

# **2010 IEEE Information Theory Workshop**

## **(ITW 2010)**

**Dublin, Ireland**  
**30 August – 3 September 2010**



**IEEE Catalog Number:** CFP10ITW-PRT  
**ISBN:** 978-1-4244-8262-7

# TABLE OF CONTENTS

## PLENARY TALK:

|   |   |
|---|---|
| Abelian Varieties in Coding and Cryptography..... | 1 |
| <i>Ian F. Blake</i>                               |   |

## CODING AND INFORMATION-THEORETIC METHODS IN CRYPTOGRAPHY:

|   |    |
|---|----|
| Recent Results on Bent and Hyper-bent Functions and Their Link With Some Exponential Sums ..... | 6  |
| <i>Sihem Mesnager</i>   |    |
| Boolean Functions Whose Restrictions are Highly Nonlinear .....                                 | 11 |
| <i>Constanza Riera, Matthew G. Parker</i>   |    |
| Hecke Operators with odd Determinant and Binary Frameproof Codes                                |    |
| Beyond the Probabilistic Bound? .....   | 16 |
| <i>Hugues Randriam</i>  |    |
| Robust Parent-identifying Codes.....  | 21 |
| <i>Alexander Barg, G. Robert Blakley, Grigory Kabatiansky, Cedric Tavernier</i>                 |    |
| Coding Solutions for the Secure Biometric Storage Problem .....                                 | 25 |
| <i>Davide Schipani, Joachim Rosenthal</i>   |    |
| Identification Codes in Cryptographic Protocols.....  | 29 |
| <i>Julien Bringer, Hervé Chabanne, Gerard Cohen, Bruno Kindarji</i>                             |    |

## COOPERATION AND THROUGHPUT IN NETWORKS:

|   |    |
|---|----|
| Cooperative Strategies for Relay-Aided Multi-Cell Wireless Networks with Backhaul.....                                  | 34 |
| <i>Jinfeng Du, Ming Xiao, Mikael Skoglund</i>   |    |
| Throughput and Latency of Acyclic Erasure Networks with Feedback in a Finite Buffer Regime.....                         | 39 |
| <i>Nima Torabkhani, Badri N. Vellambi, Faramarz Fekri</i>   |    |
| Cooperative ARQs with Opportunistic Distributed Space-time Coding: Effective<br>Protocols and Performance Analysis..... | 44 |
| <i>Hsin-Li Chiu, Sau-Hsuan Wu, Jin-Hao Li</i>   |    |
| On the Deterministic Multicast Capacity of Bidirectional Relay Networks .....   | 49 |
| <i>M. Mokhtar, Y. Mohasseb, M. Nafie, H. El Gamal</i>   |    |

## LOW-DENSITY CODES:

|  |    |
|--|----|
| Structured LDPC Codes from Permutation Matrices Free of Small Trapping Sets.....       | 54 |
| <i>Dung Viet Nguyen, Bane Vasic, Michael Marcellin, Shashi Kiran Chilappagari</i>      |    |
| Quasi-cyclic Asymptotically Regular LDPC Codes .....                                   | 59 |
| <i>David G. M. Mitchell, Roxana Smarandache, Michael Lentmaier, Daniel J. Costello</i> |    |
| Irregular Repeat-accumulate-like Codes with Improved Error Floor Performance.....      | 64 |
| <i>David F. Hayes, Sarah J. Johnson, Steven R. Weller</i>                              |    |
| Lossy Source Compression of Non-uniform Binary Sources Using GQ-LDGM Codes.....        | 69 |
| <i>Lorenzo Cappellari</i>  |    |

## COMMUNICATION WITH SECRECY SONCTRRAINTS:

|  |    |
|--|----|
| Strong Secrecy for Erasure Wiretap Channels .....  | 74 |
| <i>Ananda T. Suresh, Arunkumar Subramanian, Andrew Thangaraj, Matthieu Bloch, Steven W. McLaughlin</i> |    |
| Wiretap Channel with Shared Key .....  | 79 |
| <i>Wei Kang, Nan Liu</i>   |    |
| Multiple Access Wiretap Channels with Strong Secrecy.....  | 84 |
| <i>Mohammad Hossein Yassaee, Mohammad Reza Aref</i>  |    |

|  |    |
|--|----|
| <b>Secure Type-based Multiple Access: Transmission Strategy and Analysis for Perfect Secrecy</b> | 89 |
| <i>Hyoungsuk Jeon, Daesung Hwang, Hyuckjae Lee, Jeongseok Ha, Jinho Choi</i>                     |    |

