

Marco Mondelli

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Research Interests

Data science, machine learning, information theory, coding theory, wireless communication systems.

Current Employment

Sept. 2019 - onwards **Assistant Professor**, *Institute of Science and Technology (IST) Austria*.

Previous Employment

Feb. 2017 - Aug. 2019 **Postdoctoral Scholar**, *Information Systems Laboratory, Stanford University, USA*.
Host: Prof. Andrea Montanari.

Aug. 2018 - Dec. 2018 **Research Fellow**, *Simons Institute for the Theory of Computing, Berkeley, USA*.
Program: Foundations of Data Science.

Aug. - Dec. 2015 **Visiting Graduate Student**, *Information Systems Laboratory, Stanford University, USA*. Advisor: Prof. Andrea Montanari.

Mar. - Apr. 2015 **Visiting Graduate Student**, *Simons Institute for the Theory of Computing, Berkeley, USA*. Program: Information Theory.

Aug. - Nov. 2011 **Intern**, *Center for Signal and Image Processing, Georgia Institute of Technology, USA*. Advisor: Prof. Xiaoli Ma.

Mar. - Apr. 2010 **Intern**, *Centre de Mathématique et de Leurs Applications, Ecole Normale Supérieure (ENS) de Cachan, France*. Advisor: Prof. Jean-Michel Morel.

Education

Sept. 2012 - Jan. 2017 **Ph.D. in Computer and Communication Sciences**, *École Polytechnique Fédérale de Lausanne (EPFL), Switzerland*. Advisor: Prof. Rüdiger Urbanke.
Dissertation title: “From Polar to Reed-Muller Codes: Unified Scaling, Non-standard Channels, and a Proven Conjecture”.
Recipient of the **2018 EPFL Doctorate Award** and the **2017 Patrick Denantes Memorial Prize**.

Oct. 2010 - July 2013 **Honors College Master’s Student in Engineering**, *Sant’Anna School of Advanced Studies, Italy*. Grade: 100/100 cum laude.

Oct. 2010 - July 2012 **Master’s Degree in Telecommunications Engineering**, *University of Pisa, Italy*. Grade: 110/110 cum laude.

Oct. 2007 - Nov. 2010 **Honors College Bachelor’s Student in Engineering**, *Sant’Anna School of Advanced Studies, Italy*. Grade: 100/100 cum laude.

Oct. 2007 - July 2010 **Bachelor’s Degree in Telecommunications Engineering**, *University of Pisa, Italy*. Grade: 110/110 cum laude.

Honors and Awards

2019 **Lopez-Loreta Prize** (1M EUR for a 5-year research project).

2018 **Simons-Berkeley Research Fellowship** for the program “Foundations of Data Science”.

2018 **EPFL Doctorate Award** (given among all departments at EPFL).

- 2017 **Patrick Denantes Memorial Prize** for the best Ph.D. thesis in the School of Computer and Communication Sciences at EPFL.
- 2017 **Early Postdoc.Mobility Fellowship**, Swiss National Science Foundation.
- 2017 **Exemplary Reviewer**, IEEE Communication Letters.
- 2016 **STOC Best Paper Award** for “Reed-Muller Codes Achieve Capacity on Erasure Channels” (with S. Kudekar, S. Kumar, H. D. Pfister, E. Şaşıoğlu, and R. Urbanke).
- 2016 **2nd Place** in the **Shannon Centennial Student Competition**.
- 2015 **IEEE Jack Keil Wolf ISIT Student Paper Award** for “Unified Scaling of Polar Codes: Error Exponent, Scaling Exponent, Moderate Deviations, and Error Floors”.
- 2015 **Dan David Prize Scholarship**.
- 2014 **Master Thesis Award “Matteo Carmassi” for Innovation**.
- 2014 **I&C Outstanding Teaching Assistant Award**, EPFL.
- 2012 **Departmental Fellowship**, EPFL.

Teaching Experience

Teaching Assistant at EPFL

- Random Walks, Spring 2015 and Spring 2016.
- Discrete Structures, Fall 2013 and Fall 2014.
- Graph Theory Applications, Spring 2014.
- Probability and Statistics, Spring 2013.

