Activity Report 2016–2017

Institute of Communications Engineering

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NACHRICHTENTECHNIK
Universität Ulm

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Impressum

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Preface

The institute for *Communications Engineering* was founded in October 2011 by the union of the two former institutes *Information Technology* and *Telecommunications and Applied Information Theory* (Siemens donation chair). It provides research and teaching for several courses of study in the area of communications within the faculty of *Electrical Engineering, Computer Science, and Psychology* of the *Ulm University*. Since 2014 the institute is largely responsible for the international Master Course *Communications Technology*. Research areas and offered lectures and labs range from physical-layer methods over reliable and secure information transmission in time and space, up to man-machine interfaces.
The present report covers all activities of members of our institute from January 2016 through December 2017.

1 People

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Prof. Dr.-Ing. Georg Schmidt	Hochschule Esslingen

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Dr.-Ing. Katharina Schilling	(until 02/16)
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2 Visitors and Visits

Visiting Scholars

- ***Serbia***
  Marijana Grujović — 06/2016
- ***University of Helsinki, Finland***
  Prof. Kristiina Jokinen — 06/2016
- ***University of Granada, Spain***
  Prof. Zoraida Callejas Carrión — 06/2016
- ***Micron Technology, USA***
  Dr. Yingquan Wu — 07/2016
- ***University of Auckland, New Zealand***
  Prof. Ulrich Speidel — 10/2016, 12/2016
- ***University of Nebraska–Lincoln, United States***
  Jessalyn Bolkema — 11/2016
- ***Technical University of Denmark, Denmark***
  Prof. Dr. Johan Rosenkilde — 12/2016
- ***Constance University of Applied Scienes, Germany***
  Mohammed Rajab — 04/2017–07/2017
- ***University of the Witwatersrand Johannesburg, South Africa***
  Dr. Ing. Jaco Versfeld — 07/2017
- ***Sun Yat-sen University, Guangzhou, China***
  Prof. Li Chen — 07/2017
- ***Nara University of Science and Technology (NAIST), Japan***
  Kiyoshiro Sugiyama — 10/2017–12/2017
- ***ITMO University of Saint Petersburg, Russia***
  Denis Ivanko — 10/2017–03/2018
- ***ITMO University of Saint Petersburg, Russia***
  Alexei Romanenko — 10/2017–03/2018
- ***Nara University of Science and Technology (NAIST), Japan***
  Yuki Matsuda — 10/2017–09/2018

- ***Nara University of Science and Technology (NAIST), Japan***
  Yuta Takahashi 11/2017–12/2017
- ***Nara University of Science and Technology (NAIST), Japan***
  Kazuma Nagano 11/2017–12/2017
- ***Cambridge University, UK***
  Dr.-Ing. Stefan Ultes 12/2017

Research Stays at other Universities

- ***University of Auckland, New Zealand***
  Martin Bossert 01/2016
- ***Technical University of Denmark, Kopenhagen, Denmark***
  Sven Puchinger 03/2016
- ***Technion — Israel Insititute of Technology, Haifa, Israel***
  Sven Puchinger 05/2016

3 Lectures

A detailed description of the modules is available online.

Advanced Channel Coding (English) Master 2L/1E

Symbol-by-Symbol APP Decoding; Iterative Decoding of Concatenated Codes; LDPC Codes; Algebraic List Decoding

Angewandte Mathematik für Ingenieure (German) Master 3L/1E
(Applied Mathematics for Engineers)

Stochastic Processes; Normal Forms of Matrices and their Application in System Theory; Special Functions (e.g., Bessel Functions) and their Application; Algebraic Structurs (e.g., Finite Fields)

Applied Information Theory (English) Master 3L/2E/1P

Uncertainty (Entropy); Mutual Information; Source Coding Theorem; Source Coding Schemes (Shannon–Fano, Huffman, Tunstall, Arithmetic Coding); Universal Source Coding (Lempel–Ziv, Elias–Willems); Channel Capacity and Channel Coding Theorem; Gaussian Channel; Random Coding; Multi-User Information Theory; Dirty Paper Coding; Tomlinson–Harashima Precoding; Information Theory and Cryptology

Benutzerschnittstellen (German) Bachelor/Master 2L/2S
(User Interfaces)

Introduction into the area of human-computer interaction (HCI); Focus: design and development principles of multimodal user interfaces; Usability engineering and evaluation of multimodal user interfaces

Channel Coding (English) Master 3L/2E/1P

Block Codes (BCH, Reed–Solomon, Reed–Muller, Hamming, Simplex, Golay); Decoding Algorithms (Majority Logic, Algebraic, Soft, Hard, GMD); Convolutional Codes and Decoding (Viterbi, Fano, Zigangirov–Jelinek); Generalized Code Concatenation; Coded Modulation

Communications Engineering Seminar (German/English) Master 2S

Each semester a current, changing topic from the fields of Communications Engineering, Digital Transmission, Information Theory, Coding Theory, and Signal Processing and its related disciplines is addressed.

Communication Systems (English) Master 2L/1E

Mobile Radio Channel; Basics of Mobile Communication Systems; GSM and UMTS

Compressed Sensing (English) Master 2L/1E

Geometry of N Dimensions; Geometrical Interpretation of Systems of Linear Equations; Convex Polytopes; Arrangements of Hyperplanes; Approximation Theory; Distance Measures in Banach Spaces; Optimization and Linear Programing; Sampling by Compressed Sensing; Data Acquisition by Compressed Sensing

Dialogue Systems (German) Master 2L/2E

Introduction into the area of multimodal spoken natural language dialogue systems; Focus: Acoustic Processing; Speech Signal Analysis; Speech Recognition; Spoken Natural Language Understanding; Dialogue Processing and Speech Synthesis

Dialogue Systems Project (German/English) Master 4–6S

Multimodal spoken language dialogue systems; component development; practical studies; evaluation

Dialogue Systems Proseminar (German/English) Bachelor 2S

Participants deal with current topics in Spoken Dialogue Systems research.

Dialogue Systems Seminar (German/English) Bachelor 2S

Participants deal with current topics in Spoken Dialogue Systems research.

