Patrick Emami

Machine Learning Research Scientist
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Research Statement

I am a machine learning research scientist at the National Renewable Energy Lab. Currently, I am working on developing scientific foundation models. In the past, I have researched advances in deep generative modeling and reinforcement learning. I am broadly interested in applications of AI to clean energy systems.

Education

2016–2021	**University of Florida**, Gainesville, FL Ph.D., Computer Science (Machine Learning) Thesis: Neural algorithms for object-centric scene understanding	Advisor: Dr. Sanjay Ranka
2012–2016	**University of Florida**, Gainesville, FL B.Sc., Computer Engineering	Cum Laude, GPA: 3.74/4.0

Research Experience

National Renewable Energy Lab, Research Scientist. May 2023–Present
● *Artificial Intelligence, Learning, and Intelligent Systems (ALIS) group*.

National Renewable Energy Lab, Postdoctoral Researcher. January 2022–May 2023
● *Artificial Intelligence, Learning, and Intelligent Systems (ALIS) group*.

National Renewable Energy Lab, Graduate Research Intern. May 2021–August 2021
● *Complex Systems, Simulation, and Optimization Lab. Regional Mobility*.

University of Florida, Department of Computer Science, Graduate Research Assistant. 2016–2021
● *MALT Lab.*
● *UF Transportation Institute*.

Selected Honors and Awards

2024	MCCS Postdoctoral Publication Award ($1,200)
2023	Outstanding Mentor at NREL ($100)
2022	Top Reviewer at ICLR'22
2021	Top 10% Reviewer at ICML'21
2020	Student of the Year USDOT STRIDE Center (10 universities) ($1,000)
2016–2021	McKnight Doctoral Fellowship ($65,000)
2016–2021	CISE Department Graduate Research Fellowship ($150,000)
2016	President's Honor Roll
2015–2016	Northrop Grumman Engineering Scholarship ($1,000)
2014–2015	University Scholars Program Research Grant ($1,750)
2014	IROS'14 Best Entertainment Robots and Systems Paper Finalist

Publications

Peer-Reviewed Conferences and Workshops

[1] **Emami, P.**, Sahu, A., Graf, P. BuildingsBench: A Large-Scale Dataset of 900K Buildings and Benchmark for Short-Term Load Forecasting. NeurIPS'23 Datasets & Benchmarks. [Github].

[2] Sigler, D., Biagioni, D., **Emami, P.**, Zamzam, AS., Knueven, B. Optimization of Distribution Feeder Topology: A Differential Programming Learning Approach. IEEE PESGM'23.

[3] **Emami, P.**, Zhang, X., Biagioni, D., Zamzam, AS. Non-Stationary Policy Learning for Multi-Timescale Multi-Agent Reinforcement Learning. IEEE CDC'23.

[4] **Emami, P.**, Perreault, A., Law, J., Biagioni, D., John, PCS. Plug & Play Directed Evolution of Proteins with Gradient-based Discrete MCMC. 36th Conference on Neural Information Processing Systems Workshop on Machine Learning in Structural Biology (NeurIPS'22 MLSB). 2022.

[5] He, P., **Emami, P.**, Ranka, S., Rangarajan, A. Self-Supervised Robust Scene Flow Estimation via the Alignment of Probability Density Functions. AAAI'22. **15% acceptance rate**.

[6] **Emami, P.**, He, P., Ranka, S., Rangarajan, A. Efficient Iterative Amortized Inference for Learning Symmetric and Disentangled Multi-Object Representations. International Conference on Machine Learning (ICML'21). 2021. **21.5% acceptance rate**.

[7] **Emami, P.**, He, P., Rangarajan, A., Ranka, S. A Symmetric and Object-Centric World Model for Stochastic Environments. 34th Conference on Neural Information Processing Systems Workshop on Object Representations for Learning and Reasoning (NeurIPS '20). 2020. **Spotlight**.

[8] **Emami, P.***, Vargas, L.*, Traynor, P. On the Detection of Disinformation Campaign Activity with Network Analysis. CCSW 2020: The ACM Cloud Computing Security Workshop. 2020. **Equal contribution*

[9] **Emami, P**., Pourmehrab, M., Martin-Gasulla, M., Ranka, S., Elefteriadou, L. A Comparison of Intelligent Signalized Intersection Controllers Under Mixed Traffic. IEEE Intelligent Transportation Systems Conference, 2018.

[10] Omidvar, A., Pourmehrab, M., **Emami, P**., Kiriazes, R., Esposito, J., Letter, C., Elefteriadou, L., Ranka, S., Crane, C. Deployment and Testing of Optimized Autonomous and Connected Vehicle Trajectories at a Closed-Course Signalized Intersection. Transportation Research Board's 97th, 2018.

[11] **Emami, P**., & Pourmehrab, M., & Elefteriadou, L., & Ranka, S., & Crane, C. A Demonstration of Fusing DSRC and Radar for Optimizing Intersection Performance. Automated Vehicles Symposium (AVS'17), 2017.

[12] **Emami, P**., Elefteriadou, L., Ranka, S. Tracking Vehicles Equipped with Dedicated Short-Range Communication at Traffic Intersections. 7th ACM International Symposium on Design and Analysis of Intelligent Vehicular Networks and Applications (DIVANet'17), 2017.

[13] Hamlet, A., **Emami, P**., Crane, C. The Cognitive Driving Framework: Joint Inference for Collision Prediction and Avoidance in Autonomous Vehicles. In the 15th International Conference on Control, Automation and Systems (ICCAS), pp. 1714-1719. IEEE, 2015.

[14] Hamlet, A., **Emami, P**., Crane, C. A Gesture Recognition System for Mobile Robots That Learns Online. In the 2014 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'14), pp. 2114-2119. IEEE, 2014.

