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LEAST-SQUARES ESTIMATION OF PROBABILISTIC CHARACTERISTICS OF POLYRHYTHMIC SIGNALS

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Investigation of consistency is performed for the least-squares estimate of the mean value and correlation function of polyrhythmic signals. The criteria of asymmetric nonbias of the correlation function are formulated. An example of processing of a polyrhythmic signal is presented.

Stochastic behavior and polyrhythmic variability is inherent in many processes occurring in radio-engineering systems. The appropriateness of models in the form of almost periodically correlated random processes (APCRP) for processing of signals with polyrhythmic structure has been discussed in [1–3]. Consider the representation of a polyrhythmic signal by APCRP

$$\xi(t) = \xi_0(t) + \sum_{n=0}^{L_1} \left[\xi_n^c(t) \cos \omega_n t + \xi_n^s(t) \sin \omega_n t \right]$$

where $\omega_n = 2\pi/T_n$, T_n is the period of correlativity, while $\{\xi_0(t), \xi_n^{(\bullet)}(t), n = \overline{1, L_1}\}$ is the vector-like $(2L_1 + 1)$-dimensional stationary random process with a limited sum of variances of its components.

The expressions of the mean value and correlation function can be written, respectively, as

$$m(t) = m^T e^{\omega}(t), \quad b(t,u) = B^T(u) e^{\nu}(t), \tag{1}$$

where the column vectors $m = (m_0, m_1^c, \ldots, m_{L_1}^c, m_1^s, \ldots, m_{L_1}^s)^T$ and $B(u) = (B_0(u), B_1^c(u), \ldots, B_{L_2}^c(u), B_1^s(u), \ldots, B_{L_2}^s(u))^T$ are the Fourier coefficients of the mean value and correlation function, respectively,

$$e^{\omega}(t) = \left(1, \cos(\omega_1 t), \ldots, \cos(\omega_{L_1} t), \sin(\omega_1 t), \ldots, \sin(\omega_{L_1} t)\right)^T$$

and

$$e^{\nu}(t) = \left(1, \cos(\nu_1 t), \ldots, \cos(\nu_{L_1} t), \sin(\nu_1 t), \ldots, \sin(\nu_{L_1} t)\right)^T$$

are the column vectors of basic functions, m_0, $m_n^{(\bullet)}$ are the mean values of the modulating processes $\xi_0(t)$, $\xi_n^{(\bullet)}(t)$, respectively, and the correlative components $B_0(u)$ and $B_n^{(\bullet)}(u)$ are defined by self- and cross-correlation links of the two processes.

By a prescribed mean value $m(t)$ and correlation function $b(t, u)$, their magnitudes can be calculated, respectively, by formulas

$$m_0 = \lim_{\theta \to \infty} \frac{1}{2\theta} \int_{-\theta}^{\theta} m(t) dt, \quad m_n = \lim_{\theta \to \infty} \frac{1}{\theta} \int_{-\theta}^{\theta} m(t) e^{-j\omega_n t} dt;$$

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