

# Patrick Emami

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## Summary

- Machine learning PhD student with expertise in deep learning and deep learning frameworks, computer vision, and reinforcement learning (expected graduation in 2021)
- Recently gave a spotlight talk on my work “A Symmetric and Object-centric World Model for Stochastic Environments” at the NeurIPS’20 Workshop on Object Representations for Learning and Reasoning
- Named the 2020 US-DOT Southeastern University Transportation Center Student of the Year (out of approx. 10 universities)

## Education

2016–present	<b>University of Florida</b> , Gainesville, FL Ph.D., Computer Science (Machine Learning)	Advisor: Dr. Sanjay Ranka
Summer 2019	<b>University College London</b> , London, UK Machine Learning Summer School (MLSS)	Marc Deisenroth & Arthur Gretton
2012–2016	<b>University of Florida</b> , Gainesville, FL B.Sc., Computer Engineering	Cum Laude, GPA: 3.74/4.0

## Experience

### **MALT Lab, Graduate Research Assistant.** 2016–present

- *Stochastic object-centric world models. NeurIPS 2020 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.

- *SPG: Sinkhorn Policy Gradient. arXiv 2018.* [[Github](#)]

Introduced the first actor-critic deep reinforcement learning architecture for learning policies on permutation matrices. Demonstrated a technique for end-to-end training via a continuous relaxation of permutations using Sinkhorn balancing. Achieved competitive performance on combinatorial tasks such as sorting, maximum weight matching, and traveling salesperson.

### **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 built on ZeroMQ 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.

- *Survey on data association for multi-object tracking. ACM CSUR '20.*

Synthesized nearly one decade of research on learning-based algorithms for data association step in multi-object tracking. Provided a unifying perspective from the lens of combinatorial optimization. Highlighted the novel research direction of end-to-end learning of linear and multi-dimensional assignment for multi-object tracking.

## Publications

### Peer-Reviewed Journals

- [1] He, P., & **Emami, P.**, & Ranka, S., & Rangarajan, A. Learning Scene Dynamics From Point Cloud Sequences. *International Journal of Computer Vision*. 2021. *Under review*.
- [2] **Emami, P.**, & Elefteriadou, L., & Ranka, S. Long-range Tracking of Vehicles at Traffic Intersections Without a GPU. *Transactions on Intelligent Transportation Systems*. 2020. *Under review*. [[UFTI article](#)]
- [3] **Emami, P.**, & Panos M. P., & 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] **Emami, P.**, He, P., Rangarajan, A., Ranka, S. Efficient Iterative Amortized Inference for Learning Symmetric and Disentangled Multi-Object Representations. 2021. *Under review*.
- [2] **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**.
- [3] **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*
- [4] **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.
- [5] 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.
- [6] **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.
- [7] **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.
- [8] 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.
- [9] 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.

### Preprints

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