3.1.2 Communication Systems

Module title: Communication Systems

Module summary
Module code: EITM 120I
Module coordinator: Prof. Dr. Manfred Litzenburger
Credits (ECTS): 5 CP workload: in lecture 60 h, independent study time 60 h
Semester: 1st or 2nd semester
Pre-requisites with regard to content: Knowledge in Systems Theory, Digital Signal Processing, and Digital Communications
Pre-requisites according to the examination regulations: none
Competencies: After having successfully completed the course, the students • know principles and performance of advanced signal processing algorithms in modern digital communication systems like adaptive equalisation, optimum sequence detection, and multi-antenna processing • understand the mathematical principles and the importance of adaptive optimisation for efficient digital signal transmission • are able to apply these principles to adaptive systems like equalisers, smart antennas and adaptive MIMO-schemes • understand the architectural principles and components of modern digital communication systems • are able to design critical building blocks in the digital frontend of a communication device like filters, decimators / interpolators, and converters • can assess and quantify the computational complexity of these functional building blocks • know the motivation and the background of software-defined radios and the roads towards their realisation in actual communication systems
Assessment: Assessment is done by either a written exam (90 minutes) or an oral examination (20 minutes). The form of examination will be announced at the beginning of the semester
Usability: *General:* The module provides theoretical background and practical knowledge on advanced schemes for adaptive signal processing algorithms in digital transmission systems as well as architectural principles and functional building blocks of modern digital transmitters / receivers. *Connection with other modules:* Based on knowledge in digital modulation and digital signal processing techniques, this module introduces specific algorithms for signal processing in communication systems and basic architectures for communication devices. Complementary to the module "RF-Instrumentation" which focuses on analog RF-frontends, this module concentrates on the digital part of the communication system, including A/D- and D/A-converters as the interface between these two domains. Information theoretical aspects and error correction coding are covered by the module "Information Theory and Coding".

Course: Architecture of Communication Systems
Module code: EITM 121I
Lecturer: Prof. Dr. Manfred Litzenburger

Contact hours: by arrangement
Semester of delivery: yearly, winter semester
Type/mode: lecture 2h/week; mandatory in the study field Information technology, optional in the other study fields of the program
Language of instruction: English or German; the course language will be announced at the beginning of the semester
Content: • Transmitter- and receiver architectures, digital frontends • Digital down- and up- conversion • Multi-rate signal processing • Direct digital synthesis (DDS) • A/D- and D/A- converters in communication systems • Software Defined Radio
Recommended reading: F. Harris: *Multirate Signal Processing for Communication Systems*, Prentice-Hall, 2004 J. Reed: *Software Radios. A modern approach to Radio Engineering*, Prentice Hall, 2002 J. Mitola: *Software Radio Architecture*, Wiley, 2001 A. Oppenheim, R. Schafer, J. Buck: *Discrete-Time Signal Processing*, Prentice-Hall, 1999 J. Proakis: *Digital Communications*, McGraw Hill, New York, 5. Ed., 2008 K. D. Kammeyer: *Nachrichtenübertragung*, Teubner, Stuttgart, 5. Aufl. 2011 Data Sheets and Application Notes of current integrated circuits for digital communication systems
Comments: -

Course: Signal Processing in Communication Systems
Module code: EITM 122I
Lecturer: Prof. Dr. Manfred Litzenburger
Contact hours: by arrangement
Semester of delivery: yearly, winter semester
Type/mode: lecture 2h/week; mandatory in the study field Information technology, optional in the other study fields of the program
Language of instruction: English or German; the course language will be announced at the beginning of the semester
Content: • Adaptive filters und equalisation • Maximum-likelihood detection • Channel estimation / System identification • Multi - antenna algorithms (smart antennas, beamforming, MIMO-schemes)
Recommended reading: S. Haykin: *Adaptive Filter Theory*, Prentice Hall A. Oppenheim, R. Schafer, J. Buck: *Discrete-Time Signal Processing*, Prentice-Hall J. Proakis: *Digital Communications*, McGraw Hill, New York K. D. Kammeyer: *Nachrichtenübertragung*, Teubner, Stuttgart D. Tse, P. Viswanath: *Fundamentals of Wireless Communication*, Cambridge University Press
Comments: -