COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced transmission technics in wireless systems

Course

Field of study
Electronics and Telecommunications

Year/Semester
II/IV

Area of study (specialization)

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	
Tutorials	**Projects/seminars**	
0	0	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
dr hab. inż. Maciej Krasicki

Responsible for the course/lecturer:

Prerequisites

Fundamentals of signal propagation over wireless channel, wireless systems, digital modulation, theory of computer simulation

Course objective

The aim of the course is to provide students with the current research results on cutting-edge techniques of wireless signal modulation and coding, including those invented at PUT. The course starts with a brief review of a simple Viterbi decoder. Then its soft-output version (SOVA) is considered to highlight benefits of the use of soft decisions in the decoding process. At the right time, Bit-Interleaved Coded Modulation (BICM) with its Iteratively Decoded amendment is introduced. Finally, some recent solutions, like irregular BICM-ID modulation, or BICM-ID with extended mapping are presented. The students are also taught how to use EXtrinsic Information Transfer chart to assess the iterative decoding convergence and how to assess error bounds.

Course-related learning outcomes

Knowledge

1. The students know the idea of channel coding and channel-capacity-related issues.

2. They know the idea of BICM, BICM-ID and derivatives, as well as the structure of BICM, and BICM-ID receiver.

Skills

1. The students can analyze properties of a given channel code and compare different channel codes.

2. They can evaluate the impact of a given signal labeling map on the overall system performance.

3. They can interpret the results of EXtrinsic Information Transfer analysis and know the reasons of decoding trajectory pinch-off.

Social competences

1. The students appreciate the role of advanced wireless system design in modern wireless communications.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The outcomes are verified during an oral exam. A student is asked to answer 3-4 open questions covering the topics presented on lectures. In the case of a high number of students attending the course, a written exam (again, with 3-4 open questions) will be organized instead.

Programme content

Lecture - Viterbi decoder, SOVA decoder, Bit-Interleaved Coded Modulation and its applications, the impact of signal labeling on the system performance, EXIT chart analysis, Pairwise Error Probability and the method to assess error bound, BICM with Iterative Decoding, space-time diversity for BICM-based systems, extended mapping, labeling-based recipient identification

Lab classes: analysis of convolutional code properties: free distance, number of error events, error event weight; BICM(-ID): computation of pair-wise error probability, asymptotic coding gain, Monte Carlo simulation.

Teaching methods

Lecture: slide presentation, discussion about research papers distributed to students.

Lab classes: the students execute MATLAB scripts developed by the teacher to take some measures. They should draw conclusions from what they can observe. The most advanced students are asked to implement some enhancements to the MATLAB exercises with the aim to study some extra cases.

Bibliography

Basic

K. Wesołowski, "Introduction to Digital Communication Systems", Wiley 2009

Scientific papers related to BICM(-ID), available for free at ieeexplore.org

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	75	3,0
Classes requiring direct contact with the teacher	40	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests) [1]	35	1,0

[1] delete or add other activities as appropriate