EITG05 – Digital Communications

(Previously: ETT051)

Course Information

Michael Lentmaier
Monday, August 28, 2017

About myself:

- since 2013: Lund University, Associate Professor
  Director of Master's programme in Wireless Communication
- 2008 – 2012: TU Dresden, Germany
  Vodafone Chair Mobile Communication Systems
  Senior Lecturer and Researcher
- 2005 – 2007: German Aerospace Center (DLR), Oberpfaffenhofen
  Researcher, positioning and satellite navigation
- 2003 – 2004: University of Notre Dame, South Bend, IN, USA
  Postdoctoral Resarch Associate
- 1998 – 2003: Lund University
  PhD student, telecommunication theory
- 1997: Lund University
  Erasmus student, Master's project
- 1991 – 1997: University of Ulm, Germany
  Student in Electrical Engineering

Lectures

- **Teacher:**

  Michael Lentmaier, michael.lentmaier@eit.lth.se, E:2375

  Mondays 10.15 – 12.00 in E:B, V:B, or MA 2
  Thursdays 10.15 – 12.00 in MA 7

  Observe: lecture rooms on mondays change

  ⇒ check the online schedule, available here

- **Course webpage:**

  `http://www.eit.lth.se/course/EITG05`

  - Slides from the lectures will be posted each week
  - Please check messages on this page regularly

- **Secretary:**

  Anne Andersson, anne.andersson@eit.lth.se, E:3152b

Exercises

There are two groups of exercise classes:

- **Group A:** (priority for C students)

  Muris Sarajlic, muris.sarajlic@eit.lth.se, E:2366

  Wednesdays 10.15 – 12.00 in E:2311
  Fridays 10.15 – 12.00 in E:1147 / E:1149

- **Group B:** (priority for MWIR students)

  Muhammad Umar Farooq,
  muhammad.umar_farooq@eit.lth.se, E:2367

  Wednesdays 13.15 – 15.00 in E:1123
  Thursdays 13.15 – 15.00 in E:3336

- **All exercises are held in English**
- If there is enough space in the rooms you can choose the group you prefer (otherwise see priorities above)

Examination / Laboratory

Final Exam

- Written exam
- Thursday, October 26, 2017, 14.00 – 19.00 in MA 10A–E
- Five problems with 10 points each
- 20 points or more are required to pass

Laboratory

- One laboratory lesson is included in the course (mandatory)
- The lab lessons take 4 hours and take place in study weeks 6+7
- Applications to the lab can be made about two weeks in advance
- More information, including the instructions, will be posted (check the messages on the course webpage)

Course Literature

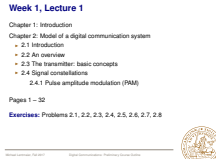
The course is based on the compendium:

"Introduction to Digital Communications"
by Göran Lindell, August 2009

Available at KFS bookstore in the LTH study center

- You are allowed to use the compendium in the written exam!
- The parts of the compendium which are related to the different lectures are defined in the course outline, which is available on the webpage
- The course outline also defines the problems that are solved in the exercise classes

Course Outline

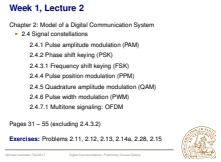


Week 1, Lecture 1

Chapter 1: Introduction
Chapter 2: Model of a digital communication system
- 2.1 Introduction
- 2.2 An overview
- 2.3 The transmitter: basic concepts
- 2.4 Signal constellations
  - 2.4.1 Pulse amplitude modulation (PAM)

Pages 1 – 32

Exercises: Problems 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8

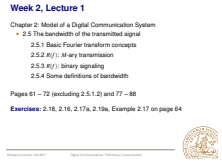


Week 1, Lecture 2

Chapter 2: Model of a Digital Communication System
- 2.4 Signal constellations
  - 2.4.1 Pulse amplitude modulation (PAM)
  - 2.4.2 Phase shift keying (PSK)
  - 2.4.3.1 Frequency shift keying (FSK)
  - 2.4.4 Pulse position modulation (PPM)
  - 2.4.5 Quadrature amplitude modulation (QAM)
  - 2.4.6 Pulse width modulation (PWM)
  - 2.4.7.1 Multitone signaling: OFDM

Pages 31 – 55 (excluding 2.4.3.2)

Exercises: Problems 2.11, 2.12, 2.13, 2.14a, 2.28, 2.15

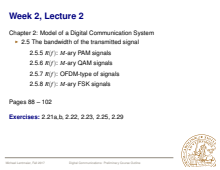


Week 2, Lecture 1

Chapter 2: Model of a Digital Communication System
- 2.5 The bandwidth of the transmitted signal
  - 2.5.1 Basic Fourier transform concepts
  - 2.5.2 *R*(*f*): *M*-ary transmission
  - 2.5.3 *R*(*f*): binary signaling
  - 2.5.4 Some definitions of bandwidth

Pages 61 – 72 (excluding 2.5.1.2) and 77 – 88

Exercises: 2.16, 2.16, 2.17a, 2.19a, Example 2.17 on page 64

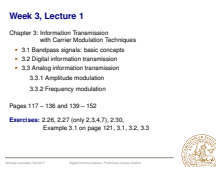


Week 2, Lecture 2

Chapter 2: Model of a Digital Communication System
- 2.5 The bandwidth of the transmitted signal
  - 2.5.5 *R*(*f*): *M*-ary PAM signals
  - 2.5.6 *R*(*f*): *M*-ary QAM signals
  - 2.5.7 *R*(*f*): OFDM-type of signals
  - 2.5.8 *R*(*f*): *M*-ary FSK signals

Pages 88 – 102

Exercises: 2.21a,b, 2.22, 2.23, 2.25, 2.29

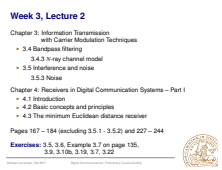


Week 3, Lecture 1

Chapter 3: Information Transmission with Carrier Modulation Techniques
- 3.1 Bandpass signals: basic concepts
- 3.2 Digital information transmission
- 3.3 Analog information transmission
  - 3.3.1 Amplitude modulation
  - 3.3.2 Frequency modulation

Pages 117 – 136 and 139 – 152

Exercises: 2.26, 2.27 (only 2.3.4.7), 2.30, Example 3.1 on page 121, 3.1, 3.2, 3.3



Week 3, Lecture 2

Chapter 3: Information Transmission with Carrier Modulation Techniques
- 3.4 Bandpass filtering
  - 3.4.3 *N*-ray channel model
- 3.5 Interference and noise
  - 3.5.3 Noise

Chapter 4: Receivers in Digital Communication Systems – Part I
- 4.1 Introduction
- 4.2 Basic concepts and principles
- 4.3 The minimum Euclidean distance receiver

Pages 167 – 184 (excluding 3.5.1 - 3.5.2) and 227 – 244

Exercises: 3.5, 3.6, Example 3.7 on page 135, 3.9, 3.10b, 3.19, 3.7, 3.22

Check the course outline on the webpage regularly, some details may change

Course Representative / Kursombud

We are looking for

- Two students from the C program
- One student from the MWIR program
- Other programs can participate if there is interest

If you are interested, please get in touch with me in the break