The Calculation of Azimuthal Distribution of Field on Tropospheric Paths. Fresnel Diffraction.

Shilyaeva Olga

Abstract – **Instant azimuthal distribution of the field were obtained by the method of equivalent sources. Characteristics field agree with experimental data.**

Keywords – **field, radio horizon, azimuthal distribution.**

I. INTRODUCTION

Known experimental data on the horizontal structure of the field on the closed tropospheric paths [1, 2]. The literature data on the calculation of the horizontal distribution of the field did not meet.

This calculation can be performed by the method of equivalent sources [3]. The method combines the geometrical optics and Kirchhof's method. In this case there is no restriction on the spatial structure of the dielectric permittivity ε (x,y,z).

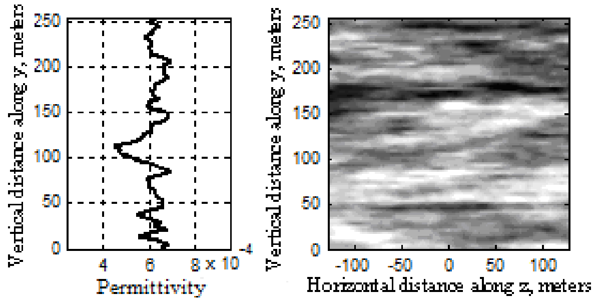
II. EXPERIMENTAL DATA

Here are the results of calculations for the path with the following parameters. Length of the path R=80km, the plane Q of equivalent sources is in the middle of the path, the height of the receiving and transmitting antennas are $h_1=h_2=5$m, wavelength λ=0,3m. Axisymmetric radiation pattern is approximated by a Gaussian function of width $\theta_{0,5}=0{,}7^0$.
Model of the medium ε(x,y,z) consisted of three characteristic components of the real atmosphere: regular distribution of the permittivity as function of height ε (y), anisotropic inhomogeneity in the form of layered structures and turbulent fluctuations of the permittivity $\tilde{\varepsilon}$. Component ε(y) corresponded to the "standard atmosphere". The energy spectrum of inhomogeneities is described with a Karman`s model

$$F(\rho) = C(\rho^2 + \psi^2)^{-11/6}. \qquad (1)$$

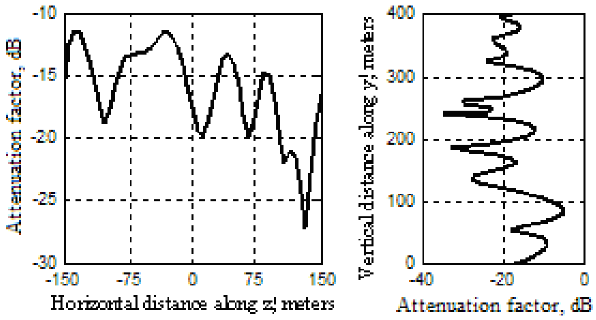
Parameter ψ = 2π/L corresponded to different outer spatial scales of inhomogeneity in the horizontal and vertical: in the horizontally – 500m, in the vertical – 50m. The spectrum of turbulent fluctuations was described by Karman's model, where parameter ψ corresponded outer scale L = 5m in all directions.

Structural components are given in the volume of a rectangular coordinate system x,y,z. The length of the volume in direction of wave propagation (along the axis x) was 40 km, the vertical (y) and horizontal (z) sizes are of 1km. In this area, the vertical profile (at x=const, z=const) in the height range (0…250)m is shown in Fig. 1*a*. Fig. 1*b* shows a fragment of an inhomogeneous medium in the plane (y, z) at x=const. Fig. 2*a* shows the current distribution of the field as function of the azimuthal angle for the sample function ε(x,y,z) (Fig.1) at height h_2=5m. The value of z'= 0 on the figure corresponds to the plane of the large circle, y' and z' – coordinates of the observation plane Vertical field distribution along the height (along y') is shown in Fig. 2*b*.



a *b*

Figure 1



a *b*

Figure 2

As can be seen from Fig. 2*a*,*b* field distributions both horizontally and vertically are substantially non-uniform.

The statistical modeling gives estimates of the correlation distance ρ_c from 30 to 80 wavelengths, the coherence parameter g=(2…3) and the depth of field fluctuations – about 17dB.

III. CONCLUSION

The method of equivalent sources can adequately describe both the vertical and horizontal distributions of the instantaneous amplitude of the field near the radio horizon and beyond for a given sample of function medium ε (x, y, z) in the decimeter wavelength range for paths that have small or middle distances (R≤100 km).

Thus statistical characteristics of the field that were obtained by statistical modeling are corresponds to the known experimental data.

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Olga Shilyaeva - Kharkiv National University of Radio Electronics, Lenina Ave, 14, Kharkiv, 61166 UKRAINE, E-mail:olyacasual@yandex.ru