Reconstruction of Methods for Estimation of Periodical Correlated Stochastic Biosignals on a Base of the Least Action Principle

Bohdan Yavorskyy

Abstract - **In this paper results of development of least action principle for estimation of periodical correlated stochastic biosignals (PCSB) are given. The informative-ness definition of the action is founded. The entropy of an estimate of PCSB power spectral density (BPSD) had been used for determine of informative-ness of PCSB estimations. Results are using for synthesis of biotechnical systems are effective as an informative.**

Keywords – **Least action, Informative-ness, Entropy, PCSB, BPSD.**

I. Introduction

Estimates of the spectral characteristics

$$\hat{S}(\omega\tau)\frac{1}{2\pi}\int_{-\theta}^{\theta}\hat{C}(t,\tau)\exp(-i\omega\tau)d\tau \qquad (1)$$

of PCSB $\xi(t)$ are given by estimates of covariances

$$\hat{C}(t,\tau)=\int_{0}^{t-}{}^{\mathbf{o}}(t-u)\,{}^{\mathbf{o}}(t-u+\tau)h(u)du\,, \qquad (2)$$

where the sign $\mathbf{o}$ denoted the centering, $h(t)$ is considered as the pulse function of an linear optimal filter [1] had been achieved, e.g. as in [2], by a sequential optimization procedure

$$\underset{k,l\in N}{\arg\min}\,VAR_d\hat{f}_k(\omega_l)\,, \qquad (3)$$

where d- variation

$$VAR_d(\cdot)=\sum_{k=1}^{K}\sum_{l=1}^{L}\left\|f_k(\omega_l)\right\|^2_{\varepsilon,\pi}\,, \qquad (4)$$

$\left\|\cdot\right\|^2_{\varepsilon,\pi}$ — a norm in Hilbert spaces ε, or p [1], f_k — BPSD of stationary component's. Nevertheless, the fundamental features for systems is informative-ness [3] is depended because periodical correlated stochastic process (PCSP) representation [1, 4]. In such sense, suppose the informative-ness is the value like to the action in well-known variation calculus. In this paper this concept is developed.

II. The Construct of PCSB Informative-ness

For definition of the informative-ness of a signal meets conditional entropy H [3, 4]. Therefore, for L- component PCSB it considered to be

$$H(K|N)=-\sum_{l}\sum_{\nu}p_{f,l}(\nu)\sum_{k}P_l(V_{\gamma,k}|\nu)\log P_l(V_{\gamma,k}|\nu)\,, \qquad (5)$$

where

$$=\sqrt{V_0}\;^{-1}(P_f)+M_0\,, \qquad (6)$$

Φ — probability integral, V_0, M_0 — variance and mathematical expectation of a reliable estimate of BPSD. The probability of the reliable decision about that what estimations of BPSD to choice were considered as

$$P_d=1-\;(\frac{\nu-M_\gamma}{V_\gamma})\,, \qquad (7)$$

where M and V — mathematical expectation and variance of average BPSD estimates of experimental PCSB.

III. Conclusion

When entropy Eq. (5) accomplish extreme by varies BPSD than that its estimate, e.g. determined with Eq. (1), is optimal. The decision about the estimate reliability will be made by the comparison of variance of average BPSD estimations with threshold value ν is determined with Eq. (6) where probability P_f is what such decision is false is given. The reliability of the estimate determines the probability P_d given by Eq. (7). At last, at the end, therefore are received values a) the correlation period of PCSB; b) segments of localness of garmonizable representations; c) a method of the spectral analysis; d) distributions of probability of BPSD for Eq. (5); e) a method for construct expression of PCSB informative-ness and so on.

References

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Bohdan Yavorskyy – Ternopil National Technical University named after Ivan Pului, Rus'ka Str., 56, Ternopil, 46001, UKRAINE, E-mail: Kaf_BT@tu.edu.te.ua

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