Digital signal processing - opis przedmiotu

Informacje ogólne

Nazwa przedmiotu	Digital signal processing
Kod przedmiotu	06.0-WE-ELEKTD-DigSigProc-Er
Wydział	Wydział Informatyki, Elektrotechniki i Automatyki
Kierunek	Elektrotechnika
Profil	ogólnoakademicki
Rodzaj studiów	Program Erasmus drugiego stopnia
Semestr rozpoczęcia	semestr zimowy 2022/2023

Informacje o przedmiocie

Semestr	2
Liczba punktów ECTS do zdobycia	5
Typ przedmiotu	obowiązkowy
Język nauczania	angielski
Sylabus opracował	• dr inż. Mirosław Kozioł

Formy zajęć

Forma zajęć	Liczba godzin w semestrze (stacjonarne)	Liczba godzin w tygodniu (stacjonarne)	Liczba godzin w semestrze (niestacjonarne)	Liczba godzin w tygodniu (niestacjonarne)	Forma zaliczenia
Wykład	30	2	-	-	Egzamin
Laboratorium	30	2	-	-	Zaliczenie na ocenę

Cel przedmiotu

- To familiarize students with basic notions of the digital signal processing.
- To provide basic knowledge about fundamentals of a spectral analysis and digital filtration of discrete signals.
- To give skills in practical implementation of a spectral analysis and filtration of discrete signals.
- To provide knowledge about design of digital filters.

Wymagania wstępne

By entering this course, student should know the following isssues:

- fundamentals of electrical engineering,
- fundamentals of mathematical analysis (function, derivative, differential, integral, complex numbers),
- fundamentals of programing in the C language.

The student should be able to create simple documentation regarding the completed tasks and prepare a text containing an overview of this implementation.

Zakres tematyczny

Fundamentals of signal theory. Notion of signal. Classifications of signals. Mathematical models of selected signals. Fourier series and Fourier transform for continuous time signals. Fourier series and Fourier transform properties. An influence of a signal observation in finite time interval on its spectrum.

Analog-to-digital and digital-to-analog conversion. Chain of signal processing during analog-to-digital and digital-to-analog conversion. Sampling, quantization and coding. Quantization error. Spectrum of a sampled signal. Aliasing. Sampling theorem. Anti-aliasing filter. Recovery of an analog signal from samples.

Discrete Fourier transform (DFT). Derivation of amplitude and phase spectrum. Leakage. Parametric and non-parametric spectral windows. Spectrum resolution improvement by zero padding. Examples of spectral analysis of discrete-time signals and their interpretation.

Fast Fourier transform (FFT). Butterfly computation schema in radix-2 FFT algorithm. Computational profit. Computation of the inverse DFT using FFT.

Linear and causal time-invariant (LTI) systems. Definitions of a discrete, linear and time-invariant system. Convolution. Stability of LTI systems in BIBO sense. Definition of causal system. Difference equation.

Z-transform. The Z-transform definition. Region of convergence for the Z-transform. The inverse Z-transform and methods of its determination. Z-transform properties. The transfer function. Poles and zeros of the transfer function. Pole locus and stability of a system.

Digital filters. Finite and infinite impulse response filters. Processing discrete-time signals by digital filters. Basic structures of digital filters. Determination and interpretation of the frequency response of digital filters. Significance of linear phase response in the processing of signal. Group delay.

Digital filters design. IIR digital filter design by bilinear transformation method. FIR digital filter design by the method based on the windowed Fourier series.

Metody kształcenia

- Lecture: conventional/traditional lecture with elements of discussion.
- Laboratory: laboratory exercises, work in groups with elements of discussion.

Efekty uczenia się i metody weryfikacji osiągania efektów uczenia się

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć
Student can use digital signal processing to analyze discrete signals, perform its spectral analysis, and interpret the obtained graphs of spectra.		• bieżąca kontrola na zajęciach • wykonanie sprawozdań laboratoryjnych	• Laboratorium
Student can describe a discrete system using differential equations and transmittance.		• kolokwium	• Wykład
Student can write programs in C language, which make spectral analysis of signals and their filtering with the application of digital filters with finite and infinite impulse response.		• bieżąca kontrola na zajęciach	• Laboratorium
Student can design the infinite and finite impulse response digital filter.		• bieżąca kontrola na zajęciach	• Laboratorium

Warunki zaliczenia

- Lecture: to receive a final passing grade student has to obtain positive grade from the final exam.
- Laboratory: to receive a final passing grade student has to obtain positive grades for all laboratory exercises provided in the laboratory syllabus.

Calculation of the final grade = lecture 55% + laboratory 45%

Literatura podstawowa

1. Mitra S.K.: *Digital Signal Processing. A Computer-Based Approach*, McGraw-Hill, 2006.
2. Oppenheim A.V., Schafer R.W., Buck J.R.: *Discrete-Time Signal Processing*, Pearson Education Limited, 2015.
3. Oppenheim A.V., Willsky A.S., Nawab H.: *Signals & Systems*, Pearson Education Limited, 2013.
4. Owen M.: *Practical signal processing*, Cambridge University Press, 2007.

Literatura uzupełniająca

1. Orfanidis S.J.: *Introduction to Signal Processing*. Prentice Hall, 2009. Available at: http://www.ece.rutgers.edu/~orfanidi/intro2sp/orfanidis-i2sp.pdf
2. Smith S.W.: *The Scientist and Engineer's Guide to Digital Signal Processing.* California Technical Publishing, Sand Diego, California 1999. Available at: http://www.dspguide.com/pdfbook.htm

Uwagi

Zmodyfikowane przez dr inż. Mirosław Kozioł (ostatnia modyfikacja: 12-04-2022 13:45)