

Ruifu Li

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Summary: Ph.D. candidate in ECE focusing on array signal processing and wireless communication. Researching algorithms for off-grid sensing, covariance estimation, and massive multiple access from a scalable perspective. Experienced in signal detection, parameter estimation, adaptive filtering, and developing low-complexity iterative algorithms.

SKILLS SUMMARY

Programming Languages : MATLAB, Python, C/C++, Mathematica
Analytical : **Signal Detection and Estimation** (Random Processes, MLE, LMMSE, MAP, CRLB); **Wireless Communication** (MIMO, OFDM, Single-Carrier, mmWave, SE, EE); **Convex Optimization** (ADMM, Projected Gradient Method, Primal-Dual Interior-Point Method); **Numerical Linear Algebra** (Compressed Sensing, Sketching, Krylov Subspace Method, Rank Reduction);
Technologies & Libraries : CuPy, MATLAB Tensor Toolbox, PyTorch/TensorFlow, LaTeX.

EDUCATION

University of California, Los Angeles, Los Angeles, CA

GPA: 3.85/4, Ph.D. Candidate, Electrical and Computer Engineering

Sep 2020 - Jun 2026

Advisor: Prof. Danijela Cabric

- **Research Areas:** Detection and Estimation, Wireless Communication, Large-scale Optimization
- **Thesis:** Robust, scalable, and distributed algorithms for array signal processing

University of Wisconsin, Madison, Madison, WI

GPA: 3.91/4, Bachelor of Science, Applied Mathematics, Physics & Engineering

Sep 2018 - Jun 2020

- **Courses:** Digital Communication, Computer Networking, Applied Stochastic Processes

INDUSTRIAL EXPERIENCE

- **Qualcomm Technology Inc.:** Interim Engineering Intern Jun 2024 - Sep 2024
 - Team: RF Platform and Interfaces; Supervisor: Dr. Intae Kang; Mentor: Dr. Ni-Chun Wang;
 - Conducted **system identification research**, implementing algorithms to identify and select basis terms for accurate nonlinear system modeling.
 - Collaborated with the RFPI team, delivering weekly technical presentations on validation results to senior engineering leadership.
 - **Deliverable:** a nonlinear system analyzer with regularized regression to optimize the selection of nonlinear basis functions, modeling and compensating PA nonlinearity.

SELECTED RESEARCH EXPERIENCE

- **Cognitive and Reconfigurable Embedded System Lab: UCLA**
 - **Scalable On-Array Processing (SOAP):** November 2024 - Present
 - Designed a decentralized Krylov subspace algorithm optimized for single-precision performance, minimizing matrix-vector multiplications to eliminate processing bottlenecks in large-scale array systems
 - Developed a dynamic criterion for selecting the number of iterations that requires no tuning of hyper-parameters, maintaining SINR loss within 2dB in range-doppler space with 80% of reductions on number of operations
 - **Fast Solver for Off-grid Parameter Estimation and Non-linear Inverse Problems:** October 2023 - Present
 - Developed a scalable and fast-converging solver for off-grid and super-resolution direction-of-arrival estimation, computing the global optimal solution with orders-of-magnitude smaller execution time.
 - Implemented the solver for multi-dimensional estimation of 28GHz mmWave multi-path channel with OFDM waveforms, achieving **sub-centimeter error of UE location estimate**, matching theoretical lower bound of estimation error in Monte Carlo simulations.
 - **Frequency Domain Multiple Access with mmWave TTD Array:** April 2021 - December 2021
 - Designed grant-free multiple access protocol for mmWave small cell with single RF-chain true-time-delay base station
 - Evaluated system performance through simulations in terms of latency, rates, and user density with a focus on **achieving sub-millisecond access delay with 99.999% reliability**.
 - **mmRapid Extension for Non-Line-of-Sight Channels:** October 2020 - October 2021
 - Developed method for codebook optimization in neural-network-assisted mmWave initial access algorithm (mmRapid)
 - Verified trade-offs between robustness and spatial resolution in codebook design through simulations
- **Undergraduate Research: Applied Mathematics, Physics & Engineering, UW-Madison**
 - **Symmetry of Generalized Lyapunov Exponent:** June 2019 - June 2020
 - Research oriented project related to products of random matrices, ergodic theory, Lie algebra
 - Investigated the symmetry of generalized Lyapunov exponent with negative momentum.
 - **Bleed-through Removal:** August 2019
 - Implementation oriented project with belief propagation, principal component analysis in Mathematica for removing bleedthrough of historic documents

