

Course

ACC - Advanced Channel Coding

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General information

Long name	Advanced Channel Coding
Approving CModule	ACC MaCSN , ACC MaTIN
Responsible	Prof. Dr. Uwe Dettmar Professor Fakultät IME
Level	Master
Semester in the year	summer semester
Duration	Semester
Hours in self-study	78
ECTS	5
Professors	Prof. Dr. Uwe Dettmar Professor Fakultät IME
Requirements	basics in linear algebra basics in stochastics good programming skills
Language	English
Separate final exam	Yes

Final exam

Details

- Form: written exam (optional: oral examination)
- Duration: 90 minutes
 - Assignment: in general 3 problems with subtasks which test on different taxonomies
 - different taxonomies are rated according to their complexity and difficulty

Note: the students can collect 25% of the total score from the two electronic intermediate tests. It is assumed that this promotes a continuous learning process.

Minimum standard

Basic knowledge can be adequately applied to known and related problems. The execution is in parts faulty. (4,0)

Exam Type

Form: written exam (optional: oral examination)

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^ Lecture / Exercises

Learning goals

Knowledge

The underlying concept of this module is a combination from lecture and tutorial. After a lecture block of approximately 20 minutes) the subjects taught are actively trained using Matlab/Octave and Python programs.

Syllabus:

- Introduction
- Basic terms and definitions
- short history of channel coding
- System and channel models
- Review of binary error correcting block and convolutional Codes
- Generator and Parity check matrices,
- decoding principles, Trellis and Viterbi Algorithm
- Some principles on Information Theory
- Channel coding theorem
- Channel capacity and example calculations
- Cyclic Codes, Reed Solomon Codes
- Encoding and Decoding, Euclidean and Berlekamp-Massey -Algorithm for Decoding
- Basics on LDPC, Polar, and TURBO Codes
- iterative decoding, Sum Product Algorithm
- Recursive Convolutional Codes
- Performance comparison
- Basics on Space Time Coding
- Channel Model, Capacity improvement, Alamouti Scheme, STBC and STTC and their decoding

These subjects are presented during the lecture. Students shall deepen their knowledge by self-study of literature and internet resources and discuss their results in small learning groups as a teamwork.

Skills

By the help of small exercises and programs during the presence time, students are able to actively train their knowledge. More extensive problems are solved and discussed in the second part of the course to activate the student's capabilities to solve relevant problems.

Students further learn

- to analyze communication systems and to estimate their performance
- to compare and rate algorithms and methods
- to apply their knowledge to technical problems

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	2
Exercises (whole course)	1
Exercises (shared course)	0
Tutorial (voluntary)	0

Separate exam

Exam Type

solving exercises within limited functional / methodical scope under examination conditions

Details

The success of the learning priócess is tested by two midterm tests. These tests consists of multiple choice and numerical questions and are implemented in the Ilias learning platform. By these two tests students can collect up to 10 points for their final score to raise their motivation for a continuous participation.

Minimum standard

40% of the total score in each test.

^ Practical training

Learning goals

Skills

Existing simulation Tools like, e.g., the Matlab Communications Toolbox or AFF3CT (aff3ct.github.io) are used to:

- test theoretical results from lecture and tutorial
- implement algorithms for error control coding
- simulate BER and rate the performance, compare schemes
- adapt programs to solve equivalent problems
- become familiar with standard simulations tools

- train cooperation in small teams

Students learn to generate, check, present, and discuss performance results for FEC codes. They need to search for and to study scientific literature as background sources for their simulations. Teams of students get different code families to study. Results are presented to the whole group.

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Practical training	1
Tutorial (voluntary)	0

Separate exam

Exam Type

working on projects assignment with your team e.g. in a lab)

Details

Present results in a 10 minutes talk and write a short paper to train the capability to publish in journals or proceedings.
The paper is reviewed by a partner group.

Minimum standard

the required deliveries are generated. Presentation and paper are acceptable regarding form and content.