Srijith Nair

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Objective

Ph.D. candidate in Electrical and Computer Engineering at NSF AI-EDGE institute at The Ohio State University specializing in federated and split learning, continual learning, in-context learning, verifiable code generation, and deep regularization. Seeking competitive research scientist roles that combine rigorous theoretical analysis with scalable implementation to advance large-scale distributed and collaborative AI systems.

Education

PhD Candidate Aug 2020–present

Electrical and Computer Engineering, The Ohio State University, CGPA: 4/4

Research topics: Federated Continual Learning, Federated Split Learning, In-Context Learning

MS May 2024

Electrical and Computer Engineering, The Ohio State University, CGPA: 4/4

Research topics: Robust image denoising; Deep inverse problems; Deep regularization; AMP
MS Thesis: Robust Blind Image Denoising via Instance Normalization

BTech May 2018

Electronics and Communication Engineering, NIT Trichy, India, CGPA 7.74/10

Capstone Project: General Video Game Artifical Intelligence

Research Experience

AI Research Intern May 2026 - Aug 2026

Emergence AI, New York City, NY

Research topics: Formal specification generation; Verifiable code generation; Lean4

- Evaluated the quality of formal specification generation (SpecGen) for verifiable code generation, extending evaluation beyond type-checking.
- Developed metrics for evaluating SpecGen in Lean4 and worked on extending the inductive-deductive algorithm for verifiable code generation.
- Co-authored a blog post and research paper on holistic evaluation of formal specification generation, listed under workshop contributions.

Graduate Research Associate May 2024–present

NSF AI-EDGE Institute, The Ohio State University

Advisor: Prof. Jia (Kevin) Liu
Research topics: Federated Split Learning; Continual Learning; In-Context Learning; Continual Learning in Agentic AI

- Designed, theoretically analyzed and implemented the FSL-SAGE algorithm which enables commodity clients to participate in Federated Learning of large models, while minimizing communication overhead by $2.5\times$. FSL-SAGE is the first provably convergent auxiliary model-based federated split learning method.
- Demonstrated efficiency of federated split learning and FSL-SAGE for LLMs on a cross-institution collaborative training testbed involving UW Madison, UT Austin, IIT Bombay and UMich.
- Developed PMF-CL, a continual learning meta-algorithm with provable convergence to a Pareto-optimal solution and memory-efficient implementations for linear and basis regression and quadratic losses.

- Currently studying the emergence of in-context learning in transformers and investigating continual learning in agentic AI; established achievability of in-context binary classification with ReLU and hard-max multi-head attention layers.

Graduate Research Associate Aug 2020 - Apr 2024

Communication and Signal Processing, The Ohio State University

Advisor: Prof. Philip Schniter

Research topics: Image inverse problems; Deep regularization; Approximate Message Passing

- Developed unrolled inverse imaging methods using 1-layer spline networks, improving memory and training efficiency while retaining PSNR/SSIM performance compared to deep regularizers.
- Established looseness of state-of-the-art Lipschitz constraints for adversarial convexity of regularizers in image inverse problems and proposed an alternative monotone operator constraint. Gained hands-on experience with constrained training of deep regularizer networks using bilevel optimization in JAX.
- Established convergence of the symmetric and asymmetric PRS-ADMM algorithm for pseudo-contractive operators and under suitable damping.

Student Research Assistant Jul 2019 - Aug 2020

Department of ECE, The Ohio State University

Mentor: Prof. Wladimiro Villarroel

Research topic: Ground Penetrating Radars

- Studied the effectiveness of time-series signal processing methods for sub-surface anomaly detection in fly-ash deposition sites using GPRs.

Research Assistant May 2018 - Jul 2019

Electrical Communication Engineering, Indian Institute of Science

Mentors: Prof. Yogesh Simmhan, Dr. Malati Hegde, S.V.R. Anand

Research topic: Wireless sensor networks; IoT for air-quality monitoring

- Developed and deployed SATVAM, a wireless sensor network for air pollution monitoring in a cross-institution setup on resource-constrained devices using a 6LoWPAN/RPL stack.
- Developed ML algorithms to calibrate electrochemical gas sensors to detect O_3 and NO_2 in the atmosphere, reducing running costs by several orders of magnitude while allowing fine-grained spatial deployment of pollutant sensors. Our work is published in the proceedings of IEEE eScience 2019.
- Designed, implemented and tested CONETSI, a decentralized ad-hoc routing method for collecting network state information in wireless IoT networks, reducing channel contention and communication costs by several times. Our work is published in the proceedings of COMSNETS 2020.