Design, Implementation and Evaluation of Dialogue Systems Project (for Cognitive Systems) (English) Master 6S

Spoken dialogue systems development; human factor studies; human-centred design approach; practical studies; evaluation

Digital Communications (English) Master 4L/2E

Equivalent Complex Baseband; Pulse-Amplitude Modulation (PAM); Variants of PAM Transmission Schemes; Signal-Space Representation; Digital Frequency and Phase Modulation; Channel Models; Equalization of Dispersive Channels; Orthogonal Frequency-Division Multiplexing (OFDM)

Digital Communications LAB (English) Master 4P

M. Introduction to MATLAB; 1. Digital Pulse Amplitude Modulation; 2. Implementation of PAM Transmission in MATLAB; 3. Variants of PAM Transmission Schemes; 4. Noncoherent Reception; 5. Signal Space Representation

Einführung in die Nachrichtentechnik (German) Bachelor 3L/2E/2P
(Introduction to Communication Engineering)

History and Milestones of Communications; Models in Communications; Shannons Uncertainty and Source Coding; Signals for Transmission of Information Channels; Decision Theory; Error Probabilty; Channel Coding Theorem; Error Correcting Codes; Reliable Data Transmission; Multiple Access; Routing; Security

Embedded Security (German/English) Master 3L/1E

Implementation and Side-Channel Attacks in Cryptology; Countermeasures to Implementation Attacks; Arithmetic for Cryptographic Hardware; Random Number Generators; Physical Unclonable Functions; Digital Tachograph System; Secure Software Download for Electronic Control Units in Cars

Iterative Methods for Wireless Communications (English) Master 2L/1E

Fix-Point Iteration; Convergence and Convergence Rate of Iterative Methods; Vector-Valued Transmission; (Iterative) Vector Equalization; Probability Theory for Iterative Decoding; Tanner Graph; Low-Density Parity Check Codes; BCJR Algorithm; Turbo Codes; Iterative Joint Demapping, Equalization, and Decoding (Turbo Equalization)

Mathematik der digitalen Medien (German) Bachelor 2L/1E

Navigation (correlation, random sequences); Mobile phone (channel estimation, convolutional codes); MP3 (digital signal processing); CD (error correction); DVD (source coding); Internet (routing, crypto)

Multiuser Communications and MIMO Systems (English) Master 3L/1E

MIMO Communications; Performance Criteria; Introduction to Lattices; Lattice Decoding and the "Sphere Decoder"; Equalization via Lattice Reduction; "Writing on Dirty Paper"; Multiuser Communications; Advanced Transmitter-Side Techniques; Interference Channel

Research Trends in Dialogue Systems Seminar (German/English) Master 2S

Participants deal with current topics in Spoken Dialogue Systems research

Satellite Communications and Navigation (English) Master 2L/1E

History, Development, and Potential of Satellite Communications; Satellite Orbits; Launch and Installation in Orbit; Modulation and Multiple Access; Satellite Channel; Link Budget Calculations; Mobile Satellite Communication Systems; Satellite Navigation

Seminar zur Industriepraxis (German/English) Bachelor/Master 3S

Subject-related knowledge and experience from professional practice; experience the business of a typical workday; carry out typical engineering tasks in research and development, quality control, and technical distribution; gain insight into modern techniques and facilities for development and fabrication of electric, electronic, mechatronic and mechanical devices as well as software and hardware components and systems; learn typical operating procedures and organization in industry, as well as the social structure in companies

Signal Theory (German) Master 2L/2E

Part I: Stochastic Signals: Random Variables and their Characterization; Principles of Estimation; Stochastic Processes and their Characterization; Mean-Square Estimation and Ergodicity; Part II: Deterministic Signals: Sampling and Interpolation; Principles of Compressed Sensing

Signale und Systeme (German) Bachelor 3L/2E/2T/1P

(Signals and Systems)

Discrete Signals and Systems; z-Transformation; Generalized Functions and Distributions; Continuous Signals and Systems; Fourier-Transformation; Sampling Theorem; Fast Fourier Transform; Laplace-Transformation its Application to Continuous LTI Systems; Stochastic Processes

4 Research

4.1 Research Topics

The research carried out at the institute is divided into the subsequent four groups.

Algebraic Coding Theory

Block and convolutional codes for error correction and detection over Hamming, rank, and combinatorial metrics are constructed and analyzed. The main focus is also on the soft- and hard-decision and list decoding of these code classes. Especially soft-decision decoding of Reed-Solomon codes is an important research area. The applications are random linear network coding, storage coding, compressed sensing, interleaved codes, concatenated codes, and hybrid ARQ protocols. Recently, the application of algebraic coding for cryptology was started.

Communication Theory

The members of the Communication Theory group address the challenges of next-generation communications systems. The main focus is on the mathematical and theoretical foundations of communication and signal processing schemes. This includes equalization methods and the utilization of interference in multiantenna and multiuser systems, in particular, via precoding. The problems caused by nonlinearities in the transmission channel, both, the peak-power problem (e.g., in OFDM transmission), as well as nonlinear transmission media (e.g., fiber optics) are addressed. Moreover, the structure of signal is exploited, e.g., via compressed sensing methods, and transmission schemes without any channel knowledge are designed. Finally, security aspects, in particular physical-layer security via coded modulation, are treated.

Dialogue Systems

The Dialogue Systems Group has placed its general research focus on the development and evaluation of user-friendly Spoken Language Dialogue Systems (SLDS). This objective is based on the following major aspects: adaptive dialogue management, assistiveness as well as evaluation and usability issues.

The Dialogue Systems Group is joint founder of the intersdisciplinary Competence Center Perception and Interactive Technologies. Research groups from Ulm University aim at developing innovative technologies in different application domains and settings for the human-computer interaction. Major research areas include sensor-based models for perception, learning mechanisms and adaptivity, interactive systems in networked applications, ubiquitous computing, multimedia and visualization as well as spoken language dialogue systems interaction and multimodality. The center proposes a framework for fundamental and applied research and combines different interdisciplinary issues.

