Mohsen Moradi

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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

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

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

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

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**

REVIEWER FOR

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

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

Dissertation

1. Dissertation. (2022). **Performance and Computational Analysis of Polarization-Adjusted Convolutional (PAC) Codes.**

Journal

2. Mohsen Moradi, Salman Habib, and David G. M. Mitchell. (2024). "**Enhancing Belief Propagation Decoding of Polar Codes: A Reinforcement Learning Approach**", IEEE Communications Letter (DOI 10.1109/LCOMM.2025.3559466)

3. Moradi, M., Mozammel, A.(2025). **A Monte-Carlo Based Construction of Polarization-Adjusted Convolutional (PAC) Codes.** Physical Communication (https://doi.org/10.1016/j.phycom.2024.102578).

4. 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

5. Moradi, Mohsen and Hessam Mahdavifar. (2024). "**On Fast SC-based Polar Decoders: Metric Polarization and a Pruning Technique**", Submitted Journal: IEEE Transactions on Communications

6. 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)

7. 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)

8. 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.

9. Moradi, Mohsen. (2021). "**On Sequential Decoding Metric Function of Polarization-Adjusted Convolutional (PAC) Codes.**" IEEE Transactions on Communications (DOI 10.1109/TCOMM.2021.3111018)

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. and Sadeghi, M.R. (2017). **Combining and Steganography of 3-D Face Textures**. Journal of Electrical and Computer Engineering Innovations (JECEI)

Conference

12. Mohsen Moradi, Sheida Rabeti, and Hessam Mahdavifar. (2025). "**On the High-Rate FDPC Codes: Construction, Encoding, and a Generalization**", Submitted ISTC 2025 Conference.

13. Mohsen Moradi, and Hessam Mahdavifar. (2025). "**PAC Codes With Bounded-Complexity Sequential Decoding: Pareto Distribution and Code Design**", Accepted ISIT 2025 Conference.

14. Mohsen Moradi, and Hessam Mahdavifar. (2025). "**On Fast SC-Based Polar Decoders: Metric Polarization and a Pruning Technique**", Accepted ISIT 2025 Conference.

15. Sheida Rabeti, Mohsen Moradi, and Hessam Mahdavifar. (2025). "**Bounds and New Constructions for Girth-Constrained Regular Bipartite Graphs**", Accepted ISIT 2025 Conference.

16. 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)

17. 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)

18. 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.

19. 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

Posters

20. Mohsen Moradi, Hessam Mahdavifar. (Summer 2025). LiteFEC. Center for Ubiquitous Connectivity (CUbiC) under the JUMP 2.0 program.

21. Mohsen Moradi, Salman Habib, and David G. M. Mitchell. (2025). Learning Sequential BP Decoding of Short Blocklength Codes for URLLC. NSF project meeting held at Qualcomm.

22. Mohsen Moradi, Hessam Mahdavifar. (Summer 2024). LiteFEC. Center for Ubiquitous Connectivity (CUbiC) under the JUMP 2.0 program.

23. Mohsen Moradi, and David G. M. Mitchell. (2023). PAC Code Rate-Profile Design Using Search-Constrained Optimization Algorithms. 2023 North American School of Information Theory (NASIT).

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)

- Theme 1 Liaison Meeting Spring 2025 (April 2) "Lightweight Forward Error Correction (LiteFEC): New Codes and Decoding Algorithms" (joint talk with Hessam Mahdavifar)

  In this talk, we discussed our recent progress in the LiteFEC task with the aim of designing and implementing high-rate and low-latency error-correcting codes in the ultra-high-speed connectivity links. In the first part of the talk, we discussed new high-rate sparse codes that are decodable with highly parallelized belief propagation (BP) decoding algorithms and can beat their 5G counterparts by an order of magnitude in the error probability. In the second part, we focused on polarization-adjusted convolutional (PAC) codes that can perform very close to fundamental limits. We discussed new methods to design the rate-profile of PAC codes that allow very efficient and low-complex implementation of sequential decoders for the designed PAC codes while demonstrating a performance that beats all other state-of-the-art codes in the same regime of code parameters.

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.