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RECOGNITION OF ORTHOGONAL SIGNALS BY RESOLVERS WITH LIMITED SEN--ETC(U)
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RECOGNITION OF ORTHOGONAL SIGNALS BY RESOLVERS WITH LIMITED SENSITIVITY

by

Ye. I. Kulikov

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EDITED TRANSLATION

FTD-ID(RS)T-0037-78 7 February 1978

MICROFICHE NR: FTD-78-C-000212

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By: Ye. I. Kulikov

English pages: 21

Source: Izvestiya Vysshikh Uchebnykh Zavedeniy, Radioelektronika, Vol. 12, No. 2, 1969, pp. 115-123

Country of origin: USSR
Translated by: Carol S. Nack
Requester: FTD/TWFE
Approved for public release; distribution unlimited.

PREPARED BY:

TRANSLATION DIVISION
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WP-AFB, OHIO.

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$sinh^{-1}$
cos	cos	ch	cosh	arc ch	$cosh^{-1}$
tg	tan	th	tanh	arc th	$tanh^{-1}$
ctg	cot	cth	coth	arc cth	$coth^{-1}$
sec	sec	sch	sech	arc sch	$sech^{-1}$
cosec	csc	csch	csch	arc csch	$csch^{-1}$

Russian	English
rot	curl
lg	log

0037

RECOGNITION OF ORTHOGONAL SIGNALS BY RESOLVERS WITH LIMITED SENSITIVITY

Ye. I. Kulikov

Summary

The probabilities of the recognition of one useful signal among a group of false signals which are not superimposed in time are determined. A number of examples are examined with consideration of the effect of additive normal noise and the limited sensitivity of the resolver on the recognition process.

Statement of Problem

The problem of the recognition (detection) of the useful signal (the true signal) among false signals arises in a number of applied problems of the statistical reception of signals. Here recognition can be realized both with and without additive noise.

True signals can be distinguished among false by using two types of information obtained during the observation of the signals and the measurement of their informative parameters. First, this includes information on the laws of the distribution and static characteristics of the signals, and second, information related to changes in certain parameters of the signals through time.

Of course, the higher the noise level and the closer the characteristics of the false signals are to the corresponding characteristics of the true signals, the greater the errors in resolution. The finite value of the sensitivity of the resolver also affects the error, besides these factors. The resolvers (including man) which can presently be realized have limited sensitivity which can theoretically be a random function of time. Without going into the reasons for fluctuations in the sensitivity of resolvers in detail, we will nevertheless point out that when man is the resolver, the sensitivity of his sensory organs which participate in the resolution process depends on many psycho-physiological factors [1].

In connection with this, it is interesting to consider the effect of the *finite sensitivity of the* resolver, as well as fluctuations in sensitivity, on the characteristics of the recognition of signals which are not superimposed in time. Here we will assume that the apriori statistics on the recognition parameters of true and false signals are known and that it is necessary to distinguish the true signal on the basis of this apriori information on the received group of true and false signals. We will solve this problem analogously to the classic problem of the recognition of one of the M-orthogonal signals [2, 3, etc.].

Discrimination of One True Signal From a False Signal

Suppose we have one true signal (IS) and one false signal (LS) with uniform probability densities of the recognition parameters $w_{nc}(x)$ and $w_{nc}(y)$, whereupon it is known apriori that the mean value of the recognition parameter for the true signal is higher than the mean value of the recognition parameter for the false signal. Suppose that the rule of resolution (recognition) is that the signal which has the highest measured value of the recognition parameter is considered to be the true signal. However, due to the limited sensitivity of the resolver which selects the highest value of the recognition parameter, the true signal will be taken as true when the measured value of parameter x of the true signal exceeds the measured value of parameter y of the false signal by a certain value δ. In other words, the true signal will be taken as true when the following condition is satisfied

$$\Delta = x - y > \delta.$$

Here the false signal y will be mistaken for the true signal when the following condition is satisfied

$$\Delta = x - y < -\delta.$$

When $-\delta < x-y = \Delta < \delta$ or $|x-y| < \delta$, the signals will not be classed as either true or false, and it is necessary to make a further analysis of the signals.

