

Telecommunications I

“Digital Transmission & Signal Processing“

WS 09/10

| L | E* | CW | Date | Subject | Remark | Literature |
|--|-----|----|-------------|--|--------|-----------------------|
| 1 | | 42 | 13.10.2009 | Introduction, Targets of Lecture <ul style="list-style-type: none"> • Questionnaire „Studiengänge, Studienordnungen“ • Introduction Telecommunications Lab • Mission Statement <ul style="list-style-type: none"> ○ Who is addressed by TC I ○ Target of TC I ○ Table of Contents ○ Literature How TC I differs from “Networks” <ul style="list-style-type: none"> • Focus on audio/visual telecommunications • What is special for audio/visual • Ingredients of a digital communications system | | Slides; Links |
| Generation / Refresh of Signal Processing | | | | | | |
| 2 | | 42 | 14.10.2009 | Digital Signal Transmission <ul style="list-style-type: none"> • Atomic signals, LTI systems • Convolution, convolutional algebra | | [Ophm97], [Herf08] |
| 3 | | 43 | 20.10.2009 | The Fourier-Transform <ul style="list-style-type: none"> • The importance of the frequency domain • Fourier-transformation of atomic signals • Fourier Series | | [Ophm97], [Herf08] |
| 4 | | | 21.10.2009 | The Laplace-Transform <ul style="list-style-type: none"> • Enforcing BIBO stability • The region of convergence • Solving linear differential equations | | [Ophm97], [Herf08] |
| 5 | | 44 | 27.10.2009 | Hilbert-Transformation <ul style="list-style-type: none"> • Fourier-transformation of real functions • Relationship of real- & imaginary spectrum • Bandpass signals, Hilbert-transformation | | [Ophm97], [Herf08] |
| 6 | 1.1 | | 28.10.2009 | Discrete Signals & Systems <ul style="list-style-type: none"> • Continuous vs discrete, analog vs digital • Becoming discrete: The sampling theorem • Sampling in the frequency domain | | [Ophm97], [Herf08] |
| 7 | | 45 | 03.11.2009 | The Discrete Fourier-Transformation (DFT) <ul style="list-style-type: none"> • Relationship to continuous Fourier-transformation • Specialties • Fast Fourier-transformation The z-Transformation <ul style="list-style-type: none"> • FIR & IIR structures | | [Ophm97], [Herf08] |
| 8 | | | 04.11.2009 | Digital Filters <ul style="list-style-type: none"> • Finite impulse response filters • Infinite impulse response filters • Filter structures | | [Herf08] |
| 9 | | 46 | 10.11.2009 | Probability & Stochastic Processes <ul style="list-style-type: none"> • Random Variables • Probability Distributions • Central limit theorem | | [Proa02] [Herf08] |
| 10 | 1.3 | | 11.11.2009 | Probability & Stochastic Processes <ul style="list-style-type: none"> • Statistical averages • Power density spectrum • Stationary and ergodic processes • Cyclostationary processes | | [Proa02] [Herf08] |
| Introduction to Digital Transmission | | | | | | |
| 11 | 1.4 | 47 | 17.11.2009. | Digital Transmission <ul style="list-style-type: none"> • Intersymbol Interference | | [Proa02] [Herf08] |

