

Report on tracking of new knowledge

PSC Meeting no. 1/2008

ETH Zurich, 22nd February 2008 (16:00-17:30 CET)

Last update Mon Feb 25, 2008.

The project partners established an IPR Policy Committee consisting of technical experts and legal experts in September, 2006. This committee defines rules and guidelines for the reuse of existing knowledge (PEKH, Pre-Existing Know-How, Background) and the tracking of new knowledge generation (Knowledge, Foreground) in the project. The IPRs generated by the project will be evaluated by the IPR Policy Committee for patent filing or for exploitation. The actual patent filing itself will be performed by the partners involved. The ultimate goal of this activity is to build up and maintain a MASCOT IPR portfolio

IPR Policy Committee Members are:

- **Legal experts:** Horst Rode (FTW), Teemu Soininen (NOKIA), Ulf Johann (FhG-HHI), Roberta Melchiorre (PoliTo), Verena Obrovski (VUT), Matias Beck (ETHZ), **N.N.** (FBM-UPF).
- **Technical experts:** Christoph Mecklenbräuer (FTW), Ari Hottinen (NOKIA), Martin Schubert (FhG-HHI), Giorgio Taricco (PoliTo), Gerald Matz (VUT), Helmut Bölcskei (ETHZ), Ezio Biglieri (FBM-UPF).

Note: FBM-UPF needs to nominate a legal expert for the MASCOT IPR Policy Committee (previously Ms. Bruna Vives was nominated on behalf of FBM-UPF, but she has changed affiliation)

New knowledge generated during 2007

1. Golden Space-Time Trellis Coded Modulation for high data rate transmission in 2x2 MIMO systems. In particular code design and optimization, performance evaluation in different channel conditions, reduced complexity decoding and VLSI implementation. Joint work by: Barbara Cerato, Yi Hong and Emanuele Viterbo.

2. Optimum receiver scheme and specific iterative decoding algorithm for space-time coded MIMO systems with imperfect channel state information at the receiver (obtained by pilot symbol insertion) and in the presence of perfect channel distribution information at the transmitter corresponding to separately correlated Rician fading channel. Joint work by: Giorgio Taricco, Giulio Coluccia, [JSAC 2007].
3. Throughput optimization for the optimum receiver scheme developed in [Taricco,Coluccia JSAC 2007] leading to a blind receiver design Joint work by: Giulio Coluccia, Giorgio Taricco, [Communications Letters 2007].
4. Generalization of the optimum receiver concept developed in Ref. [Taricco,Coluccia JSAC 2007] to MIMO-OFDM transmission. Joint work by: Giorgio Taricco, Giulio Coluccia, Erwin Riegler, and Christoph Mecklenbräuer
5. Method for the asymptotic analysis of the ergodic capacity of a narrowband MIMO communication system affected by separately correlated Rician fading and narrowband interference including iterative covariance optimization algorithm. Joint work by: Giorgio Taricco, Erwin Riegler, [ISIT 2007]
6. Algorithm for the asymptotic derivation of the mutual information statistics of a narrowband MIMO communication system affected by separately correlated Rician fading and narrowband interference. Joint work by: Erwin Riegler, Giorgio Taricco, [Globecom 2007]
7. Algorithm for the derivation of the sum capacity and of the corresponding rate region for a narrowband multiuser MIMO communication channel affected by separately correlated Rician fading. Joint work by: Erwin Riegler, Giorgio Taricco, [Globecom 2007]
8. Method for analyzing the outage characteristics of correlated Ricean fading, coherent MIMO channels and establishment of the "critical rate" notion, below which communication at zero outage is possible. Joint work by Markus Gärtner and Helmut Bölcskei [ISIT 2007]
9. Method to establish the optimal diversity-multiplexing (DM) tradeoff of coherent time, frequency and time-frequency selective-fading MIMO channels and a code design criterion for DM-tradeoff optimality for these channels. Joint work by Pedro Coronel and Helmut Bölcskei [ISIT 2007].
10. Reference VLSI implementation of a programmable matrix decomposition architecture for MIMO communication systems and a detailed investigation of associated implementation trade-offs. Joint work by Christoph Studer, Patrick Blösch, Peter Friedli, and Andreas Burg [ACSSC 2007]
11. VLSI implementation of a reduced-complexity MIMO detector with close-to ML error rate performance. Joint work by Christian Hess, Markus Wenk, Andreas Burg, Peter Lüthi, Christoph Studer, Norbert Felber and Wolfgang Fichtner [GLSVLSI 2007]
12. VLSI Implementation of a High-Speed Iterative Sorted MMSE QR Decomposition based on Givens rotations providing the base for improved layered stream decoding. Joint work by P. Luethi, A. Burg, S. Haene, D. Perels, N. Felber, W. Fichtner [ISCAS 2007]
13. Space-Time Block Codes with reduced-complexity decoders for transmission in 2x2 and 4x2 MIMO systems. In particular: code design and optimization, and performance evaluation in different channel conditions. Joint work by: Ezio Biglieri, Yi Hong and Emanuele Viterbo.

