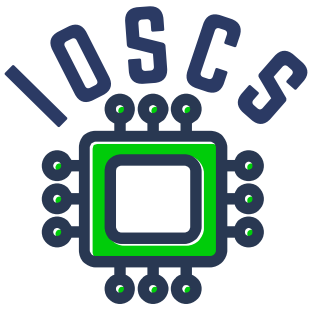
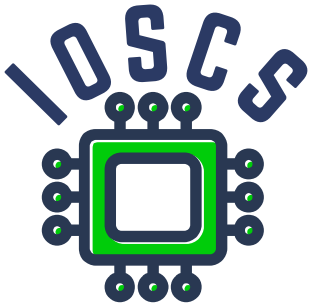


Project: Innovative Open Source Courses for Computer Science

Wireless Signal Processing in GNU Radio Environment
Syllabus

Tomasz Mąka
West Pomeranian University of Technology in Szczecin

29. 1. 2020



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Project information

Project was implemented under the Erasmus+.
Project name: **"Innovative Open Source courses for Computer Science curriculum"**
Project nr: **2019-1-PL01-KA203-065564**
Key Action: **KA2 – Cooperation for innovation and the exchange of good practices**
Action Type: **KA203 – Strategic Partnerships for higher education**

Consortium

ZACHODNIOPOMORSKI UNIWERSYTET TECHNOLOGICZNY W SZCZECINIE
MENDELOVA UNIVERZITA V BRNĚ
ŽILINSKÁ UNIVERZITA V ŽILINE

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COURSE DESCRIPTION

Field of study: Computer science

Level: First cycle

Course name: Wireless Signal Processing in GNU Radio Environment

ECTS credits: 5

Instruction forms: lecture, laboratory

Instruction hours: 30, 30

Type, extent and method of teaching activities: 3 – 0 – 3 (lectures – exercises – labs) hours weekly, presence study.

Prerequisites: Basics of Signal Processing, Mathematical Analysis

Module/course unit objective: The main objective of the course is to introduce to wireless signal processing in GNU Radio environment

After completing the course the student: Has the ability to apply acquired knowledge to design basic radio communication systems. Has the ability to use the GNU Radio environment.

Course content divided into various forms of instruction (with number of hours):

Week	Lecture (3h per week)	Laboratory (3h per week)
1	Introduction to wireless systems.	ntroduction to The GNU Radio system. Data representations, signal operations, and analysis of radio signal sources. Basics of implementation of wireless transmission systems in the graphical environment.
2	Propagation of radio waves. Antenna techniques.	Signal representations in the time and frequency domain. Analysis of the properties of signals in the frequency domain. Implementation of solutions for generation and visualization of example signals.
3	Analog-digital and digital-analog conversion mechanisms.	Implementation of continuous amplitude and angle modulation systems. Assessment of modulated signal bandwidth and analysis of modulated signals in the frequency domain depending on the modulation index.
4	Representation of radio signals in the frequency domain.	The process of modulation and demodulation of amplitude, frequency and phase shift keying systems. Analysis of signals obtained in the process of modulation and demodulation.
5	Real Properties of wireless channels.	An analysis of the distortions in the transmission channel on the data transmission efficiency using shift-keying techniques

6	Principles of the modulation process.	Quadrature modulator. Principle of digital modulation using constellation diagrams. Implementation of QPSK and QAM-16 modulations and experimental analysis.
7	Digital modulations.	Development of GMSK modulation system and comparison with selected modulations in the frequency domain.
8	Spread spectrum systems (DSSS, FHSS, THSS).	Design and implementation of spread spectrum systems using the FHSS method. The realisation of pseudo-random sequences generators using LFSR registers.
9	Software defined radio (SDR).	Simulation of an example radio transmission system with selected modulation schemes. Comparative analysis of the chosen digital modulation group.
10	Physical layers of selected wireless systems.	Radio communication system implementation in the Python language using GNU Radio library.

Student workload – forms of activity: individual work with computer in the GNU Radio environment.

Teaching methods/tools: Computer laboratory with Linux OS, installed GNU Radio environment and connection to the Internet.

Evaluation methods: Evaluation is based on two components // - the continuous evaluation during the semester and final exam. They are appreciated as follows.

Continuous examination:

- semester - 60 points: verification (written in the 9th week of the semester) - max. 40 points ,
- Special activities - min. 20 points
- Exam - 40 points: theoretical questions / tasks - min. 10 points

Final Evaluation:

Successful completion presume to obtain at least 61 points, including at least 10 points for theoretical problems. Evaluation of the subject:

- **A** 93 — 100,
- **B** 85 — 92,
- **C** 77 — 84,
- **D** 69 — 76,
- **E** 61 — 68.

To enroll for an exam the student must have at least 30.0 points.

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