As was indicated above, the sensitivity of the resolver depends on many factors, generally being a random value with a certain probability density $w_\delta(\delta)$. Since the value of δ, which determines the sensitivity of the resolver, is positive, the probability density $w_\delta(\delta)$ only differs from zero when the value of δ is positive.

With the above designations, the probability that the true signal will be taken as true (the probability of the recognition of the true signal) depends on the random value of δ, and with the rule of resolution used, it is determined by the expression

$$P_{ис}(\delta) = \int_{\delta}^{\infty} w_{ис}(x)\left[\int_{\delta}^{x-\delta} w_{лс}(y)\,dy\right]dx.$$

which agrees with the expression for the probability of the recognition of one of two orthogonal signals found in publication [2, 3] at $\delta = 0$. Averaging the probability $P_{\text{пс}}(\delta)$ for all the possible values of random value δ, we will have

$$P_{\text{пс}} = \langle P_{\text{пс}}(\delta) \rangle_\delta = \int_0^\infty P_{\text{пс}}(\delta) w_\delta(\delta) d\delta = \int_0^\infty w_\delta(\delta) \int_\delta^\infty w_{\text{пс}}(x) \int_0^{x-\delta} w_{\text{лс}}(y) dy\, dx\, d\delta. \quad (1)$$

We find the probability that a false signal will be mistaken for the true signal analogously

$$P_{\text{лс}} = \langle P_{\text{лс}}(\delta) \rangle_\delta = \int_0^\infty w_\delta(\delta) \int_0^\infty w_{\text{лс}}(y) \int_0^{y-\delta} w_{\text{пс}}(x) dx\, dy\, d\delta. \quad (2)$$

Here the probability of nonresolution is

$$P_{\text{нер}} = 1 - (P_{\text{пс}} + P_{\text{лс}}).$$

As an example, we will consider the case when recognition is based on the measurement of the signal with the maximum amplitude at the outlet of a quadratic amplitude detector. This case can be equivalent to the recognition of signals with the maximum brightness of the marks on the screen of an indicator with a brightness mark, or the recognition of radar objects from measurements of the instantaneous values of their effective surface areas of radiowave scattering. Assuming that the signals at the inlet of the detector are normal, the probability density of the signals at the outlet of an inertialess quadratic detector can be represented as

$$w_{\text{ис}}(x) = \begin{cases} \frac{1}{\sigma_{\text{ис}}} e^{-x/\sigma_{\text{ис}}}, & x > 0, \\ 0 & x < 0. \end{cases} \quad w_{\text{лс}} = \begin{cases} \frac{1}{\sigma_{\text{лс}}} e^{-y/\sigma_{\text{лс}}}, & y > 0, \\ 0 & , y < 0. \end{cases} \qquad (3)$$

where $\sigma_{\text{ис}}$ and $\sigma_{\text{лс}}$ are the mean powers of the true and false signals at the inlet of the quadratic detector, respectively. Here it is assumed apriori that $\sigma_{\text{ис}} > \sigma_{\text{лс}}$.

In order to simplify the problem, we will also assume that random value δ is distributed according to Rayleigh's law

$$w_{\delta}(\delta) = \frac{\delta}{\sigma_{\delta}^{2}} \exp\left(-\frac{\delta^{2}}{2\sigma_{\delta}^{2}}\right), \quad \delta > 0, \qquad (4)$$

where parameter σ_{δ} is numerically equal to the highest probable value of the sensitivity of the resolver.

We will point out that a number of factors prevent us from increasing the lower limit of sensitivity of actual resolvers (decreasing the value of σ_{δ}), mainly the different type of noise and instability of different components of the receiver and resolver.