14. Multiuser detection when the number of active users is unknown. In particular: Design of detectors optimized under different cost functions, dynamic models for users' activity and users' mobility, performance evaluation, and design of reduced-complexity receivers. Joint work by: Ezio Biglieri, Daniele Angelosante, Marco Lops, and Adria' Tauste Campo.
15. Neighbor detection in wireless ad hoc networks. In particular: Development of an algorithm, its analysis, and evaluation of its performance. Joint work by: Ezio Biglieri, Daniele Angelosante, and Marco Lops.
16. Method for low-complexity lattice reduction using Seysen's algorithm in MIMO detection and precoding. Joint work by Dominik Seethaler, Gerald Matz, and Franz Hlawatsch (ICASSP 2007)
17. VLSI implementation of Brun's lattice reduction for MIMO broadcast precoding. Joint work by Andreas burg, Dominik Seethaler, and Gerald Matz (ISCAS 2007)
18. Algorithm for flexible multi-user channel estimation in MIMO-OFDMA. Joint work by Peter Fertl and Gerald Matz (ICASSP 2007)
19. Method for joint data detection and channel estimation in MIMO-IDMA systems based on factor graphs. Joint work by Clemens Novak, Gerald Matz, and Franz Hlawatsch (ICASSP 2007 and ICC 2008).
20. Algorithm for low-complexity and full-diversity MIMO detection based on condition number thresholding. Joint work by J. Maurer and G. Matz (ICASSP 2007)

VHDL Reference Designs

ETHZ will make the VHDL library of reference designs available to interested external parties on request, e.g. through a web-based portal which can easily be included into MASCOT web-site. ETHZ does not give any guarantees or liability. The VHDL library of reference designs will be provided with only minimal support.

Four algorithms have been identified for inclusion into the reference designs:

1. **Sorted QR Decomposition** [P. Luethi, A. Burg, S. Haene, D. Perels, N. Felber, and W. Fichtner. VLSI implementation of a high-speed iterative sorted MMSE QR decomposition. In IEEE Int. Symp. on Circuits and Systems, pages 1421–1424, New Orleans, May 2007]
2. **Singular Value Decomposition** [C. Studer, P. Blösch, P. Friedli, and A. Burg. Matrix decomposition architecture for MIMO systems: Design and implementation trade-offs. In Proc. 41st Asilomar Conf. on Signals, Systems and Computers, Pacific Grove (CA), USA, Nov. 2007]
3. **Lattice-reduction aided precoding using Brun's algorithm** [A. P. Burg, D. Seethaler, and G. Matz. VLSI implementation of a lattice-reduction algorithm for multi-antenna broadcast precoding. In IEEE Int. Symp. on Circuits and Systems, pages 673–676, New Orleans, May 2007]



4. **425 Mbps K-BEST decoder for MIMO and Multi-User detection** [M. Wenk, M. Zellweger, A. P. Burg, N. Felber, and W. Fichtner. K-best MIMO detection VLSI architectures achieving up to 424 Mbps. In Proc. IEEE Int. Symp. on Circuits and Systems, pages 1151–1154, May 2006]

Patent Applications

1. There were no patent applications during 2006
2. During 2007 there were three patent applications (Applicant: Nokia)
 - a. Patent application NNNNNNNN1
 - b. Patent application NNNNNNNN2
 - c. Patent application NNNNNNNN2

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