

Ali Hashemi

Curriculum Vitae

Applied Scientist

I AM A PH.D. FELLOW WITH OVER SEVEN YEARS OF EXPERIENCE AND DOMAIN EXPERTISE IN MACHINE LEARNING, STATISTICS, OPTIMIZATION AND SIGNAL PROCESSING.

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Education

- 2016–2022 **PhD–Technische Universität Berlin, Computer Science and Mathematics**, Berlin, Germany.
Thesis title: “Advances in Hierarchical Bayesian Learning and Applications to Neuroimaging”
Supervisor: Prof. Dr. Klaus-Robert Müller
Co-supervisor: Prof. Dr. Stefan Haufe
- 2015–2016 **Visiting Research Fellow–Singapore University of Technology and Design, Information Systems Technology and Design**, Singapore.
Research title: “Studying Compressed Sensing under Partial Differential Equation (PDE) Constraints”
Supervisor: Prof. Ngai-Man Cheung
- 2011–2013 **MSc–Sharif University of Technology, Department of Electrical Engineering – Communication Systems**, Tehran, Iran.
Thesis title: “Compressed Spectrum Sensing in Cognitive Radio Networks”
Supervisor: Prof. Masoumeh Nasiri-Kenari
Co-supervisor: Prof. Masoud Babayi-zadeh
- 2007–2011 **BSc–University of Tabriz, Faculty of Electrical and Computer Engineering – Communication Systems**, Tabriz, Iran.
Thesis title: “Practical Physical Layer Network Coding for Two-Way Relay Channels Performance Analysis and Comparison”
Supervisor: Prof. Javad Mousavi-Nia
GPA: **18.58/20.0 – Ranked 1st**
- 2001–2007 **Secondary and High School–National Organization for Development of Exceptional Talents (NODET)**, Tehran, Iran.
GPA: **19.47/20.0**

Employment Experience

- June 2021–present **Research Scientist**, CHAIR OF UNCERTAINTY, INVERSE MODELING AND MACHINE LEARNING - *Computer Science Department*, Technische Universität Berlin, Germany.
- Managed three large research projects, in parallel; met regular deadlines.
 - Designed efficient large-scale optimization algorithms for high-dimensional settings by utilizing the mathematical tools lying in the intersection of Bayesian statistics, machine learning, convex and non-convex algorithms, and time-series analysis.
- Feb 2019–present **Research Fellow**, MACHINE LEARNING/INTELLIGENT DATA ANALYSIS GROUP - *Computer Science Department*, Technische Universität Berlin, Germany.
- Organised and presented large amounts of material in a structured and clear oral and written manner, resulted in more than 10 publications in tier-one journal and conferences such as NeuroImage and **NeurIPS**.
 - Developed machine learning and sparse signal recovery tools as well as novel deep learning techniques by merging mathematically hand-crafted methods with the state-of-the-art data-driven artificial intelligence algorithms.
 - Solved real-world challenges by applying developed methods to applications with various data types ranging from brain sources and telecommunications signals to thermal fields.
- Feb 2019–May 2021 **Data Scientist**, BRAIN AND DATA SCIENCE LAB, Berlin Center for Advanced Neuroimaging (BCAN) - Charité Universitätsmedizin Berlin, Germany.
- Team player with experience through different international multidisciplinary collaborations.
 - Ability to work in a team, while doing specific assigned task, independently and effectively.
 - Managed group assistants to deliver goal-oriented projects on-time for time frames from 3 months to 2 years.
 - Developed methods to improve source estimations by automatically learning the spatio-temporal structure of the sources from observations in a hierarchical Bayesian framework using efficient non-linear optimization.
 - Designed algorithms to automatically learn the mapping from sensor to source using state-of-the-art supervised deep learning techniques based on carefully designed synthetic training data.