Substituting probability densities (3) and (4) in formulae (1) and (2), after computing the integrals of the type (3.462.5) [4] we will obtain the following expressions for the above probabilities $P_{\text{ис}}$ and $P_{\text{лс}}$:

$$P_{\text{ис}}=\frac{\sigma_{\text{ис}}}{\sigma_{\text{ис}}+\sigma_{\text{лс}}}\left\{1-\frac{\sigma_{\delta}}{\sigma_{\text{ис}}}\sqrt{\frac{\pi}{2}}\exp\left(\frac{\sigma_{\delta}^{2}}{2\sigma_{\text{ис}}^{2}}\right)\left[1-\Phi\left(\frac{\delta_{\delta}}{\sigma_{\text{ис}}}\right)\right]\right\}, \quad (5)$$

$$P_{\text{лс}}=\frac{\sigma_{\text{лс}}}{\sigma_{\text{ис}}+\sigma_{\text{лс}}}\left\{1-\frac{\sigma_{\delta}}{\sigma_{\text{лс}}}\sqrt{\frac{\pi}{2}}\exp\left(\frac{\sigma_{\delta}^{2}}{2\sigma_{\text{лс}}^{2}}\right)\left[1-\Phi\left(\frac{\sigma_{\delta}}{\sigma_{\text{лс}}}\right)\right]\right\}, \quad (6)$$

where

$$\Phi(z)=\frac{2}{\sqrt{2\pi}}\int_{0}^{z}e^{-t^{2}/2}dt$$

is the probability integral.

If the true and false signals are received against a background of additive normal noise, $\sigma_{\text{ис}}$ and $\sigma_{\text{лс}}$ are the total intensities of the noise and signals, i.e.,

$$\sigma_{\text{ис}}=\sigma_{\text{исо}}+\sigma_{\text{исш}},\quad \sigma_{\text{лс}}=\sigma_{\text{лсо}}+\sigma_{\text{лсш}},$$

where $\sigma_{\text{исо}}$ and $\sigma_{\text{лсо}}$ are the powers of the true and false signals, respectively; and $\sigma_{\text{исп}}$ and $\sigma_{\text{лсп}}$ are the intensities of the noise at the inlet of the amplitude detector during the reception of the true and false signals, respectively.

For the further analysis it is convenient to introduce the following designations:

$$\alpha=\frac{\sigma_{\text{лсо}}}{\sigma_{\text{исо}}}$$

is the coefficient of similarity of the false signal to the true signal according to the mean power (the value of the effective surface area of radiowave scattering during radar observation);

$$q_{\text{ис}}=\frac{\sigma_{\text{исп}}}{\sigma_{\text{исо}}},\quad q_{\text{лс}}=\frac{\sigma_{\text{лсп}}}{\sigma_{\text{лсо}}}$$

are the ratios of the noise intensity to the signal power at the inlet of the detector during the reception of the true and false signals, respectively (the signal/noise ratios during the reception of the true and false signals, respectively);

$$\beta=\frac{\sigma_0}{\sigma_{\text{исо}}}$$

is the ratio of the most probable value of the sensitivity of the resolver to the power of the true signal at the inlet of the detector.

As a result of these designations, the expressions for probabilities $P_{\text{ис}}$ and $P_{\text{лс}}$ can be represented as:

$$P_{\text{ис}}=\frac{1+q_{\text{ис}}}{\alpha(1+q_{\text{лс}})+(1+q_{\text{ис}})}\left\{1-\frac{\beta}{1+q_{\text{ис}}}\sqrt{\frac{\pi}{2}}\exp\left[\frac{\beta^2}{2(1+q_{\text{ис}})^2}\right]\left[1-\Phi\left(\frac{\beta}{1+q_{\text{ис}}}\right)\right]\right\}, \tag{7}$$

$$P_{\text{лс}}=\frac{\alpha(1+q_{\text{лс}})}{\alpha(1+q_{\text{лс}})+(1+q_{\text{ис}})}\left\{1-\frac{\beta}{\alpha(1+q_{\text{лс}})}\sqrt{\frac{\pi}{2}}\exp\left[\frac{\beta^2}{2\alpha^2(1+q_{\text{лс}})^2}\right]\left[1-\Phi\left(\frac{\beta}{\alpha(1+q_{\text{лс}})}\right)\right]\right\}. \tag{8}$$