Peer-Reviewed Journals

[1] **Emami, P.**, He, P., Ranka, S., Rangarajan, A. Towards Improving the Generation Quality of Autoregressive Slot VAEs. Neural Computation. 2024.

[2] He, P., **Emami, P.**, Ranka, S., Rangarajan, A. Learning Canonical Embeddings for Unsupervised Shape Correspondence with Locally Linear Transformations. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2023.

[3] **Emami, P.**, Perreault, A., Law, J., Biagioni, D., John, PCS. Plug & Play Directed Evolution of Proteins with Gradient-based Discrete MCMC. Machine Learning: Science & Technology. 2023. [Github].

[4] He, P., & **Emami, P.**, & Ranka, S., & Rangarajan, A. Learning Scene Dynamics From Point Cloud Sequences. IJCV Special Issue on 3D Vision. 2021.

[5] **Emami, P.**, & Elefteriadou, L., & Ranka, S. Long-range Multi-Object Tracking at Traffic Intersections on Low-Power Devices. IEEE Transactions on Intelligent Transportation Systems. 2021. [UFTI article]

[6] **Emami, P.**, & Pardalos, P. M., & Elefteriadou, L., & Ranka, S. Machine Learning Methods for Data Association in Multi-Object Tracking. ACM Computing Surveys, 53, 4, Article 69. 2020.

[7] Pourmehrab, M., **Emami, P.**, Martin-Gasulla, M., Wilson, J., Elefteriadou, L., Ranka, S. Signalized Intersection Performance with Automated and Conventional Vehicles: A Comparative Study. Journal of Transportation Engineering, Part A: Systems 146.9. 2020.

Preprints

[1] **Emami, P.**, Li, Z., Sinha, S., Nguyen, T. SysCaps: Language Interfaces for Simulation Surrogates of Complex Systems. arXiv:2405.19653 [cs.LG, eess.SY], 2024.

[2] Graf, P., & **Emami, P.** Three Pathways to Neurosymbolic Reinforcement Learning with Interpretable Model and Policy Networks. arXiv:2402.05307 [cs.AI], 2024.

[3] **Emami, P.**, & Ranka, S. Learning Permutations with Sinkhorn Policy Gradient. arXiv:1805.07010 [cs.LG], 2018.

Blog Posts

[1] **Emami, P**. Deep Deterministic Policy Gradients in Tensorflow. https://pemami4911.github.io/blog/2016/08/21/ddpg-rl.html. 2016. > 100K unique views (Google Analytics). [Github]

Recent Talks

- SIAM MPE24, “Towards Scientific Foundation Models for Complex Energy Systems”, June 2024
- Idaho National Lab DICE Conference, “Accelerating Community Clean Energy Transitions with Generative AI”, May 2024
- Microsoft AI for Social Good, “Scientific Foundation Models for the Design, Analysis, and Management of Complex Energy Systems”, April 2024
- Farmingdale State College IEEE Club, “Intro to AI/ML”, March 2024

Professional Activities

Conference and Workshop Reviewing

NeurIPS Climate Change AI Workshop Meta-Reviewer 2024
LLMxHPC 2024
NeurIPS 2021–present
NeurIPS Datasets & Benchmarks Track 2023–present
NeurIPS Workshops Interp. Inductive Biases and Phys.'20, MLSB'22, MLSB'23
ICML 2021–present
ICLR 2022–present
ICLR NeSY-GEMs Workshop 2023
AISTATS 2023
CVPR 2022

Journal Reviewing

Earth Science Informatics 2023
Computer Vision and Image Understanding 2021
Transportation Research Record 2021
Optimization Letters 2020

Service

Environmental Data Science Climate Change AI Special Issue Guest Editor 2024
NREL Generative Modeling Workshop Co-Organizer January 2023
NREL ALIS Group Journal Club Organizer 2022–present
IEEE ITSC Special Session Chair 2018
UF Informatics Institute Student Data Analysis Seminar Co-Organizer 2017–2019
UF Machine Learning Reading Group Organizer 2016–2018

Mentoring

Spring 2024–present	Dawson Do (NREL intern)	UC Berkeley
Fall 2023–present	Saumya Sinha (NREL Postdoc)	CU Boulder
Summer 2023–present	Truc Nguyen (NREL Postdoc)	Univ. of Florida
Summer 2023–2024	Zhaonan Li (NREL Intern)	Columbia
Summer 2022	Aidan Perreault (NREL Intern)	Stanford
Fall 2019–2021	Yury Lebedev (Ph.D.)	Univ. of Florida
Fall 2018–2021	Kevin Chow (B.Sc.)	Univ. of Florida
Summer 2018	Anuran Rouchowdhury (M.Sc)	Univ. of Florida
Summer 2018	Ian Pelakh (B.Sc.)	Univ. of Florida
Fall 2017	Shalaka Naik (M.Sc), Individual Study	Univ. of Florida
Fall 2017	Vivek Gade (M.Sc), Individual Study	Univ. of Florida
Summer 2017	Jabari Wilson (SURF Fellow)	Univ. of Alabama

Teaching & Volunteering

2021	**Junior Science, Engineering, and Humanities Symposium**, Reviewer Reviewed 7 papers written by high school students for the speaker competition
Summer 2018	**Student Science Training Program**, Instructor Designed & taught a 6-week short course on machine learning basics
2017–2018	**Teaching Youth Programming Essentials**, Curriculum Lead Responsible for designing and improving the UF TYPE programming curriculum
2016–2017	**Teaching Youth Programming Essentials**, Instructor Teach an after school Intro to Programming course at local high schools
2014–2015	**Association of Computer Engineers**, Co-Founder and Project Manager Organized and presented at technical and professional development workshops for undergraduate computer engineering students