Summer Research Intern May 2017 - Aug 2017

Computational Neuroscience Lab, IIT Bombay

Mentors: Prof. Rohit Manchanda, Dr. Mithun Padmakumar

Research topic:

- Conducted first-principles analysis of digitally recorded electrical activities (action potentials, standard transient depolarizations) in smooth muscle cells of rats using unsupervised learning and PCA.
- Investigated variations in activity among cells to characterize the structure of the smooth muscle and the underlying neurological mechanisms.

Publications

Conference Publications

[1] H. Liu, R. Wen, **S. Nair**, J. Liu, W. Lou, C. Zhang, W. Yeoh, Y. Vorobeychik, and N. Zhang. "EcoLoRA: Communication-Efficient Federated Fine-Tuning of Large Language Models". In: *The 2025 Conference on Empirical Methods in Natural Language Processing*. 2025. URL: https://arxiv.org/abs/2506.02001.

[2] **S. Nair**, M. Lin, P. Ju, A. Talebi, E. S. Bentley, and J. Liu. "FSL-SAGE: Accelerating Federated Split Learning via Smashed Activation Gradient Estimation". In: *Forty-second International Conference on Machine Learning*. 2025. URL: https://openreview.net/forum?id=HnwcrtoDd4.

[3] **S. Nair**, A. Sahu, S. Mantravadi, S. Anand, and M. Hegde. "CONETSI: On-Demand Distributed Network State Information Collection using Opportunistic Exploration for Resource Constrained Networks". In: *2020 International Conference on COMmunication Systems & NETworkS (COMSNETS)*. 2020, pp. 491–498. DOI: 10.1109/COMSNETS48256.2020.9027403. URL: https://doi.org/10.1109/COMSNETS48256.2020.9027403.

[4] Y. Simmhan, **S. Nair**, S. Monga, R. Sahu, K. Dixit, R. Sutaria, B. Mishra, A. Sharma, A. SVR, M. Hegde, R. Zele, and S. N. Tripathi. "SATVAM: Toward an IoT Cyber-Infrastructure for Low-Cost Urban Air Quality Monitoring". In: *2019 15th International Conference on eScience (eScience)*. 2019, pp. 57–66. DOI: 10.1109/eScience.2019.00014. URL: https://doi.org/10.1109/eScience.2019.00014.

Workshop and Conference Contributions

[5] Z. Luo, J. Cai, C. Le Denmat, **S. Nair**, F. Nourzad, R. K. Sudha, Q. Wu, J. Zhang, S. Lee, Z. Li, P. Qiu, S. Shah, R. Sharma, Y. Xia, X. Zheng, Z. Liu, B. Ying, K. Chowdhury, G. Joshi, Y. Liang, R. Nowak, S. Parthasarathy, S. Prakash, B. Ravindran, S. Shakkottai, N. B. Shroff, S. Srinivasan, H. Yang, A. Yener, and J. Liu. "Toward WAN-Aware LLM Training Across Heterogeneous, Geo-Distributed Sites". In: *Proceedings of the ACM SIGCOMM 2026 Conference*. New York, NY, USA: Association for Computing Machinery, 2026, pp. 2057–2059. ISBN: 9798400724671. URL: https://doi.org/10.1145/3789240.3828748.

[6] **S. Nair**, A. Vempaty, J. Liu, and A. Jagmohan. "Beyond Type-checking: Towards Holistic Evaluation of Formal Specification Generation". In: *NeurIPS 2026 Workshop on AI for Verifiable Coding*. 2026. URL: https://openreview.net/forum?id=445UmzSXe6.

Journal Publications

[7] R. Sahu, A. Nagal, K. K. Dixit, H. Unnibhavi, S. Mantravadi, **S. Nair**, Y. Simmhan, B. Mishra, R. Zele, R. Sutaria, V. M. Motghare, P. Kar, and S. N. Tripathi. "Robust statistical calibration and characterization of portable low-cost air quality monitoring sensors to quantify real-time O_3 and NO_2 concentrations in diverse environments". In: *Atmospheric Measurement Techniques* 14.1 (2021), pp. 37–52. DOI: 10.5194/amt-14-37-2021. URL: https://amt.copernicus.org/articles/14/37/2021/.

