COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced wireless communication techniques [S2EiT1-TMiB>ZTR]

Course

Field of study
Electronics and Telecommunications

Year/Semester
1/2

Area of study (specialization)
Mobile and Wireless Technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Essentials of signal propagation over radio channels, characteristics of wireless systems, digital modulations, general knowledge on bit-interleaved coded modulation, an ability to develop C++ code.

Course objective

The course aim is to provide students with up-to-date results of the research on coding and signal modulation techniques, including those invented at Poznan University of Technology. The students broaden their knowledge on bit-interleaved coded modulation with iterative decoding. A complementary course aim is to train students in using SDR (Software Defined Radio) units by means of GNUradio platform.

Course-related learning outcomes

Knowledge:
A student knows features of BICM-ID and its descendants (irregular BICM-ID, PA-BICM-ID, BI-STCM-ID). He/she knows a method of signal recipient adressing basing on the selection of signal parameters. They know essential types of GNUradio functional blocks and the rules of creating out-of-tree blocks. They know properties of the SDR units the laboratory is equipped with.

Skills:
A student can read EXtrinsic Information Transfer (EXIT) charts and use it to judge the performance of an iteratively-decoded wireless system. A student can utilize GNUradio platform (with particular emphasis on gnuradiocompanion (GRC)) to process a signal received by means of SDR units. They can develop out-of-tree functional blocks and incorporate them into the datapath in GRC. He/she can refer to the technical documentation of GRC functions.

Social competences:
A student understands the need and benefits of the use of software defined radio blocks in research tasks and as a part of prototype signal transmitter/receiver development. They perceive the importance of bit-interleaved coded modulation for future wireless systems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture: The exam is of oral type. A student is asked 3 questions related to BICM-ID, its descendants, and GNUradio. To pass, they must obtain at least half of available points. In case of insufficient answer, extraordinary questions are asked.
Laboratory: The teacher discusses the features of a datapath of a selected wireless system. The students" role is to develop it in GNUradio. They are supervised during their work, and necessary advice is given if needed. The students" progress is evaluated judging by their diligence and the quality of developed code.
Project: The students" task is to develop their own out-of-tree blocks to process signals in GNUradio. Grades depend on both: the block type (synchronous, interpolating, decimating, or general-purpse) chosen by a student and quality of its realization.

Programme content

GNUradio: model description in Python, GRC graphical user interface, steps to develop and compile a project, functional block types, input/output blocks, the impact of sampling frequency on the reliability of signal processing, the role of a throttle block, double-clock issue
BICM-ID: analysis of the iterative process convergence by means of EXIT chart, packet appending as a method to boost the iterative decoding process, labelling-based signal recipient identification, BICM-ID descendants (irregular BICM-ID, BI-STCM-ID), BICM-ID as a mean to improve the performance in future WLAN systems.

Teaching methods

Lecture: tutorial on how to use of GRC application and create out-of-tree blocks, regular slide presentation about BICM-ID and its descendants.
Laboratory: practical tasks with SDR units and GNUradio application.
Project: students" own work with the use of cost-free code development tools. The teacher supervises the students and gives tips to them.

Bibliography

Basic:
K. Wesołowski, "Introduction to Digital Communication Systems", Wiley 2009
Cost-free scientific papers on BICM(-ID), available on ieeexplore.org webpage, patent applications distributed by the teacher
wiki.gnuradio.org webpage
Additional:
A. Alvarado, "Towards Fully Optimized BICM Transmissions", Chalmers University of Technology, 2010
L. Szczecinski, A. Alvarado, "Bit-Interleaved Coded Modulation. Foundamentals, Analysis and Design", Wiley 2015

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00