Study program: Electrical and Computing Engineering – Module: Computer and Software Engineering

Type and level of studies: Master studies (second level of studies)

Course unit: Advanced Signal Processing

Teacher in charge: Đorđe Damnjanović

Language of instruction: English

ECTS: 6

Prerequisites: -

Semester: Winter

Course unit objective

Knowledge of advanced signal processing techniques (spectral estimation and prediction, optimal and adaptive filtering, wavelets) and their use in modern control systems.

Using a combination of theory and software implementations to solve signal processing problems.

Gaining skills for using mathematic and software tools, such as Matlab, for solving the problems.

Learning outcomes of Course unit

The course enables students to apply the learned theoretical concepts from advanced signal processing techniques in software/hardware experiments, achieve significant results and conclusions in signal analysis, apply learned algorithms in the field of controlled systems. The tasks that this course should accomplish is the mastery of theoretical, methodological and practical knowledge of signal processing.

Course unit contents

Theoretical classes

1. Restoring the basics of digital signal processing (A/D and D/A conversion, correlation and convolution, spectral analysis using DFT and FFT, use of Laplace and z-transformation in system analysis and synthesis and filter design, quantization and rounding effects; 2. Theory of spectral estimation and prediction; Discrete random signals and processes; 3. Optimal filtering (Wiener filter, Kalman filter) 4. Adaptive filtering (Algorithm of least squares - LMS, Adaptive filters in the frequency domain, Recursive algorithm of least squares - RLS, monitoring of time-varying systems, 5. Wavelets, theoretical foundations and their application in the process of noise reduction from signals.

Practical classes

Realization of computational and practical examples on the blackboard and on the computer using Matlab software package. Implementation of created algorithms on a hardware platform.

Literature

[1] J. G. Proakis. D. G.Manolakis, Digital signal processing: Principles, algorithms and applications, Prentice-Hall, 2006.

[2] D. G. Manolakis, V. K. Ingle, S. M. Kogon „Statistical and Adaptive Signal Processing“, Artech house, Boston, 2005.

[3] S. Haykin, Adaptive filter theory (fourth edition.) Prentice-Hall, 2001.

[4] D. Radunović, Wavelets - From math to practice, Springer Verlag, 2009.

[5] J. Hartikainen, A. Solin, and S. Särkkä, Optimal Filtering with Kalman Filters and Smoothers, Aalto University School of Science, Finland, 2011.

Number of active teaching hours				**Other classes**
Lectures: 2	Practice: 2	*Other forms of classes:* Mentoring system	Independent work: Case study	

Teaching methods: consultations, independent individual work

Examination methods (maximum 100 points)

Exam prerequisites	No. of points:	**Final exam**	No. of points:
Student's activity during lectures	**5**	Oral examination	
Practical classes		Written examination	**40**
Seminars/homework		.....	
Project	**55**		