Thesis and Preprints

[8] **S. S. Nair**. "Robust Blind Image Denoising via Instance Normalization". M.S. Thesis. The Ohio State University, 2024. URL: http://rave.ohiolink.edu/etdc/view?acc_num=osu1714849501121502.

[9] **S. Nair**, A. Eryilmaz, and J. Liu. *PMF-CL: Pareto-Minimal-Forgetting Continual Learner for Conflicting Tasks*. [Under review]. 2026. arXiv: 2605.19145 [cs.LG]. URL: https://arxiv.org/abs/2605.19145.

[10] R. Ballamajalu, **S. Nair**, S. Chhabra, S. K. Monga, A. SVR, M. Hegde, Y. Simmhan, A. Sharma, C. M. Choudhary, R. Sutaria, R. Zele, and S. N. Tripathi. *Toward SATVAM: An IoT Network for Air Quality Monitoring*. 2018. arXiv: 1811.07847 [cs.NI]. URL: https://arxiv.org/abs/1811.07847.

Work in Progress

[11] Z. Luo*, A. Nourzad*, **S. Nair***, W. Wu, R. Krishnan, and J. Liu. "Federated and Split Training of LLMs Across Geo-distributed Nodes". [In progress]. 2026.

[12] **S. Nair**, Z. Qin, P. Ju, and J. Liu. "Demystifying In-Context Learning in Transformer Models". [In progress]. 2026.

Presentations

Poster Presentation

Jul 2025 **S. Nair**, M. Lin, P. Ju, A. Talebi, E. Bentley, J. Liu, "FSL-SAGE: Accelerating Federated Split Learning via Smashed Activation Gradient Estimation", *International Conference on Machine Learning,* 2025

Oct 2023 **S. Nair**, P. Schniter, "An Improved Spline-Based Learned Convex Regularizer for Image Recovery", *Asilomar conference on Signals, Systems and Computers,* 2023

Sept 2023 **S. Nair**, P. Schniter, "Convergent Deep Convex and Non-convex Deep Regularization", *ECE Kraus student poster competition,* 2023

Feb 2023 **S. Nair**, P. Schniter, "Deep regularization via Bi-level Optimization with Adversarial Regularization", *BASP Frontiers Conference,* 2023

Nov 2022 **S. Nair**, P. Schniter, "Deep Regularization via Bi-level Optimization", *Asilomar Conference on Signals, Systems and Computers,* 2022

Mar 2022 P. Kharwar, **S. Nair**, M. Muduli, A. Vedula, "Re-Braille: A cost-effective refreshable Braille display", *Show-OHI/O* 2021 *at The Ohio State University*

Oral Presentation Talks

Nov 2022 **S. Nair**, P. Schniter, "Deep Regularization via Bilevel Optimization", *Asilomar Conference on Signals, Systems and Computers*

Oct 2018 **S. Nair**, "Co-iOAM: An algorithm for optimal collection of network information in a WiSUN compliant IoT network using in-band techniques", *MS Ramaiah Institute of Technology, India*

Select Teaching Experience

Graduate Teaching Assistant

ECE 2050: Introduction to Discrete Signals and Systems Aug – Dec 2024
Instructors: Prof. Bradley Clymer & Prof. Gregg Chappman, The Ohio State University

ECE 5307: Introduction to Machine Learning Jan – May 2024
Instructor: Prof. Philip Schniter, The Ohio State University

ECE 5307: Introduction to Machine Learning Aug – Dec 2023
Instructor: Prof. Philip Schniter, The Ohio State University

Outreach Workshops

Jul 2019 **S. Nair**, S.V.R. Anand, "Advanced programming for IoT applications using the Contiki Operating System", *SRM University, India*: Delivered talk and demo of the Contiki OS for embedded devices to a group of researchers and PhD students.

Jun 2019 **S. Nair**, "A tutorial on MATLAB programming for Mathematics researchers", *IISc outreach, India*: Delivered a full day workshop on programming using MATLAB with applications to research in mathematics, to an audience of university-level professors in pure mathematics.