Student Project Co-Supervisor at EPFL

- Stefano Olivotto, “Feedback Schemes to Improve the Finite-Length Performance of Polar Codes”, Master thesis, Spring 2016.
- Nadim Ghaddar, “Extremes of Information Combining - Characterization of the BSC”, Master semester project, Spring 2015.
- Georg Schölly, “Explorations on a New Upper Bound on the Capacity for the Primitive Relay Channel”, Master semester project, Spring 2015.
- Fangyu Ye, “Extremes of Information Combining - Solution for the BEC”, Master semester project, Spring 2015.
- Kareem Attiah, “Demos for LDPC Codes and Density Evolution Library”, internship, Summer 2014.
- Frédéric Sabatier, “Polar Coding Tutorial”, internship, Summer 2014.

Professional Activities

Technical Program Committee Member

- IEEE International Symposium on Information Theory (ISIT), 2018 and 2019.

Event Organization

- *Workshop on Theory of Deep Learning (ToDL)*, IST Austria, September 2019.
- *Summer School on Information Processing for Large Networks (IPLN)*, Les Diablerets, Switzerland, June 2015.

Journal Review

- Entropy
- IEEE Communications Letters
- IEEE Journal on Selected Areas in Communications
- IEEE Transactions on Communications
- IEEE Transactions on Information Theory
- IEEE Transactions on Signal Processing
- IEEE Transactions on Vehicular Technology
- IEEE Transactions on Wireless Communications
- Information Sciences, Elsevier
- Physical Review X

Conference Review

- IEEE Global Communications Conference (GLOBECOM)
- IEEE International Symposium on Information Theory (ISIT)
- International Symposium on Turbo Codes & Iterative Information Processing (ISTC)
- IEEE Information Theory Workshop (ITW)
- Conference on Neural Information Processing Systems (NeurIPS)
- ACM Symposium on Theory of Computing (STOC)
- IEEE Wireless Communications and Networking Conference (WCNC)

Publications

Journal Papers

- (J1) M. Mondelli, S. H. Hassani, and R. Urbanke, “Construction of Polar Codes with Sublinear Complexity”, *IEEE Transactions on Information Theory*, accepted, Nov. 2018.
- (J2) M. Mondelli and A. Montanari, “Fundamental Limits of Weak Recovery with Applications to Phase Retrieval”, *Foundations of Computational Mathematics*, pp. 1–71, Sept. 2018.
- (J3) S. A. Hashemi, M. Mondelli, S. H. Hassani, C. Condo, R. Urbanke, and W. J. Gross, “Decoder Partitioning: Towards Practical List Decoding of Polar Codes”, *IEEE Transactions on Communications*, vol. 66, no. 9, pp. 3749–3759, Sept. 2018.
- (J4) M. Mondelli, S. H. Hassani, and R. Urbanke, “How to Achieve the Capacity of Asymmetric Channels”, *IEEE Transactions on Information Theory*, vol. 64, no. 5, pp. 3371–3393, May 2018.
- (J5) S. Kudekar, S. Kumar, M. Mondelli, H. D. Pfister, E. Şaşıoğlu, and R. Urbanke, “Reed-Muller Codes Achieve Capacity on Erasure Channels”, *IEEE Transactions on Information Theory*, vol. 63, no. 7, pp. 4298–4316, July 2017.
- (J6) M. Mondelli, S. H. Hassani, and R. Urbanke, “Unified Scaling of Polar Codes: Error Exponent, Scaling Exponent, Moderate Deviations, and Error Floors”, *IEEE Transactions on Information Theory*, vol. 62, no. 12, pp. 6698–6712, Dec. 2016.
- (J7) S. Kudekar, S. Kumar, M. Mondelli, H. D. Pfister, E. Şaşıoğlu, and R. Urbanke, “Something Old, Something New, Something Borrowed, and Something Proved”, *IEEE Information Theory Society Newsletter*, vol. 65, no. 3, pp. 21–24, Sept. 2015.
- (J8) M. Mondelli, S. H. Hassani, and R. Urbanke, “Scaling Exponent of List Decoders with Applications to Polar Codes”, *IEEE Transactions on Information Theory*, vol. 61, no. 9, pp. 4838–4851, Sept. 2015.

