ANALYSIS OF CUMULANT COEFFICIENTS OF AN ADDITIVE MIXTURE OF NOISE SIGNALS

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Objective. The source of information in passive systems for heat-and-power equipment diagnosing are noise signals, the distribution of which in general differs from Gaussian. The aim of the work is to study the cumulant coefficients of the sum of the useful noise signal and noise interference.

Results. Let the noise signal $\xi_0(t)$ and noise interference $\xi_1(t)$ be independent stationary random processes. Then the s-th order cumulant coefficients of their sum are equal to

$$\gamma_s(M) = \frac{M^{s/2}\gamma_{s,0} + \gamma_{s,1}}{(M+1)^{s/2}}, \quad s \geq 3,$$

where $M = \kappa_{2,0}/\kappa_{2,1}$ is the variance ratio of signal $\xi_0(t)$ and interference $\xi_1(t)$, $\gamma_{s,0}$, $\gamma_{s,1}$ are their cumulant coefficients.

If the signal and interference are Gaussian, then all $\gamma_{s,0} = \gamma_{s,1} = 0$ and the sum distribution is Gaussian, with all $\gamma_s(M) = 0$. If the signal has $\gamma_{s,0} = 0$, then the cumulant coefficients of the sum $\gamma_s(M) < \gamma_{s,1}$, if $\gamma_{s,1} > 0$, and $\gamma_s(M) > \gamma_{s,1}$, if $\gamma_{s,1} < 0$. Similarly, if the interference has $\gamma_{s,1} = 0$, then the coefficients $\gamma_s(M) < \gamma_{s,0}$ at $\gamma_{s,0} > 0$, and $\gamma_s(M) > \gamma_{s,0}$ at $\gamma_{s,0} < 0$.

At $M \to 0$ the coefficients $\gamma_s(M) \to \gamma_{s,1}$ and at $M \to \infty$ the coefficients $\gamma_s(M) \to \gamma_{s,0}$. If the coefficients $\gamma_{s,0}$, $\gamma_{s,1}$ have the same signs, then at $M = M_{m,s} = \left(\gamma_{s,1}/\gamma_{s,0}\right)^{2/(s-2)}$ the coefficient $\gamma_s(M)$ has a minimum. If the coefficients $\gamma_{s,0}$, $\gamma_{s,1}$ have different signs, then the coefficients $\gamma_s(M)$ may be positive, negative and equal to zero. In particular, $\gamma_s(M) = 0$ if $M = M_{0,s} = \left(-\gamma_{s,1}/\gamma_{s,0}\right)^{2/s}$.

Conclusions. The use of higher-order cumulant coefficients in the design of a noise diagnosis system and the consideration of their properties will allow to increase the sensitivity and reliability of diagnosing heat power equipment.