THE MATHEMATICS PROCESSING OF SIGNALS

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Abstract

The paper presents practical notions of metrology, methodology and instrumental technique to measure biological signals. The living organism is a permanent source of spontaneous signals and current activity evoked by various means amending the initial state (electrical stimulation, pharmacological etc.).

Biosemnalul is a support of biological information derived from various sources and reflects the physical manifestation - the chemical that accompanies and characterizes various biological activities.

1. Biosignals - definition, classification

The signals present in biological systems can be divided into: continuous and discontinuous, periodic and aperiodic.

The signal continuous / discontinuous succession is a continuous / discrete values of a specific size for a physical process or phenomenon - the chemical biosystem.

Among the listed types of signals can meet the following combinations:

a) **continuous signals**, variable aspect, how are: presionale curves registered at various levels of the blood circulatory system quantitatively correlated to describe the behavior of the vascular system; respiratory rate (typical patterns) correlated with the partial pressure of oxygen, carbon dioxide and pH of blood; the effect of the hormone regulator, investigated by quantitative dynamic study of blood levels;

b) **mixed signal predominantly discontinuous**, with continuous component meet in the relationship between train potential generated by muscle contraction motoneuron and supported; vasomotor activity, arterial and venous;

c) **discontinuous signals**, manifest in neural networks, studied neuroanatomy;

d) **mixed signal predominantly continue** with discontinuous component is to meet receptors, particularly Chemoreceptor.

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The signal is a temporal expression of how development evolves in its natural process. That defines this relationship is dependent occur to function as the signal described: f = x (t).

Initial processing of biosignals through transducers allows getting these functions - all signal by converting variation biophysical measurements into electrical signals.

2. Unit of measure and errors

Quantitative Evaluation of physical quantities (biological) measurement is done by surgery. A measure a size M means to compare with a yard (M) of the same nature, conventionally chosen as the unit of measure: m = M / (M), where m is the numerical value of M. In operation measuring size involved the following elements:

- measurement object (size measured);
- measurement method (how measured by comparing the size of the unit of measure);
- measuring instruments (all means technical-instrumentation, electronics with which to determine quantitatively measured size).

Measurements can be performed in basal conditions in which the system is, and changed conditions (electrical stimulation, chemical, pharmacological, climatic, nutritional etc.).

The measured value (X) includes an error due to limited accuracy of measuring instruments, measurement methods and imperfection of the human operator, and due to accidental influences.

True value of a quantity (X_0) is its exact value without errors.

Classification of measurement errors:

A) In terms of expression:

- Absolute error E, which represents the difference between the measured value (X) and true value (X_0) of the measured quantity. Absolute error is expressed in the same units as measured size: $E = X–X_0$.
- relative error E_r is the ratio of the absolute error and the true value of the measured quantity. Based on the relative error of measurement accuracy is determined with how the error is smaller, the better the accuracy is better.

B) In terms of the event:

- systematic error that is repeated measurements under identical conditions;
- error random error representing whose values vary unpredictably and sign the measurement in virtually identical conditions. To minimize the influence of accidental errors on measurement result means repeat in identical conditions of measurement and statistical processing of results;

- error rough is the error that far exceeds most likely errors in data measurement conditions (eg. reading of the indicated erroneous, incorrect use of a means of measuring etc.). These errors can always be avoided.

C) In terms of sources of error:

- model errors (errors from the object of measurement);
- instrumental errors (errors due to measuring instruments);
- interaction errors (means of measuring errors due to interaction - interaction and customer measurement object subjected to measurement-measuring means);
- influence of errors (errors due to external influences).

3. Means of biomeasuring

Bioinstrumentation exploratory represent all devices, equipment and measuring instruments for the capture, processing, storage and quantify various types of bio-signs.

Bioinstrumentation classification is based on multiple criteria:

a) technical and constructive features:

- large or miniaturized devices;
- modular and compact;
- low or high power;
- with independent power supply or mains powered;
- computer assisted or not.

b) intended use in various investigations:

- clinical laboratories (biochemical and biophysical analysis);
- functional exploration services specific to each compartment of investigation;
- modern exploration techniques morphological and functional (video-monitored optical microscopy) compterizata tomography, radiology by single photon emission (SPET) or positron (PET), RIA type or scan radiology, Doppler velocimetry, telemetry.

c) exploring how to perform:

- in inpatient;
- ambulatory, with the following variants:
    - mounted in auto mobiles;
    - Portable kits for direct exploration, exploration remote (telemetry) or continuous tracking (monitoring of vital parameters).

Measurement is performed using biological parameters bioinstrumentatiei in structures that fall:

i) means capture (transfer) biological signal;

ii) primary processing components;

iii) monitoring systems, playback, storage

Assembling these components is bioelectrometric chain.

4. Means of capture

To receive means adapted biological signals using the biological activity investigated:

a) electrodes for bioelectric signals;

b) transducers for non-electrical signals.

Whatever their nature, means of capture must meet the following general conditions:

- not to influence the phenomenon studied;
- do not irritate or destroy the living organism;
- be easy to handle and placed in convenient places measurements;
- to comply with sterilization;
- to provide stability over time, immunity to disturbances from electrical, electrochemical, magnetic, mechanical etc.

5. Areas and limitations of use

Exploratory bioinstrumentation is used in the following directions:

- complementary means in clinical diagnosis;
- means regular monitoring of health or disease through screening exploration;
- means of controlling the therapeutic efficiency and the degree of functional recovery and adaptation;
- establishing the physical and mental performance, work capacity and professional guidance.

User limits are dictated by the following criteria:

- destination size and scope explored (EXAMPLES: electrophysiological explorations (EEG), evoked cortical potential (PEC), PEC (visual, auditory, somatosensory);
- performante constructive (low background noise, primary and secondary processing facilities).
- conditions of use:
    - static or dynamic exploration,
    - exploration special media (immersion hipobarism, weightlessness)
- patient (type and severity of the disease, medication administered, when exploring ECG heart insignificant before).

6. Methodology and technical principles of exploration

A. Pinning explored specific domain (heart) size or explored parameter (bioelectric) method, technique (ECG) tests and exploration (stress tests)

B. Knowledge and proper selection of methods (invasive) methods and capture (electrodes in standard derivatives), primary processing (amplification

1mV / cm seam filter above 30 Hz), playback (cardioscope), monitoring (Holter) and storage (paper , tape) data exploration

C. Learning and ensuring minimal pre-test operations, test and post-test:

a) pretest:

- mental preparation, physical and instrumental patient;
- sampling;
- administration of pharmacological substances.

b) testing: respecting succession exploratory technical operations

c) post-test:

- the patient's return to its initial state (recovery);
- indications of avoiding post-test accidents.

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