4.2 Research Projects

DFG Projects (German Research Council)

During 2016–2017 the following projects were supported by the German Research Council "Deutsche Forschungsgemeinschaft" (DFG).[1]

Assistives und adaptives Dialogmanagement

Project Leader: Minker, Grant: SFB Transregio 62 TP B01
Duration: 96 months, Begin: February 2009

Finding New Overlapping Genes and their Theory (FOG-Theory)

Project Leader: Bossert, Grant: Bo 867/23-2 (SPP InKoMBio)
Duration: 60 months, Begin: January 2010

Coordination Project InKoMBio

Project Leader: Bossert, Grant: Bo 867/31-3
Duration: 60 months, Begin: January 2010

Interrelations between Channel Coding and Precoding in Transmission Strategies for Broadcast Channels and in Network Coding

Project Leader: Bossert, Grant: Bo 867/29-3 (SPP COIN), cooperation with Profs. Fischer and Huber
Duration: 24 months, Begin: October 2013

Interrelations between Channel Coding and Precoding in Transmission Strategies for Broadcast Channels and in Network Coding

Project Leader: Fischer, Grant: Fi 982/4-3 (SPP COIN), cooperation with Profs. Bossert and Huber
Duration: 24 months, Begin: October 2013

Rang-Metrik in der Codierungstheorie und im maschinellen Lernen

Project Leader: Bossert, Grant: Bo 867/32-1
Duration: 36 months, Begin: January 2014

Verbesserte und zuverlässige RNA-Sequenzierung: Einzelzell-Transkriptomik zur Analyse bakterieller Individualität

Project Leader: Bossert, Grant: Bo 867/30-1 (SPP InKoMBio)
Duration: 24 months, Begin: January 2014

[1] SPP: "Schwerpunktprogramm" (priority project); SFB: "Sonderforschungsbereich" (SFB).

Diskret-wertige, dünn besetzte Signale: Theorie, Algorithmen und Anwendungen

Project Leader: Fischer, Grant: Fi 982/8-1, cooperation with Profs. Kutyniok and Pfander
Duration: 24 months, Begin: October 2014

Komplexwertige Reed-Solomon Codes für deterministisches Compressed Sensing

Project Leader: Bossert, Grant: Bo 867/35-1 (SFB Compressed Sensing in der Informationsverarbeitung)
Duration: 36 months, Begin: June 2015

Aufwandsgünstige HF-Frontends und inkohärente Detektionsverfahren für "Massive MIMO"

Project Leader: Fischer, Grant: Fi 982/12-1, cooperation with Prof. Waldschmidt
Duration: 36 months, Begin: December 2015

Lipschitz Integers für Codierte Modulation und Vorcodierung

Project Leader: Fischer, Grant: Fi 982/13-1, cooperation with Prof. Freudenberger
Duration: 36 months, Begin: December 2015

Codierte Modulation, optimierte Decoder und Entzerrer für faseroptische Kanäle

Project Leader: Fischer, Grant: Fi 982/14-1, copperation with Dr. J. Fischer
Duration: 36 months, Begin: February 2016

Do it yourself, but not alone: Companion-Technologie für die Heimwerkerunterstützung

Project Leader: Minker, Grant: SFB Transregio 62
Duration: 36 months, Begin: January 2017

Mit Argumenten begeistern — Verbesserung der Überzeugungskraft von virtuellen Argumenten

Project Leader: Minker, Grant: Mi 741/8-1
Duration: 36 months, Begin: September 2017

BMBF Projects (Federal Ministry of Education and Research)

EUREKA-Projekt SENDATE-Secure-DCI (SEcure Networking for a DATa center cloud in Europe — Sichere und flexible Datenzentrums-Interkonnektivität)
Code- und Lattice-basierte Sicherheitskonzepte auf der physikalischen Schicht und für „post-quantum"-Kryptographie

Project Leader: Fischer, Grant: 16K/S0483
Duration: 36 months, Begin: June 2016

EU — Horizon 2020

KRISTINA: A Knowledge-Based Information Agent with Social Competence and Human Interaction Capabilities

Project Leader: Minker, Grant: HORIZON 2020-LEIT-ICT 22 - 2014
Duration: 36 months, Begin: March 2015

Industry Project

Lower-Power-Mobile TV Tuner Architecture

Project Leader: Fischer, Grant: Sony Deutschland GmbH Stuttgart
Duration: 24 months, Begin: June 2015

5 Publications

The publications are sorted according to the respective professor, which coincides with the research topics (Bossert: Groups A and B; Fischer: Group C; Minker: Group D).

Publications by Prof. Bossert's Group

Books and Book Chapters

[1] Martin Bossert, editor. Information- and Communication Theory in Molecular Biology, Springer Verlag, 2018. ISBN: 978-3-319-54729-9.

Journal and Conference Papers

[1] Peter Beelen, Sven Puchinger, and Johan Rosenkilde né Nielsen. Twisted Reed–Solomon Codes. In *IEEE International Symposium on Information Theory (ISIT)*, 2017.

[2] Yuval Cassuto, Evyatar Hemo, Sven Puchinger, and Martin Bossert. Multi-Block Interleaved Codes for Local and Global Read Access. In *IEEE International Symposium on Information Theory (ISIT)*, 2017.

[3] Mostafa H. Mohamed, Sven Puchinger, and Martin Bossert. Guruswami–Sudan List Decoding for Complex Reed-Solomon Codes. In *International ITG Conference on Systems, Communications and Coding (SCC)*, 2017.

[4] Sven Müelich and Martin Bossert. Applying convolutional codes to key extraction using ring oscillator pufs. In *8th International Workshop on Optimal Codes and Related Topics (OCRT), Sofia, Bulgaria*. VDE, 2017.

[5] Sven Müelich and Martin Bossert. A new error correction scheme for physical unclonable functions. In *SCC 2017; Proceedings of 11th International ITG Conference on Systems, Communications and Coding, Hamburg, Germany*, pages 1–6. VDE, 2017.

