Generalized Method of Nonlinear Filtering of Biomedical Signals with Locally Concentrated Signs

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Abstract - **The task of structural identification (SI) of biomedical signals (BMS) with a locally concentrated signs (LCS) with a nonlinear filter (NF) is considered in the work. The models of the useful signal (MUS) and the methods of transformation of BMS with LCS on basis MUS are described. Generalized method of nonlinear filtering for BMS with LCS is offered.**

Keywords - **Structural identification, Biomedical signal with a locally concentrated signs, Nonlinear filter, Model of the useful signal.**

I. Introduction

The design of computer-assisted diagnostic systems for the assessment of the heart and cardiovascular system to increase the effectiveness of diagnostics of cardiovascular diseases is an important problem of medical cybernetics. The main stages of processing of BMS with LCS in computer-assisted diagnostic systems are described in [1]. This BMS with LCS are quasiperiodic signals of complex form consisting of periodically alternating structural elements (SEs). The SEs can be considered as small fragments of interval of observation of BMS with LCS which contained information about the object. One of the most responsible and difficult formal stages of processing of BMS with LCS is the stage of SI that means the selection of SEs on the background noise. This task can be solved using a NF which based on the MUS. The goal of the NF is to find a transformation based on the set of SEs of BMS with LSP, which may result in getting a signal with given characteristics.

II. Models of the useful signal

The different MUS are considered in [1, 2]. Each model in accordance to some criterion well describes SEs.

In model MUS-1 BMS can be considered as a discrete function of time. This is the simplest model. The characteristics of BMS with LCS are not considered. Model MUS-2 is model of decomposition of BMS in terms of basis functions. For example Fourier series or wavelets can be used in the MUS-2. Period of BMS can be considered in MUS-3 model as the function which piecewise defined by a sequence of fragments on the period. At the same time one's separate approximating function as a SE characteristic is specified on the each time interval. Model MUS-4 is a structural-linguistic model of the period's representation of the BMS with LCS. In model MUS-5 BMS with LCS can be considered like set of objects in space of parameters. Some features of the MUS-3 (parameters of piecewise defined approximating functions are used in order to representation of object) and some features of the MUS-4 (BMS are considered as set of object) are included in model MUS-5.

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III. The generalized method of nonlinear filtering

The following transformation methods of BMS with LCS can be identify on basis of mentioned above models: contour analysis (MUS-1); Fourier and wavelet transformation (MUS-2); the structural transformation of the basis of the parse (MUS-3); the transformation into the adaptive space of parameters of approximating function (MUS-5). The analysis of these methods allows to identify the similar stages during the SI of BMS with LCS. The following scheme of SI is offered as a result of our work (Fig. 1).

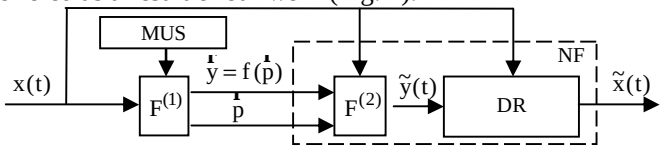

Fig. 1. The scheme of structural identification of BMS with the LSP on the basis of the nonlinear filter

The transformation of the first level $F^{(1)}$ is one method of the BMS with LCS $x(t)$ transformation into vector $\vec{y} = f(\vec{p})$ on basis of MUS, taking into account parameter vector $\vec{p}$. The transformation of the second level $F^{(2)}$ is to obtain a new temporary function $\tilde{y}(t)$. Performing analysis of this function, the SI of an appropriate decision rule (DR) is satisfied. Transformation $F^{(2)}$ together with the decision rule are the basis of the NF. The adequacy of a certain MUS for each SE is different, so we offer to combine the partial decision rules into the collective of decision rules for the design of NF.

IV. Conclusion

The analysis of MUS and methods of transformation of BMS with LCS possible to identify similar stages in SI of BMS with LCS. Generalized scheme of SI of BMS with LCS with NF are proposed, which takes into account the dignity of the main methods of transformation of BMS with LCS.

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