



EUROPEAN UNION  
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Development and Education



Zdroj: <https://predmety.fbmi.cvut.cz/cs/doktorske-bme>

Name of study subject: **Digital processing of one-dimensional biosignals**

**Brief annotation of the subject:**

The aim of the course is to acquaint students with digital one-dimensional biosignal processing.

**Brief Syllabus of Lectures:**

1. Real time and off line processing of biological signals. Computer networks. Statistical characteristics of biosignals. Probability distribution. Stochastic processes and analysis of time series. Acquisition and preprocessing of biological data, discretization - the basic chain of transfer to the computer. A/D converters. Problems of sampling and signal quantization. Aliasing. Filtration.
2. Spectral Analysis Basic Methods. Periodogram, autoregressive model. Parametric and nonparametric methods. Practical problems of spectrum estimation. Cross-spectrum, coherence and phase. FFT and its application. Compressed spectral array (CSA). Interhemispheric and local coherence. Medial synchrony and symmetry. Phase measurement.
3. Topographic mapping of electrophysiological activity. Principle of brain mapping. Amplitude and frequency mapping. Interpolation. Use in clinical diagnostics. Dynamic mapping.
4. Adaptive Segmentation. Non-stationarity of biosignals. Basic methods. Multi-channel on-line adaptive segmentation. Feature extraction.
5. Neural networks and signal processing. Principal component analysis and neural networks. Hebb's Learning. Multichannel signals - compression and reconstruction. Self-organizing principal component analysis.
6. Automatic classification - Teaching without a teacher. Metrics. Data normalization. Cluster analysis. K-means algorithm. Fuzzy sets. Optimal number of classes. Limits and constraints of cluster analysis. Learning Classifiers. Comparing the properties of supervised and non-supervised learning. Online Classification. Classic and fuzzy k-NN classifier.
7. Automatic detection of epileptic grafoelements. Automatic peak detector based on median filtering. Arithmetic detector. Combined detector. Principal component analysis and classical filtration for detection.
8. Electrocardiographic signal - Digital processing, properties. Frequency analysis, filtration, adaptive filtration.
9. Electrocardiographic signal - Data reduction, feature extraction, Holter ecg.
10. Respirometry, description of signal parameters. basic algorithms and output data.
11. Video signals. Multidimensional signals and sequences. Specific software for image processing.

**Brief Syllabus of Exercises:**

1. Filtration and segmentation of EEG signal.
2. Classification of EEG signal.
3. ECG signal feature extraction.