[6] Sven Müelich, Sven Puchinger, and Martin Bossert. Low-Rank Matrix Recovery using Gabidulin Codes in Characteristic Zero. *Electronic Notes in Discrete Mathematics*, 57:161–166, 2017.

[7] Sven Müelich, Sven Puchinger, David Mödinger, and Martin Bossert. An Alternative Decoding Method for Gabidulin Codes in Characteristic Zero. In *IEEE International Symposium on Information Theory (ISIT)*, pages 2549–2553, 2016.

[8] Sven Puchinger, Irene Bouw, and Johan Rosenkilde né Nielsen. Improved Power Decoding of One-Point Hermitian Codes. In *International Workshop on Coding and Cryptography*, 2017.

[9] Sven Puchinger, Sven Müelich, and Martin Bossert. On the Success Probability of Decoding (Partial) Unit Memory Codes. In *International Workshop on Optimal Codes and Related Topics*, 2017.

[10] Sven Puchinger, Sven Müelich, Karim Ishak, and Martin Bossert. Code-Based Cryptosystems Using Generalized Concatenated Codes. In Ilias S. Kotsireas and Edgar Martínez-Moro, editors, *Springer Proceedings in Mathematics & Statistics: Applications of Computer Algebra: Kalamata, Greece, July 20–23 2015*, volume 198, pages 397–423. Springer International Publishing, 2017.

[11] Sven Puchinger, Sven Müelich, David Mödinger, Johan Rosenkilde né Nielsen, and Martin Bossert. Decoding interleaved Gabidulin codes using Alekhnovich's algorithm. *Electronic Notes in Discrete Mathematics*, 57:175–180, 2017.

[12] Sven Puchinger, Sven Müelich, Antonia Wachter-Zeh, and Martin Bossert. Timing Attack Resilient Decoding Algorithms for Physical Unclonable Functions. In *International ITG Conference on Systems, Communications and Coding*, 2017.

[13] Sven Puchinger, Johan Rosenkilde né Nielsen, and John Sheekey. Further Generalisations of Twisted Gabidulin Codes. In *International Workshop on Coding and Cryptography*, 2017.

[14] Sven Puchinger and Johan Rosenkilde né Nielsen. Decoding of Interleaved Reed–Solomon Codes Using Improved Power Decoding. In *IEEE International Symposium on Information Theory (ISIT)*, 2017.

[15] Sven Puchinger, Johan Rosenkilde né Nielsen, Wenhui Li, and Vladimir Sidorenko. Row Reduction Applied to Decoding of Rank-Metric and Subspace Codes. *Designs, Codes and Cryptography*, 82(1-2):389–409, 2017.

[16] Sven Puchinger, Sebastian Stern, Martin Bossert, and Robert F.H. Fischer. Space-Time Codes Based on Rank-Metric Codes and Their Decoding. In *IEEE International Symposium on Wireless Communication Systems (ISWCS)*, pages 125–130, 2016.

[17] Sven Puchinger and Antonia Wachter-Zeh. Sub-Quadratic Decoding of Gabidulin Codes. In *IEEE International Symposium on Information Theory (ISIT)*, pages 2554–2558, 2016.

[18] Sven Puchinger and Antonia Wachter-Zeh. Fast Operations on Linearized Polynomials and their Applications in Coding Theory. *accepted at: Journal of Symbolic*

Computation, 2017.

[19] Michael Schelling and Martin Bossert. Code constructions based on reed-solomon codes. *OCRT2017, Sofia*, 2017.

[20] Ulrich Speidel, Sven Puchinger, and Martin Bossert. Constraints for Coded Tunnels Across Long Latency Bottlenecks with ARQ-based Congestion Control. In *IEEE International Symposium on Information Theory (ISIT)*, 2017.

Publications by Prof. Fischer's Group

Books and Book Chapters

[1] Robert F.H. Fischer, Michael Cyran, Sebastian Stern, Johannes B. Huber. Modulo-Type Precoding for Networks. In Wolfgang Utschick, editor, *Communications in Interference Limited Networks*, pp. 31–52. Springer Verlag, Berlin Heidelberg, Feb. 2016.

Journal and Conference Papers

[1] Michael Cyran, Birgit Schotsch, Johannes B. Huber, Robert F.H. Fischer. Layering of Communication Networks and a Forward-Backward Duality. In *Proceedings of 11. International ITG Conference on Systems, Communications, and Coding (SCC)*, Hamburg, Germany, Feb. 2017.

[2] Sameh Eldessoki, Johannes Dommel, Khaled Shawky, Lars Thiele, Robert F.H. Fischer. Peak-to-Average-Power Reduction for FBMC-based Systems. In *Proceedings of International ITG/IEEE Workshop on Smart Antennas (WSA)*, Mar. 2016.

[3] Robert F.H. Fischer, Michael Cyran, Sebastian Stern. Factorization Approaches in Lattice-Reduction-Aided and Integer-Forcing Equalization. In *2016 International Zurich Seminar on Communications*, Zurich, Switzerland, Mar. 2016.

[4] Robert F.H. Fischer, Michael Cyran, Vahid Forutan, Johannes B. Huber. Network Coding Security for Bidirectional Network Flows. In *Proceedings of 11. International ITG Conference on Systems, Communications, and Coding (SCC)*, Hamburg, Germany, Feb. 2017.

[5] Vahid Forutan, Robert Elschner, Carsten Schmidt-Langhorst, Colja Schubert, Robert F.H. Fischer. Towards Information-Theoretic Security in Optical Networks. In *ITG-Fachtagung Photonische Netze*, Leipzig, Germany, May 2017.

[6] Felix Frey, Robert Elschner, Carsten Schmidt-Langhorst, Robert Emmerich, Colja Schubert, Johannes K. Fischer, Robert F.H. Fischer. Investigation of Nonlinear Inter-channel Interference in Heterogeneous Flexible Optical Networks. In *Pro-*

ceedings of 11. International ITG Conference on Systems, Communications, and Coding (SCC), Hamburg, Germany, Feb. 2017.

