GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Applications of Signal Processors II, PG_00048584 | | |
| Field of study | Electronics and Telecommunications | | |
| Date of commencement of studies | February 2023 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-cycle studies | Subject group | Optional subject group<br>Subject group related to scientific research in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 2 | Language of instruction | Polish |
| Semester of study | 3 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Microelectronic Systems -> Faculty of Electronics, Telecommunications and Informatics | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Maciej Kokot | |
| | Teachers | dr inż. Maciej Kokot | |

| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|---|
| | Number of study hours | 15.0 | 0.0 | 15.0 | 15.0 | 0.0 | 45 |
| | E-learning hours included: 0.0 | | | | | | |

| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|---|
| | Number of study hours | 45 | 4.0 | 51.0 | 100 |

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| Subject objectives | Acquaintance with architecture and programming digital signal processors (DSP), learning how to use the evaluation kit with advanced software tools, as well as knowledge of typical applications DSP. |

## Learning outcomes

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K7_W03] Knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum. | Student lists the processor signal differs from the other processors and whether the processor is suitable for a particular application. The student explains the architecture of the digital signal processor and used arithmetic. The student discusses basic digital filtering algorithms, explains the change in sampling rate and the algorithms for calculating the FFT. The student describes the use of adaptive filters for noise reduction and echo cancelation filters and other digital signal processing,of speech and image signals. | [SW1] Assessment of factual knowledge |
| [K7_W04] Knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices | Student lists the processor signal differs from the other processors and whether the processor is suitable for a particular application. The student explains the architecture of the digital signal processor and used arithmetic. The student discusses basic digital filtering algorithms, explains the change in sampling rate and the algorithms for calculating the FFT. The student describes the use of adaptive filters for noise reduction and echo cancelation filters and other digital signal processing,of speech and image signals. | [SW1] Assessment of factual knowledge |
| [K7_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, making assessment and critical analysis of the prepared software as well as a synthesis and creative interpretation of information presented with it | Student starts integrated application development environment, Visual DSP + +. The student writes and runs programs in C and assembler, and check their operation in the evaluation kit EZ-KIT Lite. | [SU1] Assessment of task fulfilment<br>[SU4] Assessment of ability to use methods and tools |

## Subject contents

1. History, developmental tendencies and comparison of fixed- and floating-point signal processors (SP) of various firms.
2. Introduction to architecture of Analog Devices ADSP 21161N SP in laboratory use. Harward architecture, separated program memory and data memory buses, separated ALU and MAC. Memory organization and input/output ports.
3. Arithmetics used, hardware multiplier, long accumulator, pipling data processing.
4. Program flow control, multifunction computation and special addressing.
5. Evaluation and development tools. Assembler language.
6. Sampled data systems: antialiasing filters, low-pass, band-pass and IF sampling. Distortion and quantization noise. Trends in ADCs and DACs applications.
7. Basic filtering algorithms in fixed- and floating-point systems. Undesirable side effects and hardware possibilities. Multirate filters: changing sampling rate by decimation and interpolation.
8. Application of SP in adaptive systems used for solving practical problems. Prediction, noise and distortion cancellation, correction and parameter identification.
9. Discrete Fourier Transformation, realization of Fast Fourier Transformation in SP. Goertzel's algorithm. Spectrum analysers.
10. Processing of fonic signals: quantization, companding and compressing (PCM, ADPCM). Noise and distortion cancellation. Block filters of MPEG standard.
11. SP application in digital image processing: edge broadening elimination, broadband noise and impulse disturbance, computation of field relocation and motion parameters. Morfological processing, computer tomography and finding objects.
12. SP application in control systems and motion technique.
13. Algorithms and a few chosen SP applications in wire telecommunication: modems and fax construction, broadband transmission systems, modulation and demodulation, coding and decoding with correction.
14. SP application in wireless telecommunication: architecture and structure of the GSM network. Effective management of spectral resources. Hopping, power control, speech coding, interwining, modulation.
15. GPRS, EDGE and UMTS: architecture, services, protecion, realization.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="2">No requirements</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td></td><td>50.0%</td><td>10.0%</td></tr>
<tr><td></td><td>50.0%</td><td>50.0%</td></tr>
<tr><td></td><td>50.0%</td><td>40.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Alan V. Oppenheim, Ronald W. Schafer, Digital Signal Processing. Prentice-Hall, Inc.,Englewood Cliffs, New Jersey 1975<br>2. Tomasz P. Zieliński, Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań. WKiŁ. Warszawa 2005.<br>3. S. W. Smith: Digital Signal Processing: A Practical Guide for Engineers and Scientists Published by arrangement with Elsevier, 2003.<br>5. ADSP-21000 Family Application Handbook Voliume1. 1994 Analog Devices Inc.</td></tr>
<tr><td>Supplementary literature</td><td>1. Dag Stranneby, Digital Signal Processing..<br><br>2. ADSP-21000 Family Application Handbook Voliume1. 1994 Analog Devices Inc.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Write a program FIR digital filter in C, then the assembler for the signal processor ADSP 21161. Start the integrated development environment of Visual DSP + + mode simulator and test the two programs comparing computation times (in clock cycles), then load the program into a evaluation kit EZ-KIT Lite and check the operation of the system leading to the entrance signal generator and the output oscilloscope. In addition, observe the test impulse response filter FIR.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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