## **COMMUNICATION THEORY 1:**

|  |     |
|--|-----|
| <b>Exact PWM Representation of Bandlimited Signals</b>   | 94  |
| <i>Jing Huang, Krishnan Padmanabhan, Oliver M. Collins</i>   |     |
| <b>Fading Channels with 1-bit Output Quantization: Optimal Modulation, Ergodic Capacity and Outage Probability</b> | 99  |
| <i>Stefan Krone, Gerhard Fettweis</i>  |     |
| <b>On Optimum Communication Cost for Joint Compression and Dispersive Information Routing</b>                      | 104 |
| <i>Kumar Viswanatha, Emrah Akyol, Kenneth Rose</i>   |     |
| <b>On the Secure Outage Performance for Wireless Multicasting through Slow Fading Channels</b>                     | 109 |
| <i>Md. Zahurul I. Sarkar, Tharmalingam Ratnarajah</i>  |     |

## **CODING FOR MEMORIES:**

|  |     |
|--|-----|
| <b>Dense Error-correcting Codes in the Lee Metric</b>                                    | 114 |
| <i>Tuvi Etzion, Alexander Vardy, Eitan Yaakobi</i>                                       |     |
| <b>On The Parallel Programming of Flash Memory Cells</b>                                 | 119 |
| <i>Eitan Yaakobi, Anxiao Andrew Jiang, Paul H. Siegel, Alexander Vardy, Jack K. Wolf</i> |     |
| <b>Efficient Two-write WOM-codes</b>   | 124 |
| <i>Eitan Yaakobi, Scott Kayser, Paul H. Siegel, Alexander Vardy, Jack K. Wolf</i>        |     |
| <b>Constrained Codes for Phase-change Memories</b>                                       | 129 |
| <i>Anxiao Andrew Jiang, Jehoshua Bruck, Hao Li</i>                                       |     |

## **COMMUNICATION WITH MULTIPLE ANTENNAS:**

|  |     |
|--|-----|
| <b>An Achievable Rate for the MIMO Individual Channel</b>  | 134 |
| <i>Yuval Lomnitz, Meir Feder</i>   |     |
| <b>How to Achieve the Optimal DMT of Selective Fading MIMO Channels?</b>                                       | 139 |
| <i>Lina Mroueh, Jean-Claude Belfiore</i>   |     |
| <b>A New Full-diversity Criterion and Low-complexity STBCs with Partial Interference Cancellation Decoding</b> | 144 |
| <i>Lakshmi Prasad Natarajan, B. Sundar Rajan</i>   |     |
| <b>Information-theoretic Performance Analysis of LMS MIMO Communications</b>                                   | 149 |
| <i>Giuseppa Alfano, Antonio De Maio, Antonia M.Tulino</i>  |     |
| <b>Coding for the MIMO ARQ Block-fading Channel with Imperfect Feedback and CSIR</b>                           | 154 |
| <i>A. Taufiq Asyhari, Albert Guillen i Fabregas</i>  |     |

## **SECURE COMMUNICATION:**

|  |     |
|--|-----|
| <b>Stopping Sets for Physical-layer Security</b>   | 159 |
| <i>Willie K. Harrison, Joao Almeida, Demijan Klinec, Steven W. McLaughlin, Joao Barros</i> |     |
| <b>Non-systematic Codes for Physical Layer Security</b>                                    | 164 |
| <i>Marco Baldi, Marco Bianchi, Franco Chiaraluce</i>                                       |     |
| <b>Low-complexity Wire-tap Codes with Security and Error-correction Guarantees</b>         | 169 |
| <i>Yuval Cassuto, Zvonimir Bandic</i>  |     |
| <b>An Extension of Massey Scheme for Secret Sharing</b>                                    | 174 |
| <i>Romar dela Cruz, Annika Meyer, Patrick Sole</i>   |     |

## **POLAR CODES:**

|  |     |
|--|-----|
| <b>Universal Source Polarization and Sparse Recovery</b> | 179 |
| <i>Emmanuel Abbe</i>                                     |     |
| <b>Secrecy-achieving Polar-coding</b>                    | 184 |
| <i>Eran Hof, Shlomo Shamai</i>                           |     |

|   |     |
|---|-----|
| <b>On Speed of Channel Polarization .....</b> | 189 |
| <i>Toshiyuki Tanaka</i>                       |     |