[7] Felix Frey, Florian Wäckerle, Johannes K. Fischer, Robert F.H. Fischer. Optimized Detection and Decoding of 4D Signals for the Nonlinear Fiber-optical Channel. In *Proceedings Signal Processing in Photonic Communications*, New Orleans, LA, USA, July 2017.

[8] Felix Frey, L Molle, Robert Emmerich, Colja Schubert, Johannes K. Fischer, Robert F.H. Fischer. Single-step Perturbation-based Nonlinearity Compensation of Intra- and Inter-Subcarrier Nonlinear Interference. In *Proceedings of European Conference and Exhibition on Optical Communication (ECOC)*, Gotheburg, Sweeden, Sep. 2017.

[9] Sven Puchinger, Sebastian Stern, Martin Bossert, Robert F.H. Fischer. Space-Time Codes Based on Rank-Metric Codes and Their Decoding. In *International Symposium on Wireless Communication Systems (ISWCS)*, Sep. 2016.

[10] Susanne Sparrer, Robert F.H. Fischer. Enhanced Iterative Hard Thresholding for the Estimation of Discrete-Valued Sparse Signals. In *2016 European Signal Processing Conference (EUSIPCO 2016)*, Sep. 2016.

[11] Susanne Sparrer, Robert F.H. Fischer. Algorithms for the Iterative Estimation of Discrete-Valued Sparse Vectors. In *Proceedings of 11. International ITG Conference on Systems, Communications, and Coding (SCC)*, Hamburg, Germany, Feb. 2017.

[12] Susanne Sparrer, Robert F.H. Fischer. Unveiling Bias Compensation in Turbo-Based Algorithms for (Discrete) Compressed Sensing. In *2017 European Signal Processing Conference (EUSIPCO 2017)*, Kos, Greece, Sep. 2017.

[13] Hannes Stahl, Jan Mietzner, Martin Kirscht, Robert F.H. Fischer. Sub-Nyquist Radar with Optimized Sensing Matrices - Performance Evaluation Based on Simulations and Measurements. In *4th International Workshop on Compressed Sensing Theory and its Applications to Radar, Sonar and Remote Sensing*, Aachen, Germany, Sep. 2016.

[14] Sebastian Stern, Robert F.H. Fischer. Joint Algebraic Coded Modulation and Lattice-Reduction-Aided Preequalisation. *IET Electronics Letters*, Vol. 52, No. 7, pp. 523–525, 2016.

[15] Sebastian Stern, Robert F.H. Fischer. Lattice-Reduction-Aided Precoding for Coded Modulation over Algebraic Signal Constellations. In *Proceedings of International ITG/IEEE Workshop on Smart Antennas (WSA)*, Mar. 2016.

[16] Sebastian Stern, Robert F.H. Fischer. Advanced Factorization Strategies for Lattice-Reduction-Aided Preequalization. In *Proceedings of International Symposium on Information Theory (ISIT)*, Barcelona, Spain, July 2016.

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[1] Florian Nothdurft, Stefan Ultes, and Wolfgang Minker. User-centred spoken dialogue management. In Stefan Ultes, Florian Nothdurft, Tobias Heinroth, and Wolfgang Minker, editors, *Next Generation Intelligent Environments*, pages 265–294. Springer International Publishing, Cham, 2016.

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[16] Louisa Pragst, Juliana Miehle, Wolfgang Minker, and Stefan Ultes. Challenges for adaptive dialogue management in the kristina project. In *ISIAA 2017: Proceedings of the 1st ACM SIGCHI International Workshop on Investigating Social Interactions with Artificial Agents*, pages 11–14, New York, NY, USA, 2017. ACM.

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and Stefanos Vrochidis. Design of knowledge-based agent as a social companion. In *Proceedings of the International Conference on Health and Social Care Information Systems and Technologies (HCist)*, November 2017.

[32] Leo Wanner, Josep Blat, Stamatia Dasiopoulou, Mónica Domínguez, Gerard Llorach, Simon Mille, Federico Sukno, Eleni Kamateri, Ioannis Kompatsiaris, Stefanos Vrochidis, Elisabeth André, Florian Lingenfels, Gregor Mehlmann, Andries Stam, Ludo Stellingwerff, Lori Lamel, Bianca Vieru, Wolfgang Minker, Louisa Pragst, and Stefan Ultes. Towards a multimedia knowledge-based agent with social competence and human interaction capabilities. In *Proceedings of the 1st International Workshop on Multimedia Analysis and Retrieval for Multimodal Interaction*, pages 21–26. ACM, 2016.

Publications by Other Members of the Institute

[1] Alister Burr, Laurent Clavier, Goran Dimić, Tomaz Javornik, Werner G. Teich, Mohamad Mostafa, and Joan Olmos. Evolved physical layer. In Narcis Cardona, editor, *Cooperative Radio Communications for Green Smart Environments*, pages 305–340. River Publishers, 2016.

[2] Mohamad Mostafa, Giuseppe Oliveri, Werner G. Teich, and Jürgen Lindner. A continuous-time recurrent neural network for joint equalization and decoding - analog hardware implementation aspects. In Joao Luis G. Rosa, editor, *Artificial Neural Networks - Models and Applications*, chapter 04. InTech, Rijeka, 2016.

[3] Giuseppe Oliveri, Mohamad Mostafa, Werner G. Teich, Jürgen Lindner, and Hermann Schumacher. Advanced low power high speed nonlinear signal processing: An analog vlsi example. *Journal of Signal Processing Systems*, 89(1):163–180, Oct 2017.

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[5] Martin Schüssel. Angle of arrival estimation using wifi and smartphones. In *7th International Conference on Indoor Positioning and Indoor Navigation, Oktober 4-7 2016, Alcalá de Henares, Madrid, Spain*, 2016.

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[7] Werner G. Teich. Low-power high-speed signal processing for future mobile communication systems: From iterative algorithm to analog circuits. In *Artificial*

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[10] Thanawat Thiasiriphet, W. G. Teich, and Jürgen Lindner. A novel comb filter based rake-like receiver for code-reference uwb transmission. In *11th International Conference on Signal Processing and Communication Systems; Proceedings of*, 2017.