In the absence of noise ($\sigma_{\text{лсш}}=\sigma_{\text{исш}}=0$) these formulae are simplified:

$$P_{\text{ис}}=\frac{1}{\alpha+1}\left\{1-\beta\sqrt{\frac{\pi}{2}}e^{\frac{\beta^2}{2}}[1-\Phi(\beta)]\right\},$$
$$P_{\text{лс}}=\frac{\alpha}{\alpha+1}\left\{1-\frac{\beta}{\alpha}\sqrt{\frac{\pi}{2}}e^{\frac{\beta^2}{2\alpha^2}}\left[1-\Phi\left(\frac{\beta}{\alpha}\right)\right]\right\}. \tag{9}$$

wherepon when $\beta \ll 1$ (very high sensitivity of the resolver)

$$P_{\text{ис}}\simeq\frac{1}{\alpha+1},\quad P_{\text{лс}}\simeq\frac{\alpha}{\alpha+1}. \tag{10}$$

Figure 1 shows the dependences of probabilities $P_{\text{ис}}$ and $P_{\text{лс}}$ on the coefficient of the similarity of the false signal to the true signal α at different values of parameter β and $q_{\text{ис}} = q_{\text{лс}} = 0$.

Figure 2 shows the dependences of probabilities $P_{\text{ис}}$ and $P_{\text{лс}}$ on the noise/signal ratio $q = q_{\text{ис}}$ for $\sigma_{\text{иср}} = \sigma_{\text{лср}} (q_{\text{лс}} = q/\alpha)$, $\beta = 0{,}1$ and three values of the coefficient of the similarity of the false signal to the true signal.

General formulae (1) and (2) and formulae (5), (6), (7)-(10) obtained above for the common case of exponential laws of the distribution of the recognition parameters were derived with consideration of the apriori data, so that the mean value of the recognition parameter of the true signal is higher than that of the recognition parameter of the false signal. On the other hand, i.e., when the mean value of the recognition parameter of the true signal is lower than that of the false signal, the expressions for $P_{\text{ис}}$ and $P_{\text{лс}}$ are obtained analogously.

Recognition of One True Signal Among a Group of Identical False Signals

In the majority of practical problems, it is necessary to recognize the true signal from among a number of false signals.

We will assume that one signal is singled out of N+1 signals, for which we know that the mean value of its recognition parameter x is higher than the mean value of the recognition parameter of any of the N identical false signals. Then at an assigned sensitivity of the resolver δ, which is characterized by probability density $w_\delta(\delta)$, the probability of the recognition of the true signal is defined as the probability that all the values of the recognition parameters of the false signals will be lower than the values of the recognition parameter of the true signal by the value δ

$$P_{ис}(\delta) = \int_{\delta}^{\infty} w_{ис}(x) \left[\int_{-\infty}^{x-\delta} w_{лс}(y)\,dy \right]^N dx.$$

Averaging this expression for all the values of δ, we will obtain the formula for the probability of the recognition of the true signal

$$P_{ис} = \langle P_{ис}(\delta) \rangle_\delta = \int_{0}^{\infty} w_\delta(\delta) \int_{\delta}^{\infty} w_{ис}(x) \left[\int_{-\infty}^{x-\delta} w_{лс}(y)\,dy \right]^N dx\,d\delta. \quad (11)$$

In this case, the probability of nonresolution can be defined as the probability that none of the recognition parameters of the false signals will exceed the limits $x \pm \delta$.

