Mohsen Moradi

Email: m.moradi@northeastern.edu
Phone: 575-650-5532
Website: moradi-coding.github.io/
LinkedIn: linkedin.com/in/moradi-coding

Research Interests

Wireless Communications, Error Correcting Codes, Quantum Error Correction, Information Theory, Machine Learning, Deep Learning, Network communication, Cryptography, Linear Systems, Reinforcement Learning

Education

Bilkent University Ankara, Turkey
Ph.D. in Electrical and Electronics Engineering (Coding Theory), 2017–2022

- Thesis: "**Performance and Computational Analysis of Polarization-Adjusted Convolutional (PAC) Codes**"
- Advisor: Prof. **Erdal Arıkan**: 2019 Claude E. Shannon Award winner and 2018 IEEE Richard W. Hamming medal recipient, father of polar codes.

Tehran Polytechnic (Amirkabir University of Technology) Tehran, Iran
M.S. in Coding Theory, 2011–2013

- Thesis: "Construction of Polar Codes for Capacity-Achieving of Channel"
- Advisor: Dr. **Mohammad-Reza (Rafsanjani) Sadeghi**.

Georgia Institute of Technology GA, US
Two Courses of Machine Learning and Deep Learning 2023

PostDoc Experience

Bilkent University - Electrical and Electronics Engineering Ankara, Turkey
Post Doctoral Research Associate 2022–2023

- Topic:
  - **Massive Access Solutions for Next Generation Wireless Communication Systems**
  - **Iterative Decoding for PAC Codes**
- Advisor: Prof. **Tolga M. Duman**

New Mexico State University - Electrical and Computer Engineering Las Cruces, US
Post Doctoral Research Associate 2023–2024 (Feb)

- Topic:
  - **Data Compression and Channel Coding**
  - **Enhancing Belief Propagation Decoding of Polar Codes: A Reinforcement Learning Approach**
  - **A Reinforcement Learning Approach for Decoding Quantum LDPC Codes (currently in progress)**
  - **Sequential Decoding of Quantum Convolutional Codes (currently in progress)**
- Advisor: Prof. **David G. M. Mitchell**

Northeastern University - Electrical and Computer Engineering Boston, US
Post Doctoral Research Associate 2024 –2024 (Feb)

- Topic:
  - **High Rate Channel Coding (Fair-Density Parity-Check Codes, PAC Codes)**
  - **Quantum Error Correction**
  - **Coding for Quantum Key Distribution**
- Advisor: Prof. **Hessam Mahdavifar**

Reviewer for

- IEEE Transactions on Communications (13 Reviews)
- IEEE Transactions on Vehicular Technology (2 Reviews)
- IEEE Transactions on Information Theory (1 Reviews)
- IEEE Journal on Selected Areas in Information Theory (1 Reviews)
- IEEE Communications Letters (12 Reviews)
- IEEE Wireless Communications Letters (5 Reviews)
- Electronics Journal (1 Reviews)
- IEEE Global Communications Conference (2 Reviews)
- IEEE International Symposium on Information Theory (ISIT) (5 Reviews)
- IEEE International Conference on Communications (ICC) (1 Reviews)
- IEEE Wireless Communications and Networking Conference (WCNC) (3 Reviews)
- IEEE 2022 14th International Conference on Wireless Communications and Signal Processing (WCSP 2022) (1 Reviews)
- IEEE 2023 International Symposium on Topics in Coding (ISTC 2023) (1 Reviews)
- Journal of Electrical and Computer Engineering Innovations (JECEI) (5 Reviews)

Teaching

- **Teaching Assistant** at Bilkent Universiry 10 Semesters
  Probability and Statistics (Lecturer: Prof. Erdal Arıkan)
- **Teaching Assistant** at Bilkent Universiry 1 Semester
  Introduction to Data Science (Lecturer: Prof. Selim Aksoy)
- **Teaching Assistant** at Bilkent Universiry 1 Semester
  Control and Optimization of Stochastic Systems (Lecturer: Prof. Serdar Yüksel)
- **Teaching Assistant** at Bilkent Universiry 2 Semesters
  Signals and Systems (Lecturers: Prof. Levent Onural & Dr. Mehmet Alper Kutay)
- **Teaching Assistant** at Bilkent Universiry 2 Semesters
  Engineering Mathematics (Lecturers: Prof. Orhan Arıkan & Dr. Nil Şahin)

Programming languages and skills

- **Programming Languages:** MATLAB, C++, C, Python
- **Deep Learning and Machine Learning Frameworks:** TensorFlow, PyTorch, Keras

- **Libraries & Tools:** NumPy, Pandas, Scikit-learn, linear regression, logistic regression, decision trees, random forests, K-means, hierarchical clustering, dimensionality reduction (PCA, t-SNE), CNN, RNN, optimization algorithms like gradient descent, stochastic gradient descent (SGD), Adam, RMSProp, and their variants.
- **Other Topics:** Computer Science, Data Analysis, Data Science, Digital Transformation, Algorithm, Signal Processing, Telecommunications, Cryptography, Linear Systems, Linear Algebra, Optimization, Communication Network Analysis.