- Feb 2016–Jan 2019 **Doctoral Researcher**, COMPUTER SCIENCE DEPARTMENT AND INSTITUT FÜR MATHEMATIK, Technische Universität Berlin, Germany.
- Developed efficient optimization and machine learning techniques for solving ill-posed inverse problems with applications in neuroimaging and thermal monitoring, using co-sparsity, Bayesian inference and compressed sensing mathematical tools.
- Feb 2015–Jan 2016 **Research Scientist**, INFORMATION SYSTEMS TECHNOLOGY AND DESIGN DEPARTMENT, Singapore University of Technology and Design, Singapore.
- Developed a sparse domain for classifying brain signals using a “task-based dictionary” by merging machine learning with compressed sensing methods.
 - Modeled and incorporated partial differential equations (PDE) as side information into the compressed sensing and sparse signal recovery algorithm.
 - Achieved 10 dB improvement in reconstruction accuracy with 90% less computational complexity, compared to the benchmark.
 - Gained project management skills and fundamental international experiences through collaboration with MIT and UPenn.
- 2012–2014 **Data Scientist**, WIRELESS RESEARCH LABORATORY (WRL), Sharif University of Technology, Tehran.
- Teaching and examination of more than 300 electrical engineering and computer science students in 2 years.
 - Prepared a complete survey of different classical machine learning approaches accompanied by their efficient implementation in MATLAB as a software product.
 - Developed a MIMO wide-band spectrum sensing method based on the entropy of the cyclostationary signals and compressed sensing machinery.

Research Interests

- General Interest **Machine Learning**, Deep Learning (**Variational Autoencodes**, **Deep Learning on Graphs**, **Bayesian Deep Learning**), **Statistical Bayesian Inference with Uncertainty Analysis**, **Time-series Analysis and Forecasting**, **Large-scale Convex, Non-convex and Geometric Optimization**, **Inverse Problems** with Applications in Neuroscience, Compressed Sensing (CS) and Sparsity, Statistical Learning Theory and High-Dimensional Probability, Sparse Representations using Transform/Dictionary Learning, Signal Processing.
- Recent Focus **Interpretable Regression Techniques Benefiting from Rigorous Uncertainty Analyses**: Develop and validate novel inverse source imaging techniques with well-calibrated built-in uncertainty estimates
- Graph Neural Network**: Design end-to-end supervised neural networks, e.g. graph NN (GNN) based approaches that are equipped with built-in uncertainty estimates, which can learn the mapping from sensor to source time series using synthetic examples
- Previous Work **Inverse Problems**: Solved inverse problems by **unfolding** sparse signal recovery methods into deep neural network structures and train a universal model with optimal system model parameters.
- Compressed Sensing and Sparse Signal Recovery**: Developed large-scale spatio-temporal Bayesian sparse signal recovery tools for correlated settings using the mathematical techniques from non-convex and geometric optimization and information-geometry.

Honors and Awards

- 2018 **Scholarship–Awarded for 4 Years**, *Machine Learning-Intelligent Data Analysis Group*, Technische Universität Berlin, Germany.
- 2018 **Admission and Grant–Awarded for iTWIST Doctoral School**, *CIRM*, Marseille, France.
- 2017 **Admission to SpaRTaN/MacSeNet 2017 Summer School**, *Instituto Superior Técnico*, Lisbon, Portugal.
- 2016 **Admission to Berlin Mathematical School (BMS)**, *Joint Graduate School of the Mathematics Departments of Berlin Universities*, Germany.
- 2015 **Full Fellowship–Awarded for 3 Years**, *Berlin International Graduate School in Model and Simulation-based Research (BIMoS)*, Technische Universität Berlin, Germany.
- 2014 **Research Scholarship–Awarded for 1 Year**, *Professor Ngai-Man Cheung Research Group*, Singapore University of Technology and Design, Singapore.
- 2011 **Permission to enter the M. Sc. program as a talented student bypassing the entrance exam**, *Sharif University of Technology*, Tehran, Iran.
- 2011 **Ranked 1st**, *Highest Grade Point Average (GPA) among all the electrical and computer engineering undergraduate students (among above 200)*, University of Tabriz, Iran.