The computation of the integrals in the last equations involves significant mathematical difficulties. However, analogously to [3], for a large number of false signals $N \gg 1$ we can approximately set

$$\left[\int_{\delta}^{x-\delta} w_{\text{лс}}(y)\,dy\right]^{N} = \begin{cases} 0 & \text{at } x-\delta < x_0, \\ \frac{1}{2} & \text{»} \; x-\delta = x_0, \\ 1 & \text{»} \; x-\delta > x_0. \end{cases}$$

As a result, expression (11) is simplified, assuming the form

$$P_{\text{нр}} \simeq \int_{0}^{\infty} w_{\text{к}}(\delta) \int_{x_0+\delta}^{\infty} w_{\text{лс}}(x)\,dx\,d\delta, \qquad (12)$$

where x_0 is determined from the relationship

$$\int_{0}^{x_0} w_{\text{лс}}(y)\,dy = 2^{-1/N}.$$

The probability of nonresolution when $N \gg 1$ can be approximately represented as (considering the approximate relationship $\int\limits_x^{x+\delta} w_{\text{лж}}(y)\,dy \simeq w_{\text{лж}}(x)\cdot\delta$) for small values of δ)

$$P_{\text{расп}} = \int\limits_0^\infty w_\delta(\delta)\,\delta^N \left[\int\limits_\delta^\infty w_{\text{ис}}(x)\,w_{\text{лж}}^N(x)\,dx + \int\limits_\delta^\infty w_{\text{ис}}(x)\,w_{\text{лж}}^N(x)\,dx\right] d\delta \simeq$$

$$\simeq 2\int\limits_0^\infty \delta^N w_\delta(\delta)\,d\delta \int\limits_0^\infty w_{\text{ис}}(x)\,w_{\text{лж}}^N(x)\,dx. \qquad (13)$$

We will calculate the probability of the recognition of the true signal with regard to the common situation discussed above, in which the probability densities of the recognition parameters of the true and false signals are determined by expressions (3), and the probability density of parameter δ is determined by expression (4). In this case (at $N \gg 1$), the value of x_0 is found from the relationship

$$\int\limits_0^{x_0} \frac{1}{\sigma_{\text{лж}}} e^{-\frac{x}{\sigma_{\text{лж}}}}\,dx = (1 - e^{-x_0/\sigma_{\text{лж}}}) = 2^{-1/N}.$$

Whence

$$x_0 = -\sigma_{\text{лж}} \ln(1 - 2^{-1/N}). \qquad (14)$$

Considering that at a large number N $2^{-1/N} \approx 1 - \frac{1}{N}$, the expression for the value of x_0 is approximately equal to

$x_0 \approx \sigma_{nc} \ln N.$

Substituting the relationships from (3), (4), and (14) in (12) for $w_{nc}(x)$, $w_1(\delta)$ and x_0, respectively, we will obtain the formula for the probability of the recognition of the true signal.

$$P_{no} = \exp\left[-\frac{\alpha(1+q_{nc})}{1+q_{no}}\ln N\right]\left\{1-\frac{\beta}{1+q_{nc}}\sqrt{\frac{\pi}{2}}\exp\left[\frac{\beta^2}{2(1+q_{nc})^2}\right]\left[1-\Phi\left(\frac{\beta}{1+q_{nc}}\right)\right]\right\}. \quad (15)$$

Comparing formulae (7) and (15) with each other, we can see that other conditions being equal, for a sufficiently large number of false signals N >> 1, the probability of the recognition of the true signal in the former case is k times lower than for the discrimination of the true signal from one false signal, where

$$K = \frac{(1+q_{nc})\exp\left[\frac{\alpha(1+q_{nc})}{1+q_{nc}}\ln N\right]}{\alpha(1+q_{nc})+(1+q_{nc})}.$$

The probability of nonresolution for the case in question is determined by the formula

$$P_{\text{непр}} = \frac{2}{\sigma_{лс}^{N-1} \cdot \sigma_\delta^2 (\sigma_{лс} + N\sigma_{ис})} \int_\delta^\infty \delta^{N+1} \exp\left(-\frac{\delta^2}{2\sigma_\delta^2}\right) d\delta. \quad (16)$$