- (J9) M. Mondelli, S. H. Hassani, I. Sason, and R. Urbanke, “Achieving Marton’s Region for Broadcast Channels Using Polar Codes”, *IEEE Transactions on Information Theory*, vol. 61, no. 2, pp. 783–800, Feb. 2015.
- (J10) M. Mondelli, S. H. Hassani, and R. Urbanke, “From Polar to Reed-Muller Codes: a Technique to Improve the Finite-Length Performance”, *IEEE Transactions on Communications*, vol. 62, no. 9, pp. 3084–3091, Sept. 2014.
- (J11) M. Mondelli, Q. Zhou, V. Lottici, and X. Ma, “Joint Power Allocation and Path Selection for Multi-Hop Noncoherent Decode and Forward UWB Communications”, *IEEE Transactions on Wireless Communications*, vol. 13, no. 3, pp. 1397–1409, Mar. 2014.
- (J12) M. Mondelli, “A Finite Difference Scheme for the Stack Filter Simulating the MCM”, *Image Processing On Line*, vol. 3, 2013.
- (J13) M. Mondelli and A. Ciomaga, “Finite Difference Schemes for MCM and AMSS”, *Image Processing On Line*, vol. 1, 2011.

Refereed Conference Papers

- (C1) S. A. Hashemi, C. Condo, M. Mondelli, and W. J. Gross, “Rate-Flexible Fast Polar Decoders”, accepted at *IEEE Information Theory Workshop (ITW)*, invited paper, Visby, Aug. 2019.
- (C2) M. Mondelli and A. Montanari, “On the Connection Between Learning Two-Layer Neural Networks and Tensor Decomposition”, accepted at the *22nd International Conference on Artificial Intelligence and Statistics (AISTATS)*, Okinawa, Apr. 2019.
- (C3) S. A. Hashemi, N. Doan, M. Mondelli, and W. J. Gross, “Decoding Reed-Muller and Polar Codes by Successive Factor Graph Permutations”, accepted at *International Symposium on Turbo Codes & Iterative Information Processing (ISTC)*, Hong Kong, Dec. 2018.
- (C4) N. Doan, S. A. Hashemi, M. Mondelli, and W. J. Gross, “On the Decoding of Polar Codes on Permuted Factor Graphs”, accepted at *Global Communications Conference (GLOBECOM)*, Abu Dhabi, Dec. 2018.
- (C5) A. Fazeli, S. H. Hassani, M. Mondelli, and A. Vardy, “Binary Linear Codes with Optimal Scaling: Polar Codes with Large Kernels”, accepted at *IEEE Information Theory Workshop (ITW)*, invited paper, Guangzhou, Nov. 2018.
- (C6) M. Mondelli and A. Montanari, “Fundamental Limits of Weak Recovery with Applications to Phase Retrieval”, presented at *Conference on Learning Theory (COLT)*, extended abstract, Stockholm, July 2018.
- (C7) M. Mondelli, S. H. Hassani, and R. Urbanke, “A New Coding Paradigm for the Primitive Relay Channel”, in *Proceedings of IEEE International Symposium on Information Theory (ISIT)*, Vail, pp. 351–355, June 2018.
- (C8) S. A. Hashemi, M. Mondelli, S. H. Hassani, R. Urbanke, and W. J. Gross, “Partitioned List Decoding of Polar Codes: Analysis and Improvement of Finite Length Performance”, in *Proceedings of IEEE Global Communications Conference (GLOBECOM)*, Singapore, Dec. 2017.
- (C9) M. Mondelli, S. H. Hassani, and R. Urbanke, “Construction of Polar Codes with Sublinear Complexity”, in *Proceedings of IEEE International Symposium on Information Theory (ISIT)*, Aachen, pp. 1853–1857, June 2017.
- (C10) M. Mondelli, S. H. Hassani, I. Marić, D. Hui, and S.-N. Hong, “Capacity-Achieving Rate-Compatible Polar Codes for General Channels”, in *Proceedings of IEEE Wireless Communications and Networking Conference Workshops (WCNCW)*, Mar. 2017.
- (C11) S. Kudekar, S. Kumar, M. Mondelli, H. D. Pfister, and R. Urbanke, “Comparing the Bit-MAP and Block-MAP Decoding Thresholds of Reed-Muller Codes on BMS Channels”, in *Proceedings of IEEE International Symposium on Information Theory (ISIT)*, Barcelona, pp. 1755–1759, July 2016.

