Xiao **Liu**

Research Associate · Robotics & AI

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Summary

I am a senior Computer Science Ph.D student and I work with **Prof. Heni Ben Amor** at Interactive Robotics Lab in School of Computing and Augmented Intelligence at Arizona State University. My research is focusing on Differentiable Bayesian Filters, Representation Learning, and their applications in Embodied AI and Human-robot Interaction (HRI). Several publications of my research are/were shown at **ICRA**, **IROS**, and **CoRL**. I also work as a Research Data Scientist for a Phoenix and Seattle based start-up company, RadiusAI.

Education

Arizona State University — *Tempe, Arizona*

Ph.D. in Computer Science, Advisor: Prof. Heni Ben Amor — *Aug. 2019 - May. 2024*

- Thesis Focus: Robot Learning via Deep State-Space Modeling GPA: 4.0/4.0

Case Western Reserve University — *Cleveland, Ohio*

M.S. in Mechanical Engineering, Advisor: Prof. Kiju Lee — *Aug. 2016 - May. 2019*

- Thesis Focus: Automated Facial Emotion Recognition for Human-Robot Interaction GPA: 3.8/4.0

Southwest Jiaotong University — *Chengdu, China*

B.S. in Mechanical Engineering — *Aug. 2011 - May. 2015*

- Project: Fault Diagnosis of Roller Bearing Based on Wavelet Analysis GPA: 3.6/4.0

Experience

RadiusAI, Inc. — *Tempe, Arizona*

Research Data Scientist (part-time) — *Sep. 2020 - Dec 2023*

- Refined Multi-object tracking (MOT) algorithms using Bayes Filter for Video Analytics for indoor and outdoor cameras, improved ∼9% accuracy.
- Developed multi-objective optimization technique base on Frank-Wolfe algorithm for training monocular depth prediction model across multiple datasets.
- Researched on monocular depth prediction models with varied advanced architecture, Vision Transformer and multi-scale local planar guidance blocks, achieved depth estimation with 0.117, 0.416 on abs REL and RMS error metrics and 0.868 on d1 metric on NYU depth testset.

Interactive Robtoics Lab, ASU — *Tempe, Arizona*

Research Associate — *June. 2020 - Present*

- Embodied AI: Proposed Diff-Control, an Action diffusion policy incorporating ControlNet from the domain of image generation to robot actions. **[S1]**
- Created a multimodal learning framework (α-MDF) using attention mechanism and differentiable filtering, which conducts state estimation in latent space with multiple modalities. Experimented on robot learning tasks with both rigid body robots and soft robots. **[C5]**
- Developed differentiable Ensemble Kalman Filters (DEnKF) framework