Considering an integral of the type (3.461.2) [4], the formula for the probability of nonresolution (16) when β << 1 will be

$$P_{\text{непр}} \simeq \frac{(N/2)!\, 2^{N/2-1} \beta^N}{\alpha^{N-1} (1+q_{лс})^{N-1} [\alpha(1+q_{лс}) + N(1+q_{ис})]},$$

whereupon it is simplified at $\sigma_{исп} = \sigma_{лсп}$, assuming the form $\left(q = q_{ис},\ q_{лс} = \frac{q}{\alpha}\right)$

$$P_{\text{непр}} \simeq \frac{(N/2)!\, 2^{N/2-1} \beta^N}{(\alpha+q)^{N-1} N(1+q)}.$$

The analysis of the expressions obtained above shows that with the assumptions made, β << 1 and N >> 1, the probability of nonresolution approaches zero. physically, this is due to the fact that at a large number of false signals and even relatively low sensitivity ($\beta \lesssim 0.1$), the probability that all the false signals will lie within the limits of sensitivity of the resolver $x \pm \delta$ is virtually equal to zero. With these assumptions, we can say that the probability of mistaking a false signal for the true one is equal to $P_{лс} \simeq 1 - P_{ис}$.

Figure 3 shows the dependences of coefficient K(N) on the number of false signals N at $q_{ис} = q_{лс} = 0, \beta = 0.1$ and a series of values of the similarity coefficient α.

Figure 4 shows the dependences of coefficient K(q) on the noise/signal ratio $q = q_{ис}$ at $\sigma_{лсп} = \sigma_{иcп}$ $(q_{лс} = q/\alpha)$ for two values of the number of false signals N = 10, 20; β = 0.1; and α = 0.2, 0.5, 0.7.

It is evident from these curves that the probabilities of the recognition of the true signal decrease with the increase in the number of false signals and the increase in the noise/signal ratio.

Similarly, we can find the formula for the probability of the recognition of the true signal when the decision is based on the fact that the mean value of the recognition parameter of the true signal is lower than that of the false signal. In this case

$$P_{\text{но}}=\int_0^{\infty} w_{\delta}(\delta)\int_0^{\infty} w_{\text{ис}}(x)\left[\int_{x+\delta}^{\infty} w_{\text{лс}}(y)\,dy\right]^N dx\,d\delta.$$

The probability of nonresolution when N >> 1 is determined by expression (13), like before.

With reapect to the laws of distribution (3) and (4), the probability of recognition $P_{\text{ио}}$ is determined from the formula

$$P_{\text{ис}}=\frac{\sigma_{\text{лс}}}{N\sigma_{\text{ис}}+\sigma_{\text{лс}}}\left\{1-\frac{\sigma_{\delta}}{\sigma_{\text{лс}}}N\sqrt{\frac{\pi}{2}}\exp\left(\frac{N^2\sigma_{\delta}^2}{2\sigma_{\text{лс}}^2}\right)\left[1-\Phi\left(\frac{N\sigma_{\delta}}{\sigma_{\text{лс}}}\right)\right]\right\},\quad \sigma_{\text{лс}}>\sigma_{\text{ис}},$$

whereupon, if $N\sigma_{\delta}/\sigma_{\text{лс}}\gg 1,$

$$P_{\text{ис}}\simeq 0{,}5\,\frac{\sigma_{\text{лс}}}{\sigma_{\text{лс}}+N\sigma_{\text{ис}}}.$$

When the true and false signals are a mixture of signal and noise at the inlet of a quadratic detector,

$$P_{\text{ис}}=\frac{\alpha(1+q_{\text{лс}})}{N(1+q_{\text{ис}})+\alpha(1+q_{\text{лс}})}\left\{1-\frac{\beta}{\alpha(1+q_{\text{лс}})}\sqrt{\frac{\pi}{2}}\exp\left[\frac{N^2\beta^2}{2\alpha^2(1+q_{\text{лс}})^2}\right]\left[1-\Phi\left(\frac{N\beta}{\alpha(1+q_{\text{лс}})}\right)\right]\right\}.$$

$$(\alpha\geqslant 1).$$

Figure 5 shows the dependences of the probabilities of the recognition of the true signal $P_{\text{ис}}$ on the number of false signals N at $\beta = 0.1$, $q_{\text{ис}} = q_{\text{лс}} = 0$, and three values of the similarity coefficient of the false signals $\alpha = 5$, 2 and 1.2.