- (C12) S. Kudekar, S. Kumar, M. Mondelli, H. D. Pfister, E. Şaşıoğlu, and R. Urbanke, “Reed-Muller Codes Achieve Capacity on Erasure Channels”, in *Proceedings of 48th ACM Symposium on Theory of Computing (STOC)*, Boston, MA, pp. 658–669, June 2016. **STOC Best Paper Award**.
- (C13) M. Mondelli, S. H. Hassani, and R. Urbanke, “Unified Scaling of Polar Codes: Error Exponent, Scaling Exponent, Moderate Deviations, and Error Floors”, in *Proceedings of IEEE International Symposium on Information Theory (ISIT)*, Hong Kong, pp. 1422–1426, June 2015. **IEEE Jack Keil Wolf ISIT Student Paper Award**.
- (C14) M. Mondelli, S. H. Hassani, and R. Urbanke, “How to Achieve the Capacity of Asymmetric Channels”, in *Proceedings of 52nd Annual Allerton Conference on Communication, Control, and Computing*, Monticello, IL, pp. 789–796, Oct. 2014.
- (C15) M. Mondelli, S. H. Hassani, Igal Sason, and R. Urbanke, “Achieving Marton’s Region for Broadcast Channels Using Polar Codes”, in *Proceedings of IEEE International Symposium on Information Theory (ISIT)*, Honolulu, HI, pp. 306–310, July 2014.
- (C16) M. Mondelli, S. H. Hassani, and R. Urbanke, “From Polar to Reed-Muller Codes: a Technique to Improve the Finite-Length Performance”, in *Proceedings of IEEE International Symposium on Information Theory (ISIT)*, Honolulu, HI, pp. 131–135, July 2014.
- (C17) M. Mondelli, S. H. Hassani, and R. Urbanke, “Scaling Exponent of List Decoders with Applications to Polar Codes”, in *Proceedings of IEEE Information Theory Workshop (ITW)*, Sevilla, pp. 1–5, Sept. 2013.
- (C18) M. Mondelli, Q. Zhou, X. Ma, and V. Lottici, “A Cooperative Approach for Amplify-and-Forward Differential Transmitted Reference IR-UWB Relay Systems”, in *Proceedings of IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Kyoto, pp. 2905–2908, Mar. 2012.

Submitted / In Preparation

- (S1) S. A. Hashemi, C. Condo, M. Mondelli, and W. J. Gross, “Rate-Flexible Fast Polar Decoders”, submitted, [arXiv:1903.09203](https://arxiv.org/abs/1903.09203), Mar. 2019.
- (S2) A. Javanmard, M. Mondelli and A. Montanari, “Analysis of a Two-Layer Neural Network via Displacement Convexity”, submitted, [arXiv:1901.01375](https://arxiv.org/abs/1901.01375), Jan. 2019.
- (S3) A. Fazeli, S. H. Hassani, M. Mondelli, and A. Vardy, “Binary Linear Codes with Optimal Scaling: Polar Codes with Large Kernels”, submitted, [arXiv:1711.01339](https://arxiv.org/abs/1711.01339), June 2018.

Patents

- (P1) M. Mondelli, S. H. Hassani, I. Marić, S.-N. Hong, and D. Hui, “Generalized Rate-Compatible Polar Codes”, *Ericsson Research*, San Jose, filed in Nov. 2016.

Invited Talks

- (T1) “Fundamental Limits and Practical Algorithms in Inference: From Communication to Learning”, *School of Electrical and Computer Engineering*, Cornell University, April 2019.
- (T2) —, *Electrical Engineering Department*, Columbia University, April 2019.
- (T3) —, *Institute of Science and Technology (IST) Austria*, March 2019.
- (T4) —, *Electrical and Computer Engineering Department*, UCSB, March 2019.
- (T5) —, *Department of Electrical Engineering*, Princeton University, February 2019.
- (T6) —, *Electrical and Computer Engineering Department*, UCLA, February 2019.
- (T7) —, *Max-Planck Research Group Selection Symposium*, February 2019.