6 Seminars

- Kristian Villalobos Romo. *Design and Implementation of a Software-Defined Radio Communication System in C++*, April 8, 2016.
- Chethan Venkatesan. *Non-Binary Polar Codes for Coded Modulation based on Algebraic Signal Constellations*, April 27, 2016.
- Marijana Grujović (Serbia). *Software Implementation of a Simulator for coded OFDM Systems*, June 02, 2016.
- Daniel Valdivia De Nora. *Efficient Algorithms for Solving the Shortest Independent Vector Problem*, June 20, 2016.
- Syed Tanveer Mujtaba Zaidi. *Joint Optimization of Labeling and Partitioning in Multi-Stage Bit-Wise Coded Modulation*, June 20, 2016.
- Prof. Zoraida Callejas Carrión (University of Granada, Spain). *The Conversational Interface: Talking to Smart Devices*, June 28, 2016.
- Dr. Yingquan Wu (Micron Technology, USA). *Generalized Integrated Interleaved Codes*, July 19, 2016.
- Dr. Yingquan Wu (Micron Technology, USA). *New Scalable Decoder Architectures for Reed-Solomon Codes*, July 20, 2016.
- Prof. Sergo Shavgulidze (Georgian Technical University, Georgia). *Future Development of IMT Systems*, July 27, 2016.
- Abobakr Abdellah. *High-Order Voltage-Controlled Oscillator-Based Analog-to-Digital Converters*, October 6, 2016.
- Prof. Dr. Ulrich Speidel (University of Auckland, New Zealand). *T-codes and cyclic equivalences classes*, October 18, 2016.
- Yonatan Marin. *Auslöschungskorrektur in Multimedia-Streaming mittels Partial Unit Memory Codes basierend auf Reed-Solomon Codes*, November 7, 2016.
- Michael Zurell. *Implementierung eines Encoders und Decoders für Gabidulin-Codes*, November 7, 2016.
- Ilker Bagci. *Konzeption und Modellierung eines Dialogs für die Nutzergruppe "Ältere"*, November 14, 2016.
- Jessalyn Bolkema (University of Nebraska-Lincoln, United States). *The Tensor-like Join: A Factor Graph Construction for Polar Codes*, November 22, 2016.

- Prof. Dr. Johan Rosenkilde (Technical University of Denmark, Denmark). *Efficient Padé Approximations with Applications in Coding Theory*, December 2, 2016.
- Felix Frey. *Analytical models of the fiber optical channel*, December 16, 2016.
- Matthias Kraus. *Mixed-Initiative Intent Recognition Using Cloud-Based Cognitive Services*, December 19, 2016.
- Florian Delfanti. *A Design Toolkit for Prototyping Analog-to-Digital Converters for use in Simulink*, January 9, 2017.
- Matthias Estner. *Analyse allgemeiner Schätzmethoden für Compressed Sensing*, April 3, 2017.
- Jens Markus Zihsler *Visuelles Grounding bei multilingualen Sprechern*, April 24, 2017.
- Benedikt Meinecke. *Algorithmen für diskretes Compressed Sensing mit höherstufigen Alphabeten*, April 24, 2017.
- Ranjith Ponnusamy. *Using Rank-Metric Codes in MIMO Transmission Systems*, April 24, 2017.
- Felix Frey. *Zeitbereichsdarstellung eines analytischen Glasfaser Kanalmodells*, April 24, 2017.
- Martin Herrmann. *LTE in Mass Market UAV Scenarios*, April 25, 2017.
- Nadine Gerstenlauer. *Controlling an Intelligent Operating Room with Spoken Language*, June 19, 1017.
- Alexander Tsaregorodtsev. *Designing Concatenated BCH Codes for Application in Physical Unclonable Functions*, July 20, 2017.
- Kirill Dzuba. *Emotion Estimation from Semantic Content*, September 18, 2017.
- Sven Kahle. *Multi-Block Interleaved Codes for Data-Storage Applications*, September 27, 2017.
- Rebekka Schulz. *Code-Based Cryptology Using Moderate-Density Parity-Check Codes*, October 16, 2017.
- Prince Attrams. *Topic Switching Strategies in Cloud-Based Multi-Domain Spoken Dialog Systems*, October 16, 2017.
- Lukas Zielinski. *Konzept eines proaktiven sprachgestützten Lenkzeit-Assistenten für LKW-Fahrer*, October 23, 2017.
- Veniamin Stukalov. *Error Models in Physical Unclonable Functions*, October 26, 2017.

- Liming Fan. *Using Sequential Decoding for Key Regeneration in Physical Unclonable Functions*, November 20, 2017.
- Saskia Langhammer. *A Debating Ontology for Argumentative Dialogue Systeme*, November 27, 2017.
- Dr.-Ing. Stefan Ultes (University of Cambridge, United Kingdom). *Domain-independent user satisfaction reward establishment for dialogue policy learning*, December 01, 2017.
- Maximillian Fürholzer. *Efficient Implementation of the Truncated SVD*, December 04, 2017.
- Nicolas Wagner. *User-adaptive Statistical Dialogue Management using OpenDial*, December 11, 2017.
- Stefanie Walz. *Integrating the NAO robot into the OwlSpeak framework*, December 11, 2017.
- Kazuma Nagano. *Investigation of cultural differences during searching on the browser*, December 18, 2017.
- Yuta Takahashi. *Emotion recognition for inferring tourist satisfaction by using eye tracking, head motion sensing, and audio/video recording*, December 18, 2017.
- Kyoshiro Sugiyama. *Modeling a Persona containing relevant world knowledge*, December 18, 2017.
- Manuel Allgaier. *Analyse, Bewertung und prototypische Entwicklung von Frameworks zur Entwicklung von Modellen für natürliches Sprachverstehen* December 18, 2017.
- Jhoiss Baloi. *Helper Data Methods for Error Correction in PUFs*, December 21, 2017.
- Christian Ziegler. *Effiziente Implementierung eines LDPC-Decoders*, December 21, 2017.