### **POLAR AND LDPC CODES:**

|  |     |
|--|-----|
| <b>Polar Coding for Reliable Communications over Parallel Channels .....</b>             | 194 |
| <i>Eran Hof, Igal Sason, Shlomo Shamai</i>   |     |
| <b>Non-binary Polar Codes using Reed-solomon Codes and Algebraic Geometry Codes.....</b> | 199 |
| <i>Ryuhei Mori, Toshiyuki Tanaka</i>   |     |
| <b>On LP Decoding of Polar Codes .....</b>   | 204 |
| <i>Naveen Goela, Satish Babu Korada, Michael Gastpar</i>                                 |     |

### **COMMUNICATION THEORY 2:**

|   |     |
|---|-----|
| <b>On the Capacity Region of the Degraded Z Channel.....</b>  | 209 |
| <i>Sadaf Salehkalaiab, Mohammad Reza Aref</i>   |     |
| <b>Bit-interleaved Coded Modulation with Shaping.....</b>   | 214 |
| <i>Albert Guillen I. Fabregas, Alfonso Martinez</i>   |     |
| <b>Achievable Rate Regions for Dirty Tape Channels and "Joint Writing on Dirty Paper and Dirty Tape".....</b> | 219 |
| <i>Reza Khosravi-Farsani, Bahareh Akhbari, Mohammad Reza Aref</i>   |     |
| <b>Coding for the Z Channel With a Digital Relay Link.....</b>  | 224 |
| <i>Hieu T. Do, Tobias J. Oechtering, Mikael Skoglund</i>  |     |

### **ALGEBRAIC CODES:**

|  |     |
|--|-----|
| <b>On the Degree of the Inverse of Quadratic Permutation Polynomial Interleavers .....</b> | 229 |
| <i>Eeva Suvitie, Jyrki Lahtonen</i>  |     |
| <b>The Projective Kerdock Code.....</b>  | 234 |
| <i>M. M. Nastasescu, A. R. Calderbank</i>  |     |
| <b>Information sets for Abelian Codes.....</b>   | 239 |
| <i>Jose Joaquin Bernal, Juan Jacobo Simon</i>  |     |
| <b>Additive Codes over <math>\mathbf{Z}_2 \times \mathbf{Z}_4</math>.....</b>              | 244 |
| <i>Joaquim Borges, Cristina Fernandez-Cordoba, Steven T. Dougherty</i>                     |     |

### **GRAPHICAL MODELS AND DECODING:**

|   |     |
|---|-----|
| <b>Tail-biting Products Trellises, the BCJR-construction and their Duals.....</b>                   | 247 |
| <i>Heide Gluesing-Luerssen, Elizabeth Weaver</i>  |     |
| <b>Valiant Transform of Forney Graphs.....</b>  | 252 |
| <i>Ali Al-Bashabsheh, Yongyi Mao</i>  |     |
| <b>An Algebraic View to Gradient Descent Decoding .....</b>   | 257 |
| <i>M. Borges Quintana, M. A. Borges Trenard, I. Marquez-Corbella, E. Martinez-Moro</i>              |     |
| <b>The Euclidean Algorithm for Generalized Minimum Distance Decoding of Reed-solomon Codes.....</b> | 261 |
| <i>Sabine Kampf, Martin Bossert</i>   |     |
| <b>Universal A Posteriori Metrics Game .....</b>  | 266 |
| <i>Emmanuel Abbe, Rethnakaran Pulikoonattu</i>  |     |

### **CODING AND DECODING:**

|  |     |
|--|-----|
| <b>Computation of the Robust Symmetrical Number System Dynamic Range .....</b> | 271 |
| <i>Brian L. Luke, Phillip E. Pace</i>  |     |
| <b>Properties of Optimal Prefix-free Machines as Instantaneous Codes .....</b> | 276 |
| <i>Kohtaro Tadaki</i>  |     |
| <b>Group Permutable Constant Weight Codes .....</b>                            | 281 |
| <i>Oscar Moreno, Jose Ortiz-Ubarri</i>   |     |

|   |     |
|---|-----|
| <b>Codes from Graphs Related to the Categorical Product of Triangular Graphs and <math>K_n</math></b> ..... | 286 |
| <i>Khumbo Kumwenda, Eric Mwambene</i>   |     |