- (T8) —, *Electrical and Computer Engineering Department*, University of Wisconsin-Madison, February 2019.
- (T9) —, *College of Engineering*, Purdue University, January 2019.
- (T10) —, *Department of Statistics*, London School of Economics, January 2019.
- (T11) —, *International School for Advanced Studies (SISSA)*, January 2019.
- (T12) “Analysis of a Two-Layer Neural Network via Displacement Convexity”, *Scientific Computing Seminar*, UC Berkeley, April 2019.
- (T13) —, *Linear Algebra and Optimization Seminar*, Stanford University, March 2019.
- (T14) —, *Data Science Finale* workshop at *Simons Institute for the Theory of Computing*, Berkeley, Dec. 2018.
- (T15) “Fundamental Limits of Weak Recovery with Applications to Phase Retrieval”, *Institute of Science and Technology (IST) Austria*, Nov. 2018.
- (T16) “On the Connection Between Learning Two-Layers Neural Networks and Tensor Decomposition”, *IPG Seminar*, EPFL, July 2018.
- (T17) —, *Theory Lunch*, Stanford University, Apr. 2018.
- (T18) —, *Conference on Information Sciences and Systems (CISS)*, Princeton University, Mar. 2018.
- (T19) “Fundamental Limits of Weak Recovery with Applications to Phase Retrieval”, *Information Theory and Applications Workshop (ITA)*, UCSD, San Diego, Feb. 2018.
- (T20) —, *BLISS Seminar*, UC Berkeley, Dec. 2017.
- (T21) —, *Technische Universität München (TUM)*, Munich, Dec. 2017.
- (T22) “3 Polar Bits: Non-asymptotic Scaling, Sublinear Construction and Decoder Partitioning”, *German Aerospace Center (DLR)*, Wessling, Dec. 2017.
- (T23) “Reed-Muller Codes Achieve Capacity on Erasure Channels”, *Highlights of Algorithms (HALG)*, TU Berlin, June 2017.
- (T24) “3 Polar Bits”, *Intel Labs*, Santa Clara, May 2017.
- (T25) “Construction of Polar Codes with Sublinear Complexity”, *Information Theory and Applications Workshop (ITA)*, UCSD, San Diego, Feb. 2017.
- (T26) “Polar Codes: What Are They, How Well They Perform, and How to Make Them Better”, *University of Pisa*, Nov. 2016.
- (T27) “Capacity via Symmetry I – A New Proof for an Old Code”, *Algorithmic Coding Theory Workshop, Institute for Computational and Experimental Research in Mathematics (ICERM)*, Brown University, Providence, June 2016.
- (T28) “Capacity via Symmetry”, *Shannon Centennial Student Competition*, Bell Labs, Nokia, Murray Hill, Apr. 2016.
- (T29) “Reed-Muller Codes: Thresholds and Weight Distribution”, *International Zurich Seminar on Communications (IZS)*, Zürich, Mar. 2016.
- (T30) “Chaining, Scaling and Reed-Muller: Two Polar Paradigms and a Conjecture Solved”, *Graduation-Day, Information Theory and Applications Workshop (ITA)*, UCSD, San Diego, Feb. 2016.
- (T31) “Polar Codes: How Well They Perform and How to Make Them Better”, *Ericsson Research*, San Jose, Nov. 2015.
- (T32) “Everything You Always Wanted to Know about Scaling of Polar Codes (But Were Afraid to Ask)”, *Simons Institute for the Theory of Computing*, Berkeley, Apr. 2015.

- (T33) “Unified Scaling of Polar Codes: Error Exponent, Scaling Exponent, Moderate Deviations, and Error Floors”, *Technische Universität München (TUM)*, Munich, Feb. 2015.
- (T34) —, *Graduation-Day Poster Session, Information Theory and Applications Workshop (ITA)*, UCSD, San Diego, Feb. 2015.
- (T35) “Achieving Marton’s Region for Broadcast Channels Using Polar Codes”, *Conference on Information Sciences and Systems (CISS)*, Princeton University, Mar. 2014.