7 Ph.D. Theses

7.1 Supervised Ph.D. Theses

- Helmut Lang. *Optimisation and Evaluation of Software Support Systems*, Institute of Communications Engineering, Ulm University, 2016.
  Reviewers: Prof. W. Minker, Prof. H.-P. Großmann.
- Florian Nothdurft. *User- and Situation-Adaptive Explanations in Dialogue Systems*, Institute of Communications Engineering, Ulm University, 2016.
  Reviewers: Prof. W. Minker, Prof. S. Biundo-Stephan, Ulm University, Prof. K. Jokinen, University of Helsinki, Finland.
- David Viktor Kracht. *Innovative Barcode-Konzepte für DNA-Sequenzierverfahren der zweiten Generation*, Institute of Communications Engineering, Ulm University, 2016.
  Reviewers: Prof. M. Bossert, Prof. D. Keim, University of Constance.
- Dr. Roman Sergienko. *Text Classification for Spoken Dialogue Systems*, Institute of Communications Engineering, Ulm University, 2016.
  Reviewers: Prof. W. Minker, Jun. Prof. B. Glimm, Ulm University.
- Maxim Sidorov. *Automatic Recognition of Paralinguistic Information*, Institute of Communications Engineering, Ulm University, 2016.
  Reviewers: Prof. W. Minker, Prof. S. Nakamura, Nara Institute of Science and Technology, Japan, and Karlsruhe Institute of Technology Prof. Y.N. Matveev, Bauman Moscow State Technical University, Russia.
- Mostafa Hosni Mohamed. *Algebraic Decoding over Finite and Complex Fields using Reliability Information*, Institute of Communications Engineering, Ulm University, 2017.
  Reviewers: Prof. M. Bossert, Prof. J. Freudenberger, Constance University of Applied Scienes.

7.2 Co-Supervised Ph.D. Theses

- Mark Poguntke. *Abstrakte Interaktionsmodelle für die Integration in bestehende Benutzerschnittstellen*, Ulm University, 2016.
  Reviewers: Prof. M. Weber, Prof. W. Minker.
- Luma Issa Abdul-Kreem Al-Helli. *Neural Mechanisms of Visual Perception Using Address-Event Representation*, Ulm University, 2016.
  Reviewers: Prof. H. Neumann, Prof. W. Minker.
- Sven Reichel. *Anwendungsübergreifende Dialoge durch Wissensbasen und Taskmodelle*, Ulm University, 2017.
  Reviewers: Prof. M. Weber, Prof. W. Minker.
- Felix Schüssel. *Multimodal Input Fusion for Companion Technology*, Ulm University, 2017.
  Reviewers: Prof. M. Weber, Prof. W. Minker.

8 Theses

8.1 Master Theses

[1] Abobakr Abdellah. *High-Order Voltage-Controlled Oscillator-Based Analog-to-Digital Converters*. Master's thesis, Supervisor: George Yammine; Reviewer: Prof. R. Fischer, Sep. 2016.

[2] Manuel Allgaier. *Analyse, Bewertung und prototypische Entwicklung von Frameworks zur Entwicklung von Modellen für natürliches Sprachverstehen*. Master's thesis, Supervisor: André Berton; Reviewer: Prof. W. Minker, Dec. 2017.

[3] Prince Attrams. *Topic Switching Strategies in Cloud-Based Multi-Domain Spoken Dialog Systems*. Master's thesis, Supervisor: Matthias Kraus; Reviewer: Prof. W. Minker, Nov. 2017.

[4] Youssef Dawoud. *Coding for Ultra-Reliable low-latency Train-to-Train Communication System*. Master's thesis, Supervisor: Mohammad Soliman; Reviewer: Prof. U. Fiebig, 2017.

[5] Kirill Dzuba. *Emotion Estimation from Semantic Content*. Master's thesis, Supervisor: Louisa Pragst; Reviewer: Prof. W. Minker, Sep. 2017.

[6] Liming Fan. *Using Sequential Decoding for Key Regeneration in Physical Unclonable Functions*. Master's thesis, Supervisors: Sven Müelich and Sven Puchinger; Reviewer: Prof. M. Bossert, Nov. 2017.

[7] Martin Herrmann. *LTE in Mass Market UAV Scenarios*. Master's thesis, Supervisor and Reviewer: Prof. U. Fiebig, May 2017.

[8] Matthias Kraus. *Mixed-Initiative Intent Recognition Using Cloud-Based Cognitive Services*. Master's thesis, Supervisor: Florian Nothdurft; Reviewer: Prof. W. Minker, Dec. 2016.

[9] Benedikt Meinecke. *Algorithmen für diskretes Compressed Sensing mit höherstufigen Alphabeten*. Master's thesis, Supervisor: Susanne Sparrer; Reviewer: Prof. R. Fischer, Apr. 2017.

[10] Daniel Valdivia De Nora. *Efficient Algorithms for Solving the Shortest Independent Vector Problem*. Master's thesis, Supervisor: Sebastian Stern; Reviewer: Prof. R. Fischer, May 2016.

[11] Ranjith Ponnusamy. *Using Rank-Metric Codes in MIMO Transmission Systems*. Master's thesis, Supervisors: Sebastian Stern and Sven Puchinger; Reviewer: Prof. R. Fischer, Apr. 2017.

[12] Kristian Villalobos Romo. *Design and Implementation of a Software-Defined Radio Communication System in C++*. Master's thesis, Supervisor: Sebastian Stern; Reviewer: Prof. R. Fischer, Apr. 2016.

[13] Veniamin Stukalov. *Error Models in Physical Unclonable Functions*. Master's thesis, Supervisors: Sven Müelich and Sven Puchinger; Reviewer: Prof. M. Bossert, Oct. 2017.

[14] Chethan Venkatesan. *Non-Binary Polar Codes for Coded Modulation based on Algebraic Signal Constellations*. Master's thesis, Supervisor: Sebastian Stern; Reviewer: Prof. R. Fischer, Apr. 2016.

[15] Nicolas Wagner. *User-adaptive Statistical Dialogue Management using OpenDial*. Master's thesis, Supervisor: Juliana Miehle; Reviewer: Prof. W. Minker, Dec. 2017.