ACADEMIC SERVICE

Peer Reviewer : IEEE Communication Letters, IEEE JSAC, IEEE TSP
Conference Reviewer : IEEE ICASSP 2026

LIST OF SELECTED PUBLICATIONS

• Publications (Journal):

- **R. Li** and D. Cabric, "A Coordinate Descent Approach to Atomic Norm Denoising," in *IEEE Transactions on Signal Processing*, vol. 72, pp. 5077-5090, 2024, doi: 10.1109/TSP.2024.3486533.
- **R. Li**, H. Yan and D. Cabric, "Rainbow-Link: Beam-Alignment-Free and Grant-Free mmW Multiple Access Using True-Time-Delay Array," in *IEEE Journal on Selected Areas in Communications*, vol. 40, no. 5, pp. 1692-1705, May 2022, doi: 10.1109/JSAC.2022.3143261.
- E. Kriestorac, **R. Li**, D. Cabric, J. McGraw, P. Powers, J. Vitaz, M. Salpukas, D. Eustice, and T. Allen, "Machine Learning-Assisted Computationally Efficient Target Detection and Tracking in Massive Fully Digital Phased Arrays," in *IEEE Transactions on Radar Systems*, vol. 1, pp. 353-367, 2023, doi: 10.1109/TRS.2023.3298340.

• Publications (Conference Proceedings):

- **R. Li** and D. Cabric, "Decentralized Sparse Regression for Super-Resolution DoA Estimation," IEEE ICC, Montreal, QC, Canada, 2025, pp. 5512-5517, doi: 10.1109/ICC52391.2025.11161548.
- **R. Li** and D. Cabric, "Covariance Denoising with Applications to Adaptive Beamforming," 2024 IEEE International Symposium on Phased Array Systems and Technology (PAST), Boston, MA, USA, 2024, pp. 1-8, doi: 10.1109/ARRAY58370.2024.10880401.
- **R. Li** and D. Cabric, "Robust Adaptive Beamforming with Proximal Method," 2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Rhodes, Greece, 2023, pp. 1-5, doi: 10.1109/ICASSP49357.2023.10095114.
- **R. Li**, S. Sarkar, D. Cabric, J. McGraw, P. Powers and J. Vitaz, "Fast ML-Assisted Interference Estimation and Suppression for Digital Phased Array Radar," 2022 IEEE International Symposium on Phased Array Systems & Technology (PAST), Waltham, MA, USA, 2022, pp. 1-8, a: 10.1109/PAST49659.2022.9974996.
- B. W. Domae, V. Boljanovic, **R. Li** and D. Cabric, "Machine Learning Prediction for Phase-less Millimeter-Wave Beam Tracking," 2022 IEEE 23rd International Workshop on Signal Processing Advances in Wireless Communication (SPAWC), Oulu, Finland, 2022, pp. 1-5, doi: 10.1109/SPAWC51304.2022.9833935.
- B. W. Domae, **R. Li** and D. Cabric, "Machine Learning Assisted Phase-less Millimeter-Wave Beam Alignment in Multipath Channels," 2021 IEEE Global Communications Conference (GLOBECOM), Madrid, Spain, 2021, pp. 1-7, doi: 10.1109/GLOBECOM46510.2021.9685678.

TEACHING EXPERIENCE

• Teaching Associate, UCLA:

- EE230A-LEC-80, Detection and Estimation in Communication Spring 2022
- ECE233, Wireless Commun. System Design, Modeling, and Implementation Spring 2023
- ECE205, Matrix Analysis Fall 2023