- 2011 **Ranked 15th/30,000**, *National Electrical Engineering Olympiad for Undergraduate Students*, Tehran, Iran.
- 2011 **Ranked 15th/30,000**, *National Electrical Engineering Olympiad for Undergraduate Students*, Tehran, Iran.
- 2011 **Ranked 4th/2,000**, *Iranian North-West Electrical Engineering Competition for Undergraduate Students*, Iran.
- 2010 **Introduced as a Distinguished Student**, *Exceptional Talents Center*, University of Tabriz, Iran.
- 2010 **Ranked 10th/30,000**, *National Electrical Engineering Olympiad for Undergraduate Students*, Tehran, Iran.
- 2010 **Ranked 2nd/2,000**, *Iranian North-West Electrical Engineering Competition for Undergraduate Students*, Iran.
- 2007 **Top 1% Rank**, *Ranked as top 1% of 300000 participants in nationwide university entrance exam for undergraduate degree*, Iran.

Teaching Experience

- 2013 (SS) **Teaching Assistant for “Signals and Systems” Course**, *Electrical Engineering Department*, Sharif University of Technology, Tehran, Iran.
Course Instructor: Prof. Masoumeh Nasiri-Kenari
- 2011 (WS) **Teaching Assistant for “Fields and Waves” Course**, *Faculty of Electrical and Computer Engineering*, University of Tabriz, Iran.
Course Instructor: Prof. Mohammad Bemani
- 2010 (SS) **Teaching Assistant for “Advanced Mathematics for Engineers” Course**, *Faculty of Electrical and Computer Engineering*, University of Tabriz, Iran.
- 2009 - 2011 **Instructor for “Graduate M.Sc. Degree Comprehensive Entrance Exam” Preparation Course**, *Faculty of Electrical and Computer Engineering*, University of Tabriz, Iran.
Focus on Electromagnetics and Electronics courses.

Book Chapters and Research Papers

My full list of publications with their associated DOIs can be also found in the following document: **Full List of Publications**.

- Book Chapter** A. Flinth, **A. Hashemi**, and G. Kutyniok, **“Compressed Sensing: From Theory to Praxis.”**, *Compressive Sensing of Earth Observations*, Edited by C.H. Chen, CRC Press, May 2017, Pages 1-32.
- Preprints** **A. Hashemi**, C. Cai, Y. Gao, S. Ghosh, K.-R. Müller, S. S. S. Nagarajan, and S. Haufe, **“Joint Learning of Full-structure Noise in Hierarchical Bayesian Regression Models.”**, Submitted to IEEE Transactions on Medical Imaging (TMI), 2021, (Draft is available on bioRxiv.)
- C. Cai, L. Hinkley, Y. Gao, **A. Hashemi**, S. Haufe, K. Sekihara, and S. S. Nagarajan, **“Empirical Bayesian Localization of Event-related Time-frequency Neural Activity Dynamics.”**, Submitted to NeuroImage, 2021.
- C. Cai, **A. Hashemi**, D. Chen, B. Chem, M. Diwakar, S. Haufe, K. Sekihara, W. Wu, and S. S. Nagarajan, **“Bayesian Adaptive Beamforming for Robust High-resolution Electromagnetic Brain Imaging.”**, In prepration to submit to IEEE Transactions on Medical Imaging (TMI), 2022.
- A. Flinth and **A. Hashemi**, **“Thermal Source Localization Through Infinite-Dimensional Compressed Sensing.”**, Submitted to IEEE Transactions on Signal Processing (TSP), 2021. (Draft is available on arXiv:1710.02016.)
- Research Papers** **A. Hashemi**, C. Cai, Y. Gao, S. Ghosh, K.-R. Müller, S. S. Nagarajan and S. Haufe, **“Efficient Hierarchical Bayesian Inference for Spatio-temporal Regression Models in Neuroimaging.”**, Thirty-Fifth Conference on Neural Information Processing Systems (**NeurIPS**), 2021.
- A. Hashemi**, C. Cai, G. Kutyniok, K.-R. Müller, S. S. Nagarajan, and S. Haufe, **“Unification of Sparse Bayesian Learning Algorithms for Electromagnetic Brain Imaging with the Majorization Minimization Framework.”**, NeuroImage 239, 2021.
- C. Cai, **A. Hashemi**, M. Diwakar, S. Haufe, K. Sekihara, and S. S. Nagarajan, **“Robust Estimation of Noise for Electromagnetic Brain Imaging with the Champagne Algorithm.”**, NeuroImage 225, 2021.

