



Course: Theory of Information and Signal Processing

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LANGUAGES OF EDUCATION: Ukrainian, Russian, English

THE SUBJECT of educational course: basics of information theory including calculation of information amount, entropy for independent, inter-dependent, equiprobable and non-equiprobable events, informational capacity of communication channel, influence of the noises; optimal coding, estimation of the error rate; group and cyclic codes; spectral transforms of continuous and discrete functions (Fourier, Hartley, Walsh and other); convolution and correlation analysis; wavelet transform and new methods of spectral analysis; algorithms of data acquisition and compression.

THE GOAL of the course includes formation of following **abilities** of students:

Ability to calculate entropy for different forms of dependency between the elements,

- ❖ Ability to estimate amount of information during transmitting via communication channel, informational losses, influence of noises in the channel,
- ❖ Ability to form optimal codes for different ensembles of values, events or elements with own probabilities,
- ❖ Ability to use different methods of spectral analysis for the task of processes calculation, prediction, and compression

MAIN TASK OF EDUCATIONAL COURSE

In accordance to demands of educational-professional program, after the finishing of this course must demonstrate such learning outcomes:

Knowledge:

- ✓ theoretical basis of information theory and signal processing methods
- ✓ basic algorithms of coding, decoding, error diagnostics and correction
- ✓ applying of error-correcting procedures
- ✓ estimation of redundancy for different codes
- ✓ applying of discrete and continuous spectral transforms
- ✓ using of wavelet transform to compress and analysis of the data
- ✓ correlation and auto-correlation analysis

Skills:

- ✓ theoretical basis of information theory and signal processing methods
- ✓ basic algorithms of coding, decoding, error diagnostics and correction
- ✓ applying of error-correcting procedures
- ✓ estimation of redundancy for different codes
- ✓ applying of discrete and continuous spectral transforms
- ✓ using of wavelet transform to compress and analysis of the data
- ✓ correlation and auto-correlation analysis

Experience:

- ✓ application of the general principles of information theory and signal processing methods for choosing optimal coding algorithm including error-correction, calculation of convolutions, identification of parameters, compression and prediction.

COURSE DURATION: 6,5 credits, 195 hours in total, 72 hours of lectures, 36 hours of practice, 6 hours of calculation and graphical work, 81 hours for own student's work.

REQUIREMENTS TO STUDENTS: knowledge in the field of mathematical analysis, calculation mathematics, basic programming skills.

Basic function

$$h_i(v, x) = \cos\left[\frac{2\pi}{N}vx\right] + \text{ctg}\left[\alpha\right]\sin\left[\frac{2\pi}{N}vx\right].$$

$N=12$ $\alpha = \frac{\pi}{2}$

Matrix of basic function

$$F_{Hr} = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0.86 & 0.5 & 0 & -0.5 & -0.86 & -1 & -0.86 & -0.5 & 0 & 0.5 & 0.86 \\ 1 & 0.5 & -0.5 & -1 & -0.5 & 0.5 & 1 & 0.5 & -0.5 & -1 & -0.5 & 0.5 \\ 1 & 0 & -1 & 0 & 1 & 0 & -1 & 0 & 1 & 0 & -1 & 0 \\ 1 & -0.5 & -0.5 & 1 & -0.5 & -0.5 & 1 & -0.5 & -0.5 & 1 & -0.5 & -0.5 \\ 1 & -0.86 & 0.5 & 0 & -0.5 & 0.86 & -1 & 0.86 & -0.5 & 0 & 0.5 & -0.86 \\ 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 \\ 1 & -0.86 & 0.5 & 0 & -0.5 & 0.86 & -1 & 0.86 & -0.5 & 0 & 0.5 & -0.86 \\ 1 & -0.5 & -0.5 & 1 & -0.5 & -0.5 & 1 & -0.5 & -0.5 & 1 & -0.5 & -0.5 \\ 1 & 0 & -1 & 0 & 1 & 0 & -1 & 0 & 1 & 0 & -1 & 0 \\ 1 & 0.5 & -0.5 & -1 & -0.5 & 0.5 & 1 & 0.5 & -0.5 & -1 & -0.5 & 0.5 \\ 1 & 0.86 & 0.5 & 0 & -0.5 & -0.86 & -1 & -0.86 & -0.5 & 0 & 0.5 & 0.86 \end{bmatrix}$$