[16] Syed Tanveer Mujtaba Zaidi. *Joint Optimization of Labeling and Partitioning in Multi-Stage Bit-Wise Coded Modulation*. Master's thesis, Supervisor: Florian Wäckerle; Reviewer: Prof. R. Fischer, June 2016.

[17] Lukas Zielinski. *Konzept eines proaktiven sprachgestützten Lenkzeit-Assistenten für LKW-Fahrer*. Master's thesis, Supervisor: Ute Ehrlich; Reviewer: Prof. W. Minker, Nov. 2017.

[18] Jens Markus Zihsler. *Visuelles Grounding bei multilingualen Sprechern*. Master's thesis, Supervisor: Ute Ehrlich; Reviewer: Prof. W. Minker, May 2017.

8.2 Bachelor Theses

[1] Ilker Bagci. *Konzeption und Modellierung eines Dialogs für die Nutzergruppe "ältere"*. Bachelor's thesis, Supervisor: Juliana Miehle; Reviewer: Prof. W. Minker, Nov. 2016.

[2] Jhoiss Paulo Baloi. *Helper Data Methods for Error Correction in Physical Unclenable Functions*. Bachelor's thesis, Supervisor: Sven Müelich; Reviewer: Prof. M. Bossert, Dec. 2017.

[3] Florian Delfanti. *A Design Toolkit for Prototyping Analog-to-Digital Converters for use in Simulink*. Bachelor's thesis, Supervisor: George Yammine; Reviewer: Prof. R. Fischer, Dec. 2016.

[4] Matthias Estner. *Analyse allgemeiner Schätzmethoden für Compressed Sensing*. Bachelor's thesis, Supervisor: Susanne Sparrer; Reviewer: Prof. R. Fischer, May 2017.

[5] Maximillian Fürholzer. *Efficient Implementation of the Truncated SVD*. Bachelor's thesis, Supervisor: George Yammine; Reviewer: Prof. R. Fischer, Nov. 2017.

[6] Nadine Gerstenlauer. *Controlling an Intelligent Operating Room with Spoken Language*. Bachelor's thesis, Supervisor: Juliana Miehle; Reviewer: Prof. W. Minker, May 2017.

[7] Sven Kahle. *Multi-Block Interleaved Codes for Data-Storage Applications*. Bachelor's thesis, Supervisors: Sven Puchinger and Michael Schelling; Reviewer: Prof. M. Bossert, Nov. 2017.

[8] Saskia Langhammer. *A Debating Ontology for Argumentative Dialogue Systeme*. Bachelor's thesis, Supervisor: Niklas Rach; Reviewer: Prof. W. Minker, Nov. 2017.

[9] Yonatan Marin. *Auslöschungskorrektur in Multimedia-Streaming mittels Partial Unit Memory Codes basierend auf Reed-Solomon Codes*. Bachelor's thesis, Supervisors: Sven Müelich and Sven Puchinger; Reviewer: Prof. M. Bossert, Oct. 2016.

[10] Rebekka Schulz. *Code-Based Cryptology Using Moderate-Density Parity-Check Codes*. Bachelor's thesis, Supervisor: Sven Müelich; Reviewer: Prof. M. Bossert, Nov. 2017.

[11] Alexander Tsaregorodtsev. *Designing Concatenated BCH Codes for Application in Physical Unclonable Functions*. Bachelor's thesis, Supervisors: Sven Müelich and Michael Schelling; Reviewer: Prof. M. Bossert, Sep. 2017.

[12] Stefanie Walz. *Integrating the NAO robot into the OwlSpeak framework*. Bachelor's thesis, Supervisor: Juliana Miehle; Reviewer: Prof. W. Minker, Dec. 2017.

[13] Michael Zurell. *Implementierung eines Encoders und Decoders für Gabidulin-Codes*. Bachelor's thesis, Supervisors: Sebastian Stern and Sven Puchinger; Reviewer: Prof. R. Fischer, Nov. 2016.

9 Academics

The members of the institute are active in various committees and at the university self-administration.

Prof. Martin Bossert

- Member of *Leopoldina, Deutsche Akademie der Wissenschaften*
- DFG-Fachkollegiat Nachrichtentechnik
- Vice Dean of the Faculty of Engineering, Computer Science, and Psychology (until Sep. 2015)
- Program Director of *the International Master Course "Communications Technology"* (since Sep. 2016)
- Head of *Promotionsausschuss Dr.-Ing.*
- Member of *Commission VDE Colloquium*
- Member of *ITG-Fachausschuss 5.1 Informations- und Systemtheorie*

Prof. Robert Fischer

- *Dean of Studies (Engineering)* of the Faculty of Engineering, Computer Science, and Psychology (since Oct. 2015)
- Program Director of *the International Master Course "Communications Technology"* (June 2014–August 2016)
- Head of *the Admission Board for the International Master Course "Communications Technology"* (since Sep. 2014)
- Head of *Habilitationsausschuss*
- Member of *kiz-Ausschuss*
- Member of *Selection Commitee for the Argus Award*
- Member of *ITG-Fachausschuss 5.1 Informations- und Systemtheorie*

Prof. Wolfgang Minker

- Head of *Industrial Internship Office*
- Member of *Admission Board of the joint B.Sc./M.Sc. Programme "Informationssystemtechnik"*
- Member of *GUC Advisory Board*

Dr. Werner Teich

- Academic Advisor *"Elektrotechnik", "Informationssystemtechnik", and "Communications Technology'*
- Erasmus Incoming Students Advisor
- Member of *Studienkommission "Informationssystemtechnik"*
- Member of *Fachprüfungsausschüsse der ingenieurwissenschaftlichen Studiengänge "Elektrotechnik", "Communications Technology" and "Sensorsystemtechnik"*
- Member of *Fachprüfungsausschuss "Informationssystemtechnik"*
- Member of *Admission Boards for the Master Courses "Elektrotechnik", "Informationssystemtechnik"*, and the *International Master Course "Communications Technology"*