Publications

1. Dissertation. (2022). **Performance and Computational Analysis of Polarization-Adjusted Convolutional (PAC) Codes.**
2. Moradi, Mohsen and Hessam Mahdavifar. (2024). "**PAC codes with Bounded-Complexity Sequential Decoding: Pareto Distribution and Code Design**", Submitted Journal: IEEE Transactions on Information Theory
3. Moradi, Mohsen and Hessam Mahdavifar. (2024). "**On Fast SC-based Polar Decoders: Metric Polarization and a Pruning Technique**", Submitted Journal: IEEE Transactions on Communications
4. Moradi, Mohsen. (2021). "**On Sequential Decoding Metric Function of Polarization-Adjusted Convolutional (PAC) Codes.**" IEEE Transactions on Communications (DOI 10.1109/TCOMM.2021.3111018)
5. Moradi, Mohsen and Mozammel Amir.(2023). "**A Tree Pruning Technique for Decoding Complexity Reduction of Polar Codes and PAC Codes.**" IEEE Transactions on Communications (DOI 10.1109/TCOMM.2023.3255254)
6. Moradi, Mohsen. (2023). "**Application of Guessing to Sequential Decoding of Polarization-Adjusted Convolutional (PAC) Codes.**" IEEE Transactions on Communications (DOI 10.1109/TCOMM.2023.3280548)
7. Moradi, Mohsen. (2023). "**Polarization-Adjusted Convolutional (PAC) Codes as a Concatenation of Inner Cyclic and Outer Polar- and Reed-Muller-like Codes.**" Finite Fields and Their Applications 93 (2024): 102321.
8. Moradi, Mohsen and David G. M. Mitchell. (2024). "**PAC Code Rate-Profile Design Using Search-Constrained Optimization Algorithms.**", ISIT 2024 (DOI: 10.1109/ISIT57864.2024.10619683)
9. Mohsen Moradi, Salman Habib, and David G. M. Mitchell. (2024). "**Enhancing Belief Propagation Decoding of Polar Codes: A Reinforcement Learning Approach**", Submitted Journal, IEEE Communications Letter
10. Moradi, M., Mozammel, A., Qin, K., and Arikan, E. (2020). **Performance and Complexity of Sequential Decoding of PAC Codes**. arXiv preprint arXiv:2012.04990.
11. Moradi, M., Mozammel, A.(2021). **A Monte-Carlo Based Construction of Polarization-Adjusted Convolutional (PAC) Codes.** Physical Communication (https://doi.org/10.1016/j.phycom.2024.102578).
12. Moradi, M., Mozammel, A.(2022). **Concatenated Reed-Solomon and Polarization-Adjusted Convolutional (PAC) Codes**. 2022 IEEE International Black Sea Conference on Communications and Networking (BlackSeaCom)
13. Moradi, Mohsen. (2022). **Bit-Flipping for Stack Decoding of Polarization-Adjusted Convolutional (PAC) Codes.** 2022 Tenth International Workshop on Signal Design and its Applications in Communications (IWSDA). IEEE, 2022.
14. Moradi, M. and Sadeghi, M.R. (2017). **Combining and Steganography of 3-D Face Textures**. Journal of Electrical and Computer Engineering Innovations (JECEI)
15. Moradi, M. (2017). Training Neural Networks Based on Imperialist Competitive Algorithm for Predicting Earthquake Intensity. International Conference on the New Horizons in the Basic and Technical Sciences and Engineering

Invited Talks

- Munich Workshop on Shannon Coding Techniques to present our invited talk "Learning Sequential BP Decoding of Short Blocklength Codes" (co-authored with Salman Habib and David Mitchell)

Courses

Ph.D. : Detection and Estimation Theory, Digital Communications Theory, Linear System Theory, Communication Network Analysis, Random Processes, Wireless Communications, Information Theory, Algorithms II, Algorithms I, Introduction to Robotics.
Ph.D. Qualification Exam: Engineering Mathematics I, Engineering Mathematics, Probability and Statistics, Circuit Theory, Electronic Circuit Design, Signals and Systems, Feedback Control Systems, Engineering Electromagnetics.
M.S. : Special Topics (Topics in Decoding Algorithms Implementation), Special Topics (Advanced Coding Theory), Coding Theory, Applied Algebra (Information Theory), Special Topics (Coding Theory and Applications of Algebraic Geometry), Advanced Algebra, Real Analysis I, Seminar, Geometry of Manifolds I, Machine Learning, Deep Learning.
Online Courses and Bootcamps: Optimization Problems and Algorithms, MATLAB Parallel Programming on GPUs, Cores and CPUs, Introduction to Genetic Algorithms: Theory and Applications, Practical AI with Python and Reinforcement Learning, Python for Data Science and Machine Learning Bootcamp Machine Learning Specialization (3 courses), Deep Learning Specialization (5 courses), Complete Tensorflow 2 and Keras Deep Learning Bootcamp, Machine Learning, Data Science and Deep Learning with Python.