* Exercises: Task sheet due in respective calendar week

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| | | | | <ul style="list-style-type: none"> • Eye diagram • First Nyquist criterion | | |
| 12 | 1.4 | 47 | 18.11.2009 | Digital Transmission <ul style="list-style-type: none"> • Roll-off filtering • Second Nyquist criterion • Bandwidth efficiency | | [Proa02] [Herf08] |
| 13 | 1.5 | 48 | 24.11.2009 | Channel Models <ul style="list-style-type: none"> • Information theory • Channel capacity • Shannon Theorem | | [Proa02] [Herf08] |
| 14 | | | 25.11.2009 | Binary Symmetric Channel <ul style="list-style-type: none"> • Channel capacity | | [Herf08] |
| 15 | 1.6 | 49 | 01.12.2009 | AWGN Channel <ul style="list-style-type: none"> • Entropy of Gaussian signals • Channel capacity • Matched filtering | | [Proa02] [Herf08] |
| 16 | | | 02.12.2009 | WSSUS Channel <ul style="list-style-type: none"> • Time variant impulse response • Coherence time, coherence bandwidth | | [Proa02] [Herf08] |
| 17 | 1.7 | 50 | 08.12.2009 | WSSUS Channel <ul style="list-style-type: none"> • Doppler shift • Echo Profiles • Simulation of WSSUS channels | | [Proa02] [Herf08] |
| 18 | | | 09.12.2009 | Matched Filtering <ul style="list-style-type: none"> • Correlation, SNR • Root raised cosine filter | | [Proa02] [Herf08] |
| 19 | 2.1 | 51 | 15.12.2009 | RF-Transmission <ul style="list-style-type: none"> • PSD of data signals • General form of complex baseband • PSK, QAM | | [Proa02], [Herf08] |
| 20 | | | 16.12.2009 | RF-Transmission <ul style="list-style-type: none"> • SER, BER of PSK & QAM signals • FSK, MSK, GMSK | | [Proa02] [Herf08] |
| 21 | 2.2 | 01 | 05.01.2010 | OFDM <ul style="list-style-type: none"> • Orthogonality of narrow band carriers • Cyclic Prefix / Guard Interval • Complex baseband, sampling | | [Proa02] [Herf08] |
| 22 | | | 06.01.2010 | OFDM <ul style="list-style-type: none"> • Architecture, IFFT • Guard band • PSD of OFDM signals | | [Proa02] [Herf08] |
| 23 | 2.3 | 02 | 12.01.2010 | Algebra on Finite Fields <ul style="list-style-type: none"> • Galois fields, extension • Basics of coding, Hamming bounds | | [Proa02], [Herf08] |
| 24 | | | 13.01.2010 | Linear block codes <ul style="list-style-type: none"> • Hamming codes • BCH-Codes | | [Proa02] [Herf08] |
| 25 | 2.4 | 03 | 19.01.2010 | Reed Solomon Codes <ul style="list-style-type: none"> • Basic idea of polynomials • Characteristics of Reed Solomon Codes | | [Proa02] [Herf08] |
| 26 | | | 20.01.2010 | Reed Solomon Codes <ul style="list-style-type: none"> • Algebraic decoding of RS-Codes • Systematic RS-Codes | | [Proa02], [Herf08] |
| 27 | 2.5 | 04 | 26.01.2010 | Convolutional codes <ul style="list-style-type: none"> • Minimum distance calculation • Puncturing • Viterbi decoding | | [Proa02], [Herf08] |
| 28 | | | 27.01.2010 | Complex codes <ul style="list-style-type: none"> • Concatenated codes • Turbo-Codes Combined Coding and Modulation <ul style="list-style-type: none"> • Trellis coded modulation | | [Proa02], [Herf08] |
| 29 | 2.6 | 05 | 02.01.2010 | Exam Preparation <ul style="list-style-type: none"> • Wrap-up, FAQs • Hints for the preparation Organisation (allowed and required material) | | [Herf08] |
| 30 | | | 03.02.2010 | – | | End |

Literature

- [Frie96] Bernd Friedrichs:
"Kanalcodierung", Springer, 1995
- [Göbl99]: Jürgen Göbel:
"Kommunikationstechnik", Hüthig Verlag Heidelberg, 1999
- [Herf95] Thorsten Herfet:
"Begleitskriptum ‚Digitale Übertragungstechnik‘", 1995
- [Herf08] Thorsten Herfet:
"Telecommunications 1 – Digital Transmission & Signal Processing", 2008
- [OhmL04]: Jens-Rainer Ohm, Hans Dieter Lüke:
"Signalübertragung", 9. Auflage, Springer, 2004
- [Ophm97] Oppenheim, Alan and Willsky, Alan:
"Signals & Systems 2. Edition", 1997, Prentice Hall
- [Papo02] Athanasios Papoulis, S. Unnikrishna Pillai
"Probability, random Variables and Stochastic Processes", McGraw Hill, 2003
- [Proa01] John G. Proakis:
"Digital Communications", McGraw Hill Higher Education, 2001
- [Proa02] John G. Proakis, Masoud Salehi
"Communications Systems Engineering", 2nd Edition, Prentice Hall, 2002
- [Shan63] Claude E. Shannon, Warren Weaver:
"The Mathematical Theory of Communication", University of Illinois Press, 1963