Radioelectronics and Communications Systems
Vol. 47, No. 8, pp. 37–42, 2004

Izvestiya VUZ. Radioelektronika
Vol. 47, No. 8, pp. 51–59, 2004
UDC 621.391.23

A SIMULATOR FOR A DECAMETER RADIO CHANNEL

G. G. Vertogradov

Rostov State University, Russia

The paper is devoted to analysis of experience in designing a computer-simulated imitator of a radio channel of decameter range of wavelengths, with regard to main physical mechanisms affecting the propagation of waves in the magnetoactive inhomogeneous nonstationary ionosphere. The signal processing is performed based on the fast Fourier transformation with partition of the processed sequence into individual frames. The simulator permits prediction of all traditionally used propagation characteristics of the decameter waves, including natural noise and station clutter.

One of the requirements imposed on the design of high-speed communication systems operating in the decameter (DCM) range of wavelengths is their testing under conditions closely approximating realistic ones. Until recently, the only reliable technique for such testing consisted of full-scale trials, since the available phenomenological models [1–4] of the ionospheric radio channel did not consider the actual processes in the medium and their impact on DCM wave propagation. However, the high cost of full-scale tests and impossibility of repeated reproduction of the actual channel behavior makes this approach ineffective at the stage of development of communication systems and assemblies. Another well-known approach [5] based on approximation of the wave equation solutions in the turbulent ionosphere is also of little efficiency in designing DCM-channel simulators. This approach makes it possible to obtain two-frequency, time, and spatial functions of correlation and coherence, but does not permit one to trace the field dynamics in the reception point (i.e., variations of instantaneous values of the electromagnetic field strength in time, frequency, and space).

As a consequence, there are no DCM radio channel simulators able to perform tests, trials, and thorough investigations of narrowband and broadband communication systems under conditions maximally resembling real situations. The present report represents a generalization of experience in design and maintenance of a computer-aided simulator developed based on the structural and physical approach to modeling of the ionospheric channel.

The principle of model correctness at the structural-physical (SF) approach implies revealing and adequate description of physical mechanisms having a determining effect on establishment of the field structure and on its dynamics. It also assures the necessary accuracy of the model with a minimum of expenditures. Based on the above provisions, we have formulated the following initial premises concerning the SF-model [6]:

1) the resulting field of the waves reflected from the ionosphere at the reception point and its spatial distribution depend on interference of a small number of beams;

2) the number of beams in every space-time point and their parameters are dictated by the global regular nonhomogeneity of the ionosphere related to the terminator, and by medium-scale perturbations of electron concentration having wave nature;

3) the dynamics of individual beams and of the resulting interference field depends on the terminator's movement and on displacement of the wave perturbations (WP);

REFERENCES

1. J. M. Goodman, HF Communication: Science and Technology, N. Y., USA, 1992.

2. ITU-R Recommendation 520-2. Use of High Frequency Ionosphere Simulators. ITU-R Recommendations, 1994-F series, Part 2, ISBN 92-61-05411-0. ITU, Geneva, 1994.

3. L. W. Barclay, Ionospheric characteristics needed for the setting of wideband high frequency simulators, Millenium conference on antennas & propagation (report p0856), Davos, Switzerland, 9–14 April, 2000.

4. L. Bertel, F. Marie, and D. Lemur, Model of narrow band HF ionospheric channel including both propagation and antenna effects, Millenium conference on antennas & propagation (report p1366), Davos, Switzerland, 9–14 April, 2000.

5. N. N. Zernov, V. E. Gherm, B. Lundborg, S. M. Radicalla, and H. J. Strongeways, Analytic and numerical modeling of the effects of HF propagation through the distributed ionosphere, Millenium conference on antennas & propagation (report p0287), Davos, Switzerland, 9–14 April, 2000.

6. B. G. Barabashov and G. G. Vertogradov, Matematicheskoye Modelirovaniye, Vol. 8, No. 2, pp. 3–18, 1996.

23 May 2002