

# Mohamad Dia

*PhD, Computer and Communication  
Sciences*

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Residence: Switzerland  
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## Profile

I am a **research scientist** in computer and communication sciences, working at the interface between **machine learning**, **coding theory**, **signal processing**, and **statistical physics**. I have been researching and developing efficient and scalable solutions for **high-dimensional inference** problems in the context of error-correcting codes, compressed sensing, visual recognition and community detection. I am a highly motivated researcher with solid analytical, teaching and interpersonal skills. I am passionate about system modeling, statistical learning and inference in **Big Data**, with special interest in economics and physics. I have a strong experience in numerical analysis and programming in the fields of graph signal processing and **deep learning**.

## Education

- 2014–2018 **PhD**, *Computer and Communication Sciences*, EPFL, Switzerland.  
Dissertation: High-Dimensional Inference on Dense Graphs with Applications to Coding Theory and Machine Learning
- 2012–2014 **MSc**, *Communication Systems*, EPFL, Switzerland.  
Thesis: Efficient Iterative Frequency Domain Equalization for Single Carrier Transmission Without Cyclic Prefix
- 2008–2012 **BE**, *Electrical and Computer Engineering - Minor in Mathematics*, AUB, Lebanon.
- 2009–2012 **BA**, *Economics*, AUB, Lebanon.

## Experience

- Nov. 2018 – **Research Scientist**, *FHNW & European Space Agency*, Switzerland.
  - Present
    - Developing data science tools for the “Euclid” space mission consortium in order to investigate dark matter.
    - Applying deep learning techniques (CNN’s and GAN’s) on space-based visual data.
    - Teaching machine learning and supervising student projects.
- Sep. 2014 – **Doctoral Researcher**, *Information Processing Group - EPFL*, Switzerland.
  - Nov. 2018
    - Used statistical physics techniques and message-passing algorithms to implement and analyze efficient solutions for high-dimensional inference problems in the context of error-correcting codes, compressed sensing and machine learning.
    - Used spatial coupling to construct dense graphical models that yield optimal performance under iterative algorithms.
    - Taught and designed several courses in Machine Learning, Communication Systems and Quantum Computation for undergraduate and graduate classes of 20 to 300 students.
    - Supervised master projects and summer internships.

- Sep. 2017 – **Visiting Researcher**, *Nokia - Bell Labs*, Germany.  
 Dec. 2017 ◦ Developed a novel probabilistic shaping scheme for the optical high-speed communication systems.
- Feb. 2014 – **Research Engineer**, *Sony - European Technology Center*, Germany.  
 Aug. 2014 ◦ Developed and implemented low complexity receiver algorithms for the European Digital Video Broadcast standards.
- Jun. 2011 – **Intern**, *University of California - Berkeley*, USA.  
 Aug. 2011 ◦ Interpreted Bluetooth and GPS data to validate the traffic-monitoring model for the “Mobile Millennium” project, a joint partnership between UC Berkeley’s Institute of Transportation Studies, Nokia, and the US Department of Transportation.

## Awards

- 2016 Outstanding Teaching Award - EPFL  
 2014 EDIC Fellowship - EPFL  
 2012 Valedictorian - AUB’s 143<sup>rd</sup> commencement exercises  
 2012 Best Paper Award - FEA 11<sup>th</sup> student conference  
 2004 & 2007 Excellence Award - Lebanese minister of higher education

## Teaching

- Machine Learning
- Quantum Computation
- Information, Computation and Communication
- Linear Algebra
- Communication Systems
- Wireless Communications

## Languages

Arabic (native), English (fluent), French (fluent), German (basic)

## Programming Skills

- Languages Matlab, Python, C++, SQL  
 Technologies TensorFlow, Keras, Scikit-learn, Numpy, Pandas, Matplotlib, Tableau

## Selected Projects

- 2019 Investigate and implement gravitational lensing classifiers for space-based imagery based on deep neural networks.
- 2018 Design and implement a recommender system based on the matrix factorization approach in Python.
- 2017 Devise and implement an approximate-message passing algorithm to decode spatially coupled sparse superposition codes on general channels using Matlab and C++.
- 2016 Design and correct weekly hands-on lab exercises and semester projects for the machine learning course at EPFL using Python. The lab exercises consist of implementing standard ML tasks (LR, SVM, K-means, PCA,...), while the projects involve deep learning for image segmentation and sentiment analysis applications.
- 2014 Develop and implement a low complexity receiver algorithms (with focus on frequency domain channel equalization) for single carrier transmission used in the terrestrial digital video broadcasting.