### **INTERFERENCE CHANNELS:**

|   |     |
|---|-----|
| <b>On Achievable Rates for Classes of Non-linear Deterministic Interference Channels</b> .....                                      | 291 |
| <i>Amin Jafarian, Sriram Vishwanath</i>   |     |
| <b>Outer Bounds for the Interference Channel with a Cognitive Relay</b> .....   | 296 |
| <i>Stefano Rini, Daniela Tuninetti, Natasha Devroye</i>   |     |
| <b>Capacity Regions for Some Classes of Causal Cognitive Interference Channels With Delay</b> .....                                 | 301 |
| <i>Mahtab Mirmohseni, Bahareh Akhbari, Mohammad Reza Aref</i>   |     |
| <b>Sum Capacity of K User Gaussian Degraded Interference Channels</b> .....   | 306 |
| <i>Jubin Jose, Sriram Vishwanath</i>  |     |
| <b>The Capacity Region of the Interference Channel with a Relay in the Strong Interference Regime Subject to Phase Fading</b> ..... | 311 |
| <i>Ron Dabora</i>   |     |

### **PLENARY TALK:**

|   |     |
|---|-----|
| <b>Local Computation in Codes</b> ..... | 316 |
| <i>Tali Kaufman</i>                     |     |

### **LDPC CODES:**

|  |     |
|--|-----|
| <b>Improved Linear Programming Decoding and Bounds on the Minimum Distance of LDPC Codes</b> ..... | 321 |
| <i>David Burshtein, Idan Goldenberg</i>  |     |
| <b>A Graphical Model for Computing the Minimum Cost Transposition Distance</b> .....               | 326 |
| <i>Farzad Farnoud, Chien-Yu Chen, Olgica Milenkovic, Navin Kashyap</i>                             |     |
| <b>Coupled Graphical Models and their Thresholds</b> .....   | 331 |
| <i>S. Hamed Hassani, Nicolas Macris, Ruediger Urbanke</i>  |     |
| <b>Characterization of Graph-cover Pseudocodewords of Codes over <math>F_3</math></b> .....        | 336 |
| <i>Vitaly Skachek</i>  |     |

### **WIRELESS NETWORKS:**

|  |     |
|--|-----|
| <b>Network-level Cooperative Protocols for Wireless Multicasting: Stable Throughput Analysis and Use of Network Coding</b> ..... | 341 |
| <i>Anthony Fanous, Anthony Ephremides</i>  |     |
| <b>The Benefits from Simultaneous Transmission and Reception in Wireless Networks</b> .....                                      | 346 |
| <i>P. C. Weeraddana, M. Codreanu, M. Latva-aho, Anthony Ephremides</i>   |     |
| <b>The Collection Channel In a Wireless Sensor Network</b> .....   | 351 |
| <i>Bryan Larish, George Riley</i>  |     |
| <b>Fireworks: A Random Linear Coding Scheme for Distributed Storage in Wireless Sensor Networks</b> .....                        | 356 |
| <i>Dejan Vukobratovic, Cedomir Stefanovic, Vladimir Stankovic</i>  |     |

### **ALGEBRAIC CODES AND SEQUENCES:**

|   |     |
|---|-----|
| <b>Unimodular Lattices for the Gaussian Wiretap Channel</b> .....                 | 361 |
| <i>Jean-Claude Belfiore, Patrick Sole</i>   |     |
| <b>Generalized Frobenius Extensions of Finite Rings and Trace Functions</b> ..... | 366 |
| <i>Marcus Greferath, Alexandr Nechaev</i>   |     |
| <b>The Enumeration of Costas Arrays of Order 28</b> .....                         | 371 |
| <i>Konstantinos Drakakis, Francesco Iorio, Scott Rickard</i>                      |     |

## **ESTIMATION AND PORTFOLIO THEORY:**

|   |     |
|---|-----|
| <b>The Confidence Interval of Entropy Estimation through a Noisy Channel.....</b> | 376 |
| <i>Siu-Wai Ho, Terence Chan, Alex Grant</i>                                       |     |
| <b>On Conditions for Linearity of Optimal Estimation.....</b>                     | 381 |
| <i>Emrah Akyol, Kumar Viswanatha, Kenneth Rose</i>                                |     |
| <b>On Thresholds for Robust Goodness-of-fit Tests .....</b>                       | 386 |
| <i>Jayakrishnan Unnikrishnan, Sean Meyn, Venugopal V. Veeravalli</i>              |     |
| <b>Universal Portfolio Algorithms in Realistic-outcome Markets .....</b>          | 390 |
| <i>Ami Tavory, Meir Feder</i>   |     |