Figure 6 shows the dependences of the probability of the recognition of the true signal from the noise/signal ratio $q = q_{\text{лс}}$ at $\sigma_{\text{лсп}} = \sigma_{\text{исп}}$ $(q_{\text{лс}} = q/\alpha)$ for several values of α and two values of the number of false signals N = 10 and 20.

It is also evident from these dependences that the probability of the recognition of the true signal decreases with the increase in the number of false signals and the increase in the noise/signal ratio.

Thus, this analysis of the effect of the limited sensitivity of the resolver on the characteristics of the discrimination of the true signal from false signals has shown that the errors in resolution are higher than those of perfect resolvers. The "rougher" the resolver, the greater this increase in errors. The rather simple engineering relationships obtained make it possible to compute the probability of resolution errors depending on the conditions of observation and the statistical parameters characterizing the sensitivity of the resolver.

Received 18 April 1967

After revision - 9 December 1967

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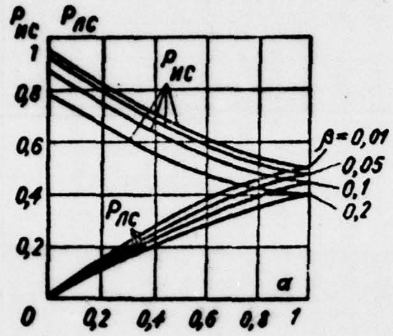

Fig. 1.

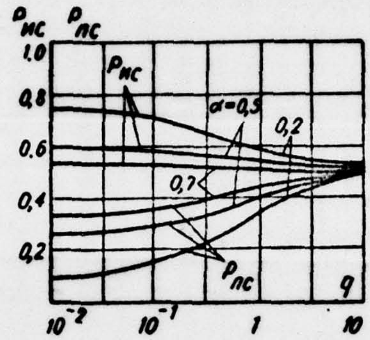

Fig. 2.

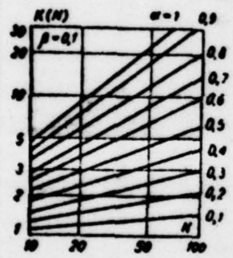

Fig. 3.

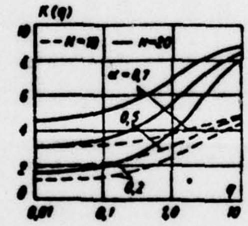

Fig. 4.

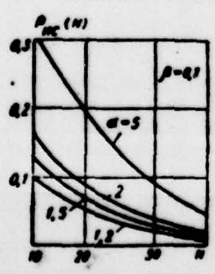

Fig. 5.

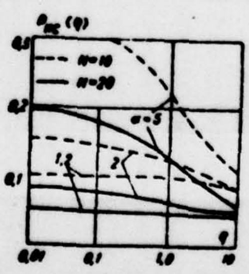

Fig. 6.

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D008	NISC	1
H300	USAICE (USAREUR)	1
P005	ERDA	1
P055	CIA/CRS/ADD/SD	1
NAVORDSTA (50L)		1
NASA/KSI		1
AFIT/LD		1
E053	AF/INAKA	1
E017	AF/ RDXTR-W	1
E404	AEDC	1
E408	AFWL	1
E410	ADTC	1
E413	ESD	2
	FTD	
	CCN	1
	ETID	3
	NIA/PHS	1
	NICD	5