- 2013 Implement an optimization algorithm used for independent component analysis and sample-based estimation techniques in biomedical imaging applications.
- 2012 Decode the GPS satellite signal and compute the real-time receiver position.
- 2011 Design and implement an energy-aware Android mobile application for heterogeneous networks that switches smoothly between 3G and Wi-Fi based on the QoS.
- 2010 Develop a distributed computing network application, using the JAVA sockets API, to compute mathematical functions among multiple connected clients. An interactive user interface was also designed for the application.

## Publications

Conferences: 7, journals: 3, h-index: 7

### Refereed Conference Papers

- M. Dia\*, V. Aref, L. Schmalen, "A Compressed Sensing Approach for Distribution Matching", in Proceedings of IEEE International Symposium on Information Theory (ISIT), Jun. 2018.
- E. Bıyık, J. Barbier, M. Dia\*, "Generalized Approximate Message-Passing Decoder for Universal Sparse Superposition Codes", in Proceedings of IEEE International Symposium on Information Theory (ISIT), Jun. 2017.
- J. Barbier, M. Dia\*, N. Macris, F. Krzakala, T. Lesieur, L. Zdeborova, "Mutual Information for Symmetric Rank-One Matrix Estimation: A Proof of the Replica Formula", Advances in 29<sup>th</sup> Neural Information Processing Systems (NIPS), Dec. 2016.
- J. Barbier, M. Dia, N. Macris, F. Krzakala, "The Mutual Information in Random Linear Estimation", in Proceedings of 54<sup>th</sup> Annual Allerton Conference on Communication, Control, and Computing, Sep. 2016.
- J. Barbier, M. Dia\*, N. Macris, "Threshold Saturation of Spatially Coupled Sparse Superposition Codes for All Memoryless Channels", in IEEE Information Theory Workshop (ITW), Sep. 2016.
- J. Barbier, M. Dia\*, N. Macris, "Proof of Threshold Saturation for Spatially Coupled Sparse Superposition Codes", in Proceedings of IEEE International Symposium on Information Theory (ISIT), Jul. 2016.
- S. Taleb, M. Dia, J. Farhat, Z. Dawy, H. Hajj, "On the Design of Energy-Aware 3G/WiFi Heterogeneous Networks Under Realistic Conditions," in the 27<sup>th</sup> IEEE International Conference on Advanced Information Networking and Applications (AINA), Mar. 2013.

### Journal Papers

- J. Barbier, M. Dia\*, N. Macris, F. Krzakala, L. Zdeborova, "Rank-One Matrix Estimation: Analysis of Algorithmic and Information Theoretic Limits by the Spatial Coupling Method", Submitted to Journal of Machine Learning Research, 2018.
- J. Barbier, M. Dia\*, N. Macris, "Universal Sparse Superposition Codes with Spatial Coupling and GAMP Decoding", IEEE Transactions on Information Theory, 2018.
- J. Barbier, N. Macris, M. Dia, F. Krzakala, "Mutual Information and Optimality of Approximate Message-Passing in Random Linear Estimation", IEEE Transactions on Information Theory, 2018.

*Note: The authors are listed in alphabetical and/or affiliation order. The publications of which I was the first author are marked by the asterisk symbol (\*) next to my name.*

## Memberships & Activities

Teaching workshops attended: Teaching toolkit (EPFL 2017) - Presenting and explaining in class (EPFL 2016).

Summer/winter schools attended: Statistical physics, learning, inference and networks (Les Houches 2017) - Nexus of information and computation theories (Henri Poincaré Institute 2016) - Information processing for large networks (Les Diablerets 2015).

IEEE member (2009 – Present).

Member of Order of Engineers and Architects - Beirut (2016 – Present).

## Interests

Politics, football, scuba diving, cooking, reading