

Homa Esfahanizadeh

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RESEARCH VISION

My research interests broadly include coding and information theory, signal processing, and statistical learning. My research addresses various aspects of large-scale information systems, such as scale-ability, reliability, heterogeneity, and privacy concerns. These issues are encountered in many modern applications such as 5G communication networks, cloud computing, autonomous driving, etc. I tackle these practical challenges from an information-theoretical perspective to propose efficient solutions and algorithms that also have theoretical guarantees. In particular, I have proposed several *low-latency* and *high-throughput* solutions for privacy-concerned machine learning, distributed coded computations, network coding, and error correction.

EDUCATION

Post-Doctoral Study, EECS Department, MIT RLE Massachusetts Institute of Technology (MIT) Advisor: Muriel Médard	Mar. 2020- Present
Ph.D, Electrical Engineering, Signals and Systems University of California, Los Angeles (UCLA) Advisor: Lara Dolecek Thesis: Spatially-coupled codes for modern data storage systems	Sep. 2015- Dec. 2019
M.Sc, Electrical Engineering, Communication Systems University of Tehran (UT) Advisors: Farshad Lahouti Thesis: Topological interference management in multiple unicast networks through index coding	Sep. 2012- Jul. 2015
B.Sc, Electrical Engineering, Telecommunications University of Tehran (UT) Advisor: Farshad Lahouti Thesis: Fixed-point implementation of turbo decoder on DSP	Sep. 2008- Jul. 2012

RESEARCH EXPERIENCES

Post-Doctoral Research Associate
Laboratory of Electronics (RLE), MIT
I develop coding schemes that improve the utility, lower the delay, and provide privacy for modern information infrastructures.

Graduate Student Researcher
Laboratory for Robust Information Systems (LORIS), UCLA
I presented novel frameworks for efficient analysis and design of low-latency error-correcting codes, suitable for modern storage systems.

Graduate Student Researcher
Wireless Multimedia Communication (WMC) Laboratory, University of Tehran
I elaborated the optimum mapping between the problems Network Coding, Index Coding, and Matrix Completion.

TEACHING EXPERIENCE

Guest Lecturer for

- **Principles of digital communication**, Massachusetts Institute of Technology (MIT), Fall 2021.
- **Probability and statistics**, University of California, Los Angeles (UCLA), Fall 2017.

Course Teacher Assistant for

- **Mathematical Foundations of Data Storage Systems**, University of California, Los Angeles (UCLA), Summer 2019.
- **Probability and statistics**, University of California, Los Angeles (UCLA), Fall 2017.
- **Communication systems**, University of California, Los Angeles (UCLA), Spring 2017.
- **Wireless multimedia communication theory**, University of Tehran, Spring 2013 and Spring 2014.

Laboratory Instructor Assistant for

- **Multimedia Communication Laboratory intended for undergraduate and graduate students**, University of Tehran, Spring 2014.
- **Microprocessor Laboratory intended for undergraduate students**, University of Tehran, Fall and Spring 2012 -2013.

MENTORSHIP EXPERIENCE

At Massachusetts Institute of Technology (MIT):

- Andrea Jaba (MEng student) and William Wu (MEng student).

At University of California, Los Angeles (UCLA):

- Lev Tauz (PhD student), Jose Suarez (Visitor PhD student), Ruiyi Wu (Master student), and Andrew Tan (Undergrad student).

INTERNSHIP EXPERIENCE

Decoder design of LDPC codes for 5G cellular networks using Reinforcement Learning, Samsung Semiconductor Inc., San Diego, CA, Summer 2018.

HONORS AWARDS

- Dissertation Year Fellowship (DYF), University of California, Los Angeles (UCLA), ECE Department, 2018.
- Memorable paper award at the Non-Volatile Memories Workshop (NVMW) for the paper “A three-stage approach for designing non-binary spatially-coupled codes for Flash memories” ([news on UCSD website](#)), March 2018.
- University fellowship, University of California, Los Angeles (UCLA), ECE Department, 2015.
- Ranked as top 10 percent among the B.Sc. students of Electrical Engineering in the year 2012, University of Tehran.
- Ranked as third in national robocup soccer simulation competition, Iran, 2006.

- Selected among Iranian high school students to participate in the rescue league of robocub international champion, Bremen, Germany, 2006.

SERVICES

- PC member: Non-Volatile Memories Workshop (NVMW) 2021.
- Journal reviewer: Elsevier Physical Communication, IEEE Communications Letters, IEEE Transactions on Communications (TCOM), IEEE Transactions on Information Theory (T-IT), IEEE Transactions on Magnetics (TMAG), and IEEE Journal on Selected Areas in Information Theory (JSAIT).
- Conference reviewer: IEEE ISIT, IEEE ITW, NVMW, and IEEE Intermag.