Jun 2019 **S. Nair**, "A tutorial on C programming for Physics researchers", *IISc outreach, India*: Delivered a full day workshop on programming using C for research in physics, to an audience of university-level professors in physics.

2013 **S.Nair**, Pranit Samarth, Satish Nair, "Three lessons on "How sensors work" to K-12 students", *TeachEngineering.org*: 1. *How sensors work* 2. *How does a sound sensor work* 3. *How does a color sensor work*

Reviewing Experience

Serving as a reviewer for NeurIPS, ICML, ICLR, IEEE Transactions on Networking (ToN), IEEE Transactions on Mobile Computing (TMC), IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), and IEEE Transactions on Education (ToE).

Select Research Projects

2026 *ongoing* **Formal Specification Evaluation for Verifiable Code Generation.** Developed Lean4 specification-generation evaluation metrics and investigated extensions to inductive-deductive code generation during an internship at Emergence AI.

2026 **Pareto-Minimal-Forgetting Continual Learning (PMF-CL).** Developed a continual learning meta-algorithm with provable convergence to a Pareto-optimal solution; implemented linear and basis regression and quadratic-loss variants requiring $O(d^2)$ memory for model dimension d. Preprint under review.

2026 *ongoing* **Demystifying In-Context Learning in Transformers.** Studying positional encodings and context spaces; established achievability of binary classification with ReLU and hard-max multi-head attention layers. Investigating deeper architectures and more complex nonlinearities.

2025 **Geo-distributed Federated Split Learning.** Implemented FSL-SAGE using PyTorch and gRPC for federated LLM fine-tuning on GPU-constrained, geographically distributed clusters; contributed to work on WAN-aware training across heterogeneous sites. Project completed; publication pending.

2024 **Robust Blind Image Denoising.** Developed scale- and shift-equivariant denoising using quantile-based instance normalization to improve robustness across test noise levels.

2023 **Deep Unrolling with Spline Networks.** Trained and evaluated unrolled spline networks for image inverse problems, improving memory and training efficiency while retaining reconstruction quality.

Co-curricular Projects

Mar 2023 Smart refrigerator that keeps track of food inventory and suggests recipes using the Llama LLM, MakeOHI/O 2023 at OSU.

Oct 2022 Smart wearable Apple device software for interactive games for encouraging physical exercises, HackOHI/O 2022 at OSU.

Apr 2022 Pitching the idea for Re-Braille, ShowOHI/O 2022 at OSU.

Mar 2022 Re-Braille: Refreshable Braille Display for the blind, MakeOH/O 2022 at OSU.

Aug 2018 Profiling Energy consumption of Zolertia RE-Mote as part of SATVAM, IISc.

Jan – May 2018 Game-agnostic playing agents using enhanced MCTS and Evolutionary algorithms at NIT Trichy, India.

Sept – Oct 2017 Face image compression using Dictionary Learning, as part of Image Processing course, NIT Trichy.

Dec 2016 E-mail spam classifier in MATLAB as part of Machine Learning by Andrew Ng on Coursera.

Oct – Dec 2015 As part of Delta Force student organization at NIT Trichy, I developed BASH and Python scripts to automate user-database creation on Linux servers.

Feb 2015 Line Follower Robot using Atmega-8 as a team project for the Line Follower Bot competition organized by Robotics and Machine Intelligence Club, NIT Trichy.

Technical Skills

DL Libraries	PyTorch, JAX, TensorFlow
Languages	Python, Java, C/C++, Embedded C
Formal methods	Lean4; Formal specification and verifiable code generation
Networking	GRPC, 6LoWPAN, RPL
Web-Dev	HTML, CSS, Javascript, PHP
Others	Linux (BASH), Contiki-OS, Assembly

Achievements

2025	Recipient of Dr. Burn Lin Graduate Travel Grant for ICML 2025
2014 - 2018	Recipient of All India Rank under 2000 scholarship by AIEEE, India
2014	All India Rank of 1792 (99.84 percentile) in the IIT-JEE Mains entrance examination, 2014
2022	Won first place in Make OHI/O 2022 for designing a refreshable Braille display for the blind in a one-day hackathon
2016	'A' Grade in B-Certificate Examination National Cadet Corps, India
2016	Silver Medal in Best Cadet Competition National Cadet Corps, India
2011	Passed the Mumbai Science Teachers Association Science Talent Search Competition