Radioelectronics and Communications Systems
Vol. 49, No. 4, pp. 1–7, 2006

Izvestiya VUZ. Radioelektronika
Vol. 49, No. 4, pp. 3–12, 2006
UDC 621.391

CHARACTERISTICS OF DETECTION OF A RADIO SIGNAL OF UNKNOWN DURATION IN THE PRESENCE OF MULTIPLE INTERFERENCE WITH UNKNOWN PARAMETERS

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The paper describes the structure and characteristics of new maximum-probable algorithms for detection of radio signals in the presence of multiplicative and additive interference with different rates of a priori indeterminacy.

Detection of signals with unknown duration mixed with intrinsic noise of reception devices has been considered in [1, 2]. However, the present-day radio-engineering systems work, as a rule, under the conditions of simultaneous operation of a great number of radio aids. The latter may represent active stations with radio interference operators, taking part in the radioelectronic struggle [3], and other radio equipment, whose signals can be described by some equivalent random process [4]. Apart from such additive interference, we must also consider the multiplicative interference [5] — when we use information transmission channels with random parameters. The multiplicative interference, interacting with a legitimate radio signal, usually transforms it into a narrow-band random process. The purpose of this work is synthesis and analysis of algorithms for detection of radio signals with unknown duration in the presence of a number of interference components of additive and multiplicative nature.

For the model of legitimate signal, distorted by a multiplicative interference, we shall use a segment of a narrow-band stationary centered random process $\xi(t)$:

$$s(t,\tau_0) = \xi(t) I[(t - \tau_0/2)/\tau_0]$$

where $I(x) = 1$ at $|x| < 1/2$ and $I(x) = 0$ at $|x| > 1/2$.

Duration of the signal τ_0 is a priori unknown and may take values from the interval $[T_1; T_2]$. Here $0 < T_1 < T_2 \le T$, where T is the time of observation. Such situation may occur in communication systems with pulse-width modulation, in the event of intensive fading of signal in some radio channels, etc. Assume also that the power spectrum of the process $\xi(t)$ is approximated by the expression [6, 7]

$$G_\xi(\omega) = \gamma_0 \{I[(\nu_s - \omega)/\Omega_s] + I[(\nu_s + \omega)/\Omega_s]\}/2$$

where ν_s and Ω_s are the central frequency and bandwidth of the process $\xi(t)$, while γ_0 is a priori unknown value of the signal power spectrum, which depends on the average power of the multiplicative interference.

For the additive interference we shall consider the intrinsic noise $n(t)$ of the receiver, and the external wide-band interference $N(t)$. By $n(t)$ is meant the white Gaussian noise with one-sided spectral density N_0. With the aid of the external wide-band interference $N(t)$ we shall describe the totality of all interfering signals from outer sources. In conformity with [4], this interference can be approximated by a centered Gaussian stationary random process with the band-pass power spectrum $G_N(\omega) = \Gamma_0 \{I[(\nu_N - \omega)/\Omega_N] + I[(\nu_N + \omega)/\Omega_N]\}/2$, whose pass-band $\Omega_N > \Omega_s$, and the central frequency

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2 December 2005