JOURNAL PUBLICATIONS

- A. Cohen (co first author), G. Thiran (co first author), **H. Esfahanizadeh (co first author)**, M. Médard, “Stream Distributed Coded Computing,” *IEEE Journal on Selected Areas in Information Theory (JSAIT) as a Special Issue on Coded Computing*, 2021.
- Alejandro Cohen, **H. Esfahanizadeh**, B. Sousa, J. P. Vilela, M. Luís, D. Raposo, F. Michel, S. Sargento, and M. Médard, “Bringing Network Coding into SDN: A Case-study for Highly Meshed Heterogeneous Communications,” *IEEE Communications Magazine (COMMAG)*, 2021.
- **H. Esfahanizadeh**, L. Tautz, and L. Dolecek, “Multi-Dimensional Spatially-Coupled Code Design: Enhancing the Cycle Properties,” *IEEE Transactions on Communications (TCOM)*, 2020.
- **H. Esfahanizadeh**, A. Hareedy, and L. Dolecek, “Finite-Length Construction of High Performance Spatially-Coupled Codes via Optimized Partitioning and Lifting,” *IEEE Transactions on Communications (TCOM)*, 2019.
- **H. Esfahanizadeh**, A. Hareedy, Ruiyi Wu, Rick Galbraith, and L. Dolecek, “Spatially-Coupled Codes for Channels with SNR Variation,” *IEEE Transactions on Magnetics (TMAG)*, 2018.
- **H. Esfahanizadeh**, A. Hareedy, and L. Dolecek, “Spatially-Coupled Codes Optimized for Magnetic Recording Applications,” *IEEE Transactions on Magnetic*, 2017.
- B. Amiri, A. Reisizadeh, **H. Esfahanizadeh**, J. Kliewer, and L. Dolecek, “Optimized Design of Finite-Length Separable Circulant-Based Spatially-Coupled Codes: An Absorbing Set-Based Analysis,” *IEEE Transactions on Communications (TCOM)*, 2016.

CONFERENCE PUBLICATIONS

- **H. Esfahanizadeh**, A. Cohen, M. Médard, “Stream iterative distributed coded computing for learning applications in heterogeneous systems,” *IEEE International Conference on Computer Communications (INFOCOM)*, accepted, 2022.
- **H. Esfahanizadeh (co first author)**, E. Ram (co first author), Y. Cassuto, and L. Dolecek, “Spatially Coupled Codes with Sub-Block Locality: Joint Finite Length-Asymptotic Design Approach,” *IEEE International Symposium on Information Theory (ISIT)*, 2020.
- L. Tautz, **H. Esfahanizadeh**, and L. Dolecek, “Non-Uniform Windowed Decoding for Multi-Dimensional Spatially-Coupled LDPC Codes,” *IEEE International Symposium on Information Theory (ISIT)*, 2020.

- **H. Esfahanizadeh**, Ruiyi Wu, and L. Dolecek, “A Finite-Length Construction of Irregular Spatially-Coupled Codes,” *IEEE Information Theory Workshop (ITW)* (invited paper), 2019.
- **H. Esfahanizadeh**, A. Hareedy, and L. Dolecek, “Multi-Dimensional Spatially-Coupled Code Design Through Informed Relocation of Circulants,” *Allerton Conference on Communication, Control, and Computing (ALLERTON)*, 2018.
- A. Hareedy, **H. Esfahanizadeh**, and L. Dolecek, “Spatially-Coupled Code Design for Partial-Response Channels: Optimal Object-Minimization Approach,” *IEEE Global Communications Conference (GLOBECOM)*, 2018.
- A. Hareedy, **H. Esfahanizadeh**, and L. Dolecek, “High Performance Non-Binary Spatially-Coupled Codes for Flash Memories,” *IEEE Information Theory Workshop (ITW)*, 2017.
- **H. Esfahanizadeh**, A. Hareedy, and L. Dolecek, “A Novel Combinatorial Framework to Construct Spatially-Coupled Codes: Minimum Overlap Partitioning,” *IEEE International Symposium on Information Theory (ISIT)*, 2017.
- **H. Esfahanizadeh**, A. Hareedy, and L. Dolecek, “The Finite Length Analysis of Spatially-Coupled Codes for 1-D Magnetic Recording Channels,” *Asilomar Conference on Signals, Systems, and Computers (ASILOMAR)*, 2016.
- **H. Esfahanizadeh**, F. Lahouti, and B. Hassibi, “A matrix completion approach to linear index coding problem,” *IEEE Information Theory Workshop (ITW)*, 2014.

PREPRINTS

- A. Yala (co first author), **H. Esfahanizadeh (co first author)**, R. Oliveira, K. Duffy, M. Ghobadi, T. Jaakkola, V. Vaikuntanathan, R. Barzilay, M. Médard, “NeuraCrypt: hiding private health data via random neural networks for public training,” arXiv 2106.02484, 2021.

WORKSHOP PUBLICATIONS

- **H. Esfahanizadeh**, A. Hareedy, and L. Dolecek, “Multi-dimensional spatially-coupled code design with improved cycle properties,” *Non-Volatile Memories Workshop (NVMW)*, 2019.
- A. Hareedy, **H. Esfahanizadeh**, and L. Dolecek, “A three-stage approach for designing non-binary spatially-coupled codes for Flash memories,” *Non-Volatile Memories Workshop (NVMW)*, 2018, **Winner of memorable paper award**.

REFERENCES

- Massachusetts Institute of Technology (MIT)
- Prof. Muriel Médard: medard@mit.edu
 - Prof. Manya Ghobadi: ghobadi@csail.mit.edu
- University of California, Los Angeles (UCLA)
- Prof. Lara Dolecek: dolecek@ee.ucla.edu