scattering direction functions, the correlation coefficient also is negative and proportionate to the ratio of spatial correlation interval to full spatial angle to the upper halfsphere.

A small-rough surface model. The feature of this model is the fact that the field scattered in reverse direction is determined in essential by the diffusion component [I,2]

$$\gamma^{kl} = 4\pi k^4 \cos^3\theta\,|\dot{a}^{kl}(\dot{\varepsilon},\theta)|^2\,W(2k\sin\theta) \qquad (5)$$

and heat field is determined by the mirror (coherent) component

$$T_B^l = [1 - |\dot{K}_f^l(\dot{\varepsilon},\theta)|^2]\,T_0, \qquad (6)$$

where $\dot{K}_f^l$-is a Fresnel coefficient; $\dot{\varepsilon}$ - is a complex inductivity; $W(\cdot)$-is an energetical spectrum of rough component.

A large-scale surface model. A correlation behaviour an analysis has been accomplished on two interesting in practice cases of a region ΔS choice. In the first case, this region is practically plane platform; its scale is significally less that that of large-roughs. The correlation coefficient behaviour depends on statistical surface description.

In the second case, e great number of the statistically homogeneous large roughs are in the range ΔS , and their averaging action is equivalent to statistical averaging on relief realization ensemble.

It has been shown that the correlation coefficient depends on the field base and cross polarization components and on fluctuations of the scattered field indicatrix depended on random dielectric surface parameters. If the roughs are sufficiently small (for sea surface, for instance), the field crossing component is neglect, and the indicatrix does not depend on inductivity fluctuations. In this case, th the correlation coefficient is $\rho \approx -I$.

A two-scale surface model. In this model investigation, two cases of the surface element ΔS value choice have been considered too. It has been shown that the correlation co -

efficient calculation can be accomplished by using a large scale surface methodic, when location angles are nearly vertical.

If the location angles surpass the variance square of large-scale rough slopes, the diffusion component predominates in the dissipation field; and the component, which predominates in the heat field, is the result of coming from medium depth quasimirror reflection of some radiation part. The case when the element is significally smaller than large rough scales and is plane in the mean (relatively to small roughs), has been investigated most of all in detail. In the calculations, the relief element slope angles have been considered as random parameters. It has been found that the correlation coefficient varies in full possible value range from -I to +I when the location angle varies from 0 to 90. Moreover, the correlation coefficient dependence has monotonous character on horizontal polarization, and this coefficient value approaches to -I at the Brewster angle on vertical polarization. Joint coherent component consideration does not influence practically on the dependence character. The temperature fluctuation decreases insignificantly the correlation coefficient value and variates markably the dependence character on temperature square fluctuation values more than 5 - IO$^{\circ}$.

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