COURSE DESCRIPTION CARD - SYLLABUS

Course name
ADVANCED DSP TECHNIQUES FOR WIRELESS COMMUNICATION

Course

Proposed by Discipline
Information and communication technology
Type of studies
Doctoral School
Form of study
full-time

Year/Semester
II/3
Course offered in
English
Requirements
elective

Number of hours

Lecture
8

Tutorials

Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Knowledge: basic knowledge of university-level mathematics, in particular probability and stochastic processes, matrix theory, optimization, and knowledge of wireless communications.

Skills: good English knowledge, ability to study international literature in the field, and math fluency.

Social competencies: ability to work systematically, good personal relationships with instructors and other Ph.D. students.

Course objective

Acquiring knowledge on new advanced techniques applied in 5G and 5G wireless communication systems.

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:
1) Current achievements in new techniques applicable in 5G and 6G wireless communication systems, [P8S_WG/SzD_W01]
2) New trends in the investigated techniques including their improvements and expansion, [P8S_WG/SzD_W02]
3) New mathematical tools and potential simulation packages useful in research on the investigated DSP techniques, [P8S_WG/SzD_W03]
4) Formulation of reports and publications in written and oral form on the investigated DSP techniques, [P8S_WG/SzD_W04]

Skills

A Ph.D. student who graduated from doctoral school can:
1) use his/her knowledge on numerical mathematics, algebra, and probability theory to formulate and solve problems associated with the advanced DSP techniques used in 5G and 6G wireless communications, [P8S_UW/SzD_U01]
2) Critically analyze and evaluate scientific research results of his/her investigations and assess the value of the results developed by other researchers and experts, [P8S_UW/SzD_U02]
3) take part in scientific discussion in English in oral or written form on the topics considered in this course, [P8S_UK/SzD_U07].

Social competencies

A PhD student who graduated from doctoral school is ready to:
1) critically evaluate his/her own achievements in the investigated field, [P8S_KK/SzD_K02]
3) be aware of meaning of the knowledge in solving practical and theoretic problems, [P8S_KK/SzD_K03]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W01, W02, W03, W04,	Writing a report on the selected topic studied during the course based on literature studies and potential simulation experiments	Discussion with the author and his/her presentation of the text and possible simulation results
U01, U02, U07	Writing a critical report on the evaluation of the results achieved by the scientists active in the considered field of DSP techniques in wireless communications	Evaluation of the quality of the submitted report

K02, K03	Writing a critical report on the evaluation of the results achieved by himself/herself in the considered field of DSP techniques in wireless communications	Evaluation of the quality of the submitted report

Programme content

Several concepts of multiantenna transmission and reception aiming at increasing capacity of wireless networks and their robustness against distortions and jamming

Course topics

1. Multiple-Input-Multiple-Output (MIMO) transmission and massive MIMO concept and properties in increasing the capacity of wireless networks
2. Interference alignment used to avoid interference in wireless networks by appropriate precoding.
3. Non-orthogonal multiple access – its idea, types and properties
4. Blind source separation – DSP method used to separate interfering signals – overview of the idea and its implementations

Teaching methods

Lecture with interactive discussion

Bibliography

1. T. L. Marzetta, E. G. Larsson, H. Yang, H. Q. Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press, 2016
2. E. Björnson, J. Hoydis, L. Sanguinetti, “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends in Signal Processing: Vol. 11, No. 3-4, pp 154–655. DOI: 10.1561/2000000093.
3. S. A. Jafar, “Interference Alignment — A New Look at Signal Dimensions in a Communication Network”, Foundations and Trends in Communications and Information Theory, Vol. 7, No. 1, 2011, DOI: 10.1561/0100000047
4. A. Benjebbour, K. Saito, A. Li, Y. Kishiyama, T. Nakamura, “Non-Orthogonal Multiple Access (NOMA): Concept and Design”, [in:] F.-L. Luo, CH. Zhang (Eds.), “Signal Processing for 5G. Algorithms and Implementations”, John Wiley & Sons, Chichester, 2016
5. Xianchuan Yu, Dan Hu, Jindong Xu, “Blind Source Separation: Theory and Applications”, John Wiley & Sons, 2014
6. https://www2.iap.fr/users/cardoso/compsep_classic.html

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2
Classes requiring direct contact with the teacher	8	0
Doctoral student's own work (literature studies, preparation for tutorials, project preparation) [1]	42	2

[1] delete or add other activities as appropriate