Patrick Emami

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Summary

- Machine learning Ph.D. candidate (expected graduation in December 2021) researching unsupervised neural algorithms for object-centric scene understanding.
- Expertise in deep learning and deep learning frameworks, deep generative modeling, computer vision, intelligent transportation systems, and reinforcement learning.
- My paper "Efficient Iterative Amortized Inference for Learning Symmetric and Disentangled Multi-Object Representations" was presented at ICML'21, where I was also recognized as a Top 10% Reviewer.

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
Summer 2019	**University College London**, London, UK Machine Learning Summer School (MLSS)	Marc Deisenroth & Arthur Gretton
2012–2016	**University of Florida**, Gainesville, FL B.Sc., Computer Engineering	Cum Laude, GPA: 3.74/4.0

Experience

National Renewable Energy Lab (NREL), Research intern. May 2021–August 2021
● *Regional Mobility*.
Developed deep reinforcement learning algorithms for NEMA-compliant traffic control using a "digital twin" of the Chattanooga, Tennessee road network.

MALT Lab, Graduate Research Assistant. 2016–present
● *EfficientMORL. ICML'21* [Github].
We re-interpret iterative assignment of pixels to object-centric slots as bottom-up inference in a hierarchical variational autoencoder. EfficientMORL has three key components: bottom-up inference with transformer-like attention to estimate an initial posterior over slots, a top-down prior to regularize and disentangle the slots, and lightweight iterative refinement to stabilize training. It is the first object-centric generative model to learn symmetric and disentangled representations while being computationally efficient.
● *Stochastic object-centric world models. NeurIPS '20 ORLR Workshop Spotlight.* [Github]
Proposed a latent state space model based on variational autoencoders for jointly learning object-centric representations and dynamics for stochastic real-world video. Formulated the integration of a stochastic latent dynamics model with segmentation-based object discovery and a novel sampling-based variational objective to fit environment stochasticity. Demonstrated superior object decomposition and stochastic future prediction on a robotic manipulation benchmark compared to prior work.

UF Transportation Institute (UFTI), Graduate Research Assistant. 2017–present.
● *Sensible. NSF Grant 1446813, 2017–present*. [Open source release forthcoming]
Software engineering lead for Sensible, a distributed Python framework for real-time multi-sensor multi-object tracking at traffic intersections. Supports V2X communication and intersections with multiple roads each equipped with multiple sensors such as Econolite cameras and Smartmicro radars. Achieves GPU-less video tracking with a novel deep convolutional network running on PyTorch. Integrates with a real-time traffic signal optimizer for advanced adaptive signal control.

Select Publications

Peer-Reviewed Journals

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

[2] **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]

[3] **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.

[4] 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.

Peer-Reviewed Conferences and Workshops

[1] 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**.

[2] **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). 2021. **21.5% acceptance rate**.

[3] **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**.

[4] **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*

[5] **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.

[6] 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.

Preprints

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

Technical Skills

- Scientific programming languages: Python, MATLAB
- General purpose languages and scripting: Java, C++, Bash
- ML frameworks: PyTorch, Tensorflow, RLlib, scikit-learn, OpenCV
- Data analysis: Jupyter, pandas, numpy, matplotlib, seaborn, Inkscape
- HPC: Slurm
- Traffic Simulation: SUMO, Flow