## **INFORMATION THEORETIC METHODS:**

|   |     |
|---|-----|
| <b>Error Exponents in Multiple Hypothesis Testing for Arbitrarily Varying Sources.....</b>  | 395 |
| <i>Naira M. Grigoryan, Ashot N. Harutyunyan</i>   |     |
| <b>Capacity of a Noisy Function.....</b>  | 400 |
| <i>Francois Simon</i>   |     |
| <b>Source Coding With Common Reconstruction and Action-dependent Side Information .....</b> | 405 |
| <i>Kittipong Kittichokechai, Tobias J. Oechtering, Mikael Skoglund</i>                      |     |
| <b>Information-theoretical Analysis of Private Content Identification.....</b>              | 410 |
| <i>S. Voloshynovskiy, O. Koval, F. Beekhof, F. Farhadzadeh, T. Holotyak</i>                 |     |

## **QUANTUM INFORMATION PROCESSING:**

|  |     |
|--|-----|
| <b>Quantum Channel Capacities.....</b>   | 415 |
| <i>Graeme Smith</i>  |     |
| <b>Stabilizer Subsystem Codes with Spatially Local Generators .....</b>                                  | 420 |
| <i>Sergey Bravyi</i>   |     |
| <b>Quantum Erasure-correcting Codes and Percolation on Regular Tilings of the Hyperbolic Plane .....</b> | 425 |
| <i>Nicolas Delfosse, Gilles Zemor</i>  |     |

## **NETWORK CODING:**

|  |     |
|--|-----|
| <b>Rotate-and-add Coding: A Novel Algebraic Network Coding Scheme .....</b>                        | 430 |
| <i>Alireza Keshavarz-Haddad, Mohammad Amir Khojastepour</i>  |     |
| <b>On the Delay Advantage of Coding in Packet Erasure Networks.....</b>                            | 435 |
| <i>Theodoros K. Dikaios, Alexandros Dimakis, Tracey Ho, Michelle Effros</i>                        |     |
| <b>Orbit Codes - A New Concept in the Area of Network Coding .....</b>                             | 440 |
| <i>Anna-Lena Trautmann, Felice Manganiello, Joachim Rosenthal</i>                                  |     |
| <b>On Secure Network Coding with Unequal Link Capacities and Restricted Wiretapping Sets .....</b> | 444 |
| <i>Tao Cui, Tracey Ho, Joerg Kliewer</i>   |     |

## **QUANTUM INFORMATION PROCESSING (CON'D):**

|   |     |
|---|-----|
| <b>On Encoders for Quantum Convolutional Codes .....</b>                              | 449 |
| <i>Markus Grassl, Martin Roetteler</i>  |     |
| <b>A Renormalization Group Decoding Algorithm for Topological Quantum Codes .....</b> | 454 |
| <i>Guillaume Duclos-Cianci, David Poulin</i>  |     |
| <b>Topological Color Codes over Higher Alphabet .....</b>                             | 459 |
| <i>Pradeep Sarvepalli</i>   |     |

## **CODING AND CAPACITY OF NETWORKS:**

|  |     |
|--|-----|
| <b>Multi-source Operator Channels: Efficient Capacity-achieving Codes .....</b>                  | 464 |
| <i>Hongyi Yao, Theodoros K. Dikaios, Sidharth Jaggi, Tracey Ho</i>                               |     |
| <b>Reduced-state Decoding in Two-way Relay Networks With Physical-layer Network Coding .....</b> | 469 |
| <i>Duc To, Jinho Choi</i>  |     |

|   |     |
|---|-----|
| <b>Approximate Capacity of a Class of Multi-source Gaussian Relay Networks.....</b> | 474 |
| <i>Sang-Woon Jeon, Sae-Young Chung, Syed A. Jafar</i>                               |     |
| <b>Gaussian Diamond Network with Adversarial Jammer.....</b>                        | 479 |
| <i>Soheil Mohajer, Suhas N. Diggavi</i>   |     |

### **PLENARY TALK:**

|   |     |
|---|-----|
| <b>Applications of Semidefinite Programming to Coding Theory.....</b> | 484 |
| <i>Christine Bachoc</i>   |     |

### **CHANNEL UNCERTAINTY:**

|   |     |
|---|-----|
| <b>Every Channel with Time Structure has a Capacity Sequence.....</b> | 489 |
| <i>Rudolf Ahlswede</i>  |     |
| <b>Coding Against Myopic Adversaries.....</b>                         | 490 |
| <i>Anand D. Sarwate</i>   |     |
| <b>A Multi-hop Multi-source Algebraic Watchdog .....</b>              | 495 |
| <i>MinJi Kim, Muriel Medard, Joao Barros</i>                          |     |
| <b>Author Index</b>   |     |