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A METHOD FOR ESTIMATING THE POWER SPECTRAL DENSITY OF AN INFORMATION SIGNAL FOR EVALUATION OF FORMANT INTELLIGIBILITY OF SPEECH UNDER LUMPED INTERFERENCE CONDITIONS

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Based on the coherency function properties, a new method for estimating the power spectral density of an information signal in the presence of lumped interference is suggested. The paper includes results of instrumental calculation of articulation characteristics when reception of signals with single-band modulation occurs in the presence of lumped interference modulated in phase by Gaussian random process.

A considerable amount of full-scale tests of noise immunity of radio communication lines for speech information $S_c(t)$ transmission is related to the need for estimating the intelligibility of speech sounds in the presence of fluctuation noise in the communication channel and of lumped interference $S_n(t)$.

The instrumental calculation can be applied only to the formant intelligibility A, which may be recalculated into the sound, syllable, or word one. For automation of the formant approach, we have to find the estimates of power spectral densities (PSD) of the speech signal $\bar{I}^*_{d_c}(f)$ and the masking noise $\bar{I}^*_{d_n}(f)$ at the output of a communication channel with interference [1, 2].

Moreover, because of nonlinear processing of the input additive mixture $S_\Sigma(t) = S_c(t) + S_n(t)$, the masking noise contains the products of interaction with the legitimate signal at carriers' detuning frequencies Δf, while the legitimate signal itself undergoes attenuation depending on the structure and level of the lumped interference [3, 4]. This situation imposes some limitations on application of the compensation method [2] for estimating PSD from the resulting spectrum at the output $\bar{I}^*_{d_\Sigma}(f)$, when the method works in the presence of the fluctuation and quantization noise.

The purpose of this work consists in elaborating the compensation method for separation of PSD of the speech signal and of the masking noise at the output of a communication channel with lumped interference. Another purpose is to evaluate the intelligibility measurement errors of this method at full-scale tests of noise immunity.

With regard for nonlinear impact $F(f)$ of the processing channel in the radio receiver, the interference component $\bar{C}^*_{d_n}(f)$ in the mixture $\bar{C}^*_{d_\Sigma}(f)$ includes also a component corresponding to interaction between the transmitted interference $S_n(t)$ and signal $S_c(t)$ $\bar{\Delta}(f)$. Obviously, this component is dictated by cross-correlation between the interference and the signal: $\bar{C}^*_{d_n}(f) = \bar{C}_{d_n}(f) + \bar{\Delta}(f)$ [2]. Moreover, variation of the amplitude and phase contributions in the legitimate signal and interference at each of the analyzed frequencies will be different. Introduce a proportionality coefficient $\xi(f)$, showing the contribution made by the interference component into the resulting spectrum of the mixture $\bar{C}^*_{d_\Sigma}(f)$ at the output of the nonlinear processing channel. Then for the averaged PSD of the interference we can write

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