- A. Hashemi**, C. Cai, Y. Gao, S. Ghosh, K.-R. Müller, S. S. Nagarajan, and S. Haufe, “**Novel Techniques for Noise Estimation in Electromagnetic Brain Source Imaging.**”, International Journal of Bioelectromagnetism, Vol. 23, 2021.
- A. Hashemi**, C. Cai, K.-R. Müller, S. S. Nagarajan, and S. Haufe, “**Joint Hierarchical Bayesian Learning of Full-structure Noise for Brain Source Imaging.**”, Medical Imaging meets **NeurIPS** (Med-NeurIPS) Workshop, 2020.
- A. Hashemi**, C. Cai, G. Kutyniok, K.-R. Müller, S. S. Nagarajan, and S. Haufe, “**Electromagnetic Brain Imaging using Sparse Bayesian Learning – Noise Learning and Model Selection.**”, The Organization for Human Brain Mapping (OHBM), 2020.
- C. Cai, **A. Hashemi**, M. Diwakar, S. Haufe, K. Sekihara, and S. S. Nagarajan, “**Noise Learning in Empirical Bayesian Source Reconstruction Algorithms for Electromagnetic Brain Imaging.**”, The Organization for Human Brain Mapping (OHBM), 2020.
- A. Hashemi**, H. Andrade Loarca, S. Haufe, G. Kutyniok, and K.-R. Müller, “**Deep Brain Source Imaging: An LSTM-inspired Approach for EEG Source Localization based on Sparse Bayesian Learning.**”, Signal Processing with Adaptive Sparse Structured Representations (SPARS), 2019.
- A. Hashemi** and S. Haufe. “**Improving EEG Source Localization Through Spatio-Temporal Sparse Bayesian Learning.**”, 26th European Signal Processing Conference (EUSIPCO), 2018.
- A. Flinth and **A. Hashemi**, “**Approximate Recovery of Initial Point-like and Instantaneous Sources from Coarsely Sampled Thermal Fields via Infinite-Dimensional Compressed Sensing.**”, 26th European Signal Processing Conference (EUSIPCO), 2018.
- A. Flinth and **A. Hashemi**, “**Soft Recovery in Infinite-Dimensional Compressed Sensing with Applications in Thermal Source Localization and Massive MIMO**”, Poster presented at International Matheon Conference on Compressed Sensing and its Applications (CSA), 2017.
- A. Hashemi**, M. Rostami, and N.M. Cheung, “**Efficient Environmental Temperature Monitoring Using Compressed Sensing.**”, Data Compression Conference (DCC), IEEE, 2016.
- R. Nikbakht, H. Aghayinia, **A. Hashemi**, and M. Kazemi, “**Cyclostationary Features-Based Wideband Compressed Spectrum Sensing for Cognitive Radio Networks**”, 2nd International Conference on Electrical, Mechanical, Computer and Mechatronics Engineering (ICE), 2015.
- R. Nikbakht, H. Aghaeinia, M. Kazemi, and **A. Hashemi**, “**Wideband Compressed Spectrum Sensing based on 2D Sparse Reconstruction of Asymmetric Cyclic Spectrum**”, 2nd International Conference on Electrical, Mechanical, Computer and Mechatronics Engineering (ICE), 2015.

Refereeing and Reviewing Work

Referee for the following journals:

- NeuroImage
- Neural Information Processing Systems (NeurIPS)
- IEEE Transactions on Medical Imaging (TMI)
- IEEE Transactions on Neural Systems & Rehabilitation Engineering
- IEEE Transactions on Signal Processing (TSP)
- IEEE Transactions on Biomedical Engineering (TBME)
- IEEE Transactions on Information Theory
- The European Physical Journal Plus

Conferences/Workshops/Seminars: Participations and Presentations

- Dec 13, 2021 **Metrology for AI in Medicine (M4AIM) Lecture Series**, *Physikalisch-Technische Bundesanstalt Braunschweig und Berlin (PTB)*, Virtual.
Presentation Title: “Numerical Optimization for Machine Learning.”
- Dec 9, 2021 **35th Conference on Neural Information Processing Systems (NeurIPS 2021)**, Virtual.
Presentation Title: “Efficient Hierarchical Bayesian Inference for Spatio-temporal Regression Models in Neuroimaging.”
- May 27, 2021 **13th International Conference on Bioelectromagnetism (ICBEM)**, Virtual.
Presentation Title: “Novel Techniques for Noise Estimation in Electromagnetic Brain Source Imaging.”
- Mar 4, 2021 **Brain and Data Science Lab Meeting**, *Charité – Universitätsmedizin Berlin*, Virtual.
Presentation Title: “Joint Hierarchical Bayesian Learning of Full-structure Noise for Brain Source Imaging.”

- Dec 12, 2020 **34th Conference on Neural Information Processing Systems (NeurIPS 2020)**, *Medical Imaging meets NeurIPS (Med-NeurIPS) Workshop*, Virtual.
Presentation Title: "Joint Hierarchical Bayesian Learning of Full-structure Noise for Brain Source Imaging."
- Aug 19-30, 2019 **Mathematics of Deep Learning, BMS Summer School**, Technische Universität Berlin, Germany.
- Jul 1-4, 2019 **Signal Processing with Adaptive Sparse Structured Representations (SPARS) workshop, INP-ENSEEIH Engineering School**, Toulouse, France.
Presentation Title: "Deep Brain Source Imaging: An LSTM-inspired Approach for EEG Source Localization based on Sparse Bayesian Learning."
- Nov 19-23, 2018 **international Traveling Workshop on Interactions between low-complexity data models and Sensing Techniques (iTWIST)**, CIRM, Marseille, France.
- Sep 3-7, 2018 **26th European Signal Processing Conference (EUSIPCO)**, Rome, Italy.
Presentation Title: "Improving EEG Source Localization Through Spatio-Temporal Sparse Bayesian Learning"
- Sep 3-7, 2018 **26th European Signal Processing Conference (EUSIPCO)**, Rome, Italy.
Presentation Title: "Approximate Recovery of Initial Point-like and Instantaneous Sources from Coarsely Sampled Thermal Fields via Infinite-Dimensional Compressed Sensing"
- Jul 17, 2018 **Presentation at AFG Oberseminar**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "Bayesian Spatio-temporal Brain Source Imaging: Nonconvex Optimization using Majorization-Minimization Method and Geodesic Convexity"
- Jan 15-17, 2018 **Mathematics and Image Analysis (MIA)**, Humboldt University of Berlin, Germany.
- Dec 4-8, 2017 **3rd International Matheon Conference on Compressed Sensing and its Applications (CSA)**, Berlin, Germany, Part of organization team (AFG Group).
Presentation Title: "Soft Recovery in Infinite-Dimensional Compressed Sensing with Applications in Thermal Source Localization and Massive MIMO"
- Nov 29 - Dec 1, 2017 **Intense Course on Deep Learning**, Technische Universität Berlin, Berlin, Germany.
Part of organization team (AFG Group).
- Nov 16, 2017 **Presentation at AFG Oberseminar**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "A Bayesian Perspective on EEG Source Localization"
- Oct 25, 2017 **Presentation at BIMoS Scientific Advisory Board**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "Sparse Signal Recovery with Spatio-temporal Correlation and Trade-off"
- Sep 13-15, 2017 **Workshop on Mathematics of Deep Learning**, Weierstrass Institute (WIAS), Germany.
- Jun 19-22, 2017 **Structured Regularization for High-Dimensional Data Analysis Summer School**, Institut Henri Poincaré, Paris, France.
- Jun 5-8, 2017 **Signal Processing with Adaptive Sparse Structured Representations (SPARS) Conference**, Instituto Superior Técnico, University of Lisbon, Portugal.
- May 31 - Jun 2, 2017 **SpaRTaN/MacSeNet 2017 Summer School**, University of Lisbon, Portugal.
- May 3-5, 2017 **Wavelet and Tensor Methods for Partial Differential Equations**, Technische Universität Berlin, Berlin, Germany.
Part of organization team (AFG Group).
- Feb 2, 2017 **Presentation at AFG Oberseminar**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "Sparsifying Transform Learning and its application in EEG source localization"
- Dec 7-9, 2016 **Compressed Sensing in Information Processing (CoSIP) Winter Retreat**, Technische Universität Berlin, Berlin, Germany.
- Nov 16, 2016 **Presentation at BIMoS Annual Report**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "Sparse Signal Recovery with Side Information"
- Jul 28, 2016 **Presentation at AFG Oberseminar**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "EEG Source Localization and Transform Learning"
- Jul 25 - Aug 5, 2016 **Mathematical and Numerical Methods in Image Processing**, BMS Summer School, Technische Universität Berlin, Germany.
Part of organization team (AFG Group).
- Jul 18, 2016 **Presentation at BIMoS Ph.D. Seminars**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "(Co-)Sparsity and Analysis Formulation for PDE-Constrained Inverse Problems"
- Jun 21, 2016 **Presentation at BIMoS Scientific Advisory Board**, Technische Universität Berlin, Berlin, Germany.
Presentation Title: "Diffusive Compressed Sensing: Theory and Applications"

- Feb 11, 2016 **Presentation at AFG Oberseminar**, *Technische Universität Berlin*, Berlin, Germany.
Presentation Title: "Compressive Sensing of PDE-Constrained Signals"
- Sep 10, 2015 **Presentation at Information Systems Technology and Design Department**, *Singapore University of Technology and Design*, Singapore.
Presentation Title: "Diffusive Compressed Sensing: Theory and Applications"
- Apr, 2015 **Poster Presentation at InnovFest unbound 2015**, *Singapore*.
Presentation Title: "DeepCAPTCHA: An Image CAPTCHA Based on Depth Perception"
- Aug, 2013 **Presentation at Electrical Engineering Department**, *Sharif University of Technology*, Tehran, Iran.
Presentation Title: "Compressed Spectrum Sensing in Cognitive Radio Networks"
- Jul, 2011 **Presentation at Faculty of Electrical and Computer Engineering**, *University of Tabriz*, Iran.
Presentation Title: "Practical Physical Layer Network Coding for Two-Way Relay Channels Performance Analysis and Comparison"

Membership in Professional Societies

- MATH+, Berlin Mathematics Research Center
- SIAM/GAMM Student Chapter
- Berlin Mathematical School (BMS)
- Berlin International Graduate School in Model and Simulation-based Research (BIMoS)

Technical Skills

Programming and Software Skills

Python, **R**, **MATLAB**, **C/C++**, **SQL** (MySQL & PostgreSQL), **Git & Github**, **L^AT_EX**, **Microsoft Office**, **Linux**, **HTML**

Data Science Tools

TensorFlow; **Keras**; **PyTorch**; Python Libraries: **Numpy**, **Pandas**, **Scipy**, **Scikit-learn**, **Seaborn**, **Bokeh**;
DNN Architectures and Methods: **CNN**, **RNN**, **LSTM**, **VAE**, **LRP**, **Autoencoders**, **Transform Learning**

Transferable Skills

Project management and leadership

- Team player with leadership experience through different international multidisciplinary collaborations.
- Ability to work in a team, while doing my specific assigned task, independently and effectively.
- Manage group assistants to deliver goal-oriented projects on-time for time frames from 3 months to 2 years.
- Teaching and examination of more than 300 electrical engineering and computer science students in 2 years.

Drive and motivation

- Very passionate about Machine Learning and Deep Learning and try to constantly improve my skills and stay up-to-date with the most state-of-the-art methods and algorithms in the mentioned areas.
- Take selective online courses from top-ranked universities and watch presentations and tutorials from tier one conferences (**NeurIPS**, **ICML**), related to the latest developments in data-science technologies.

Communication

Experienced speaker with the ability to write extensive engineering and scientific reports and proposals, and present findings to peers at internal seminars and international conferences in front of diverse audiences.

Languages

Persian	Native Speaker
English	Fluent
German	Intermediate
Arabic	Basic
Turkish	Basic

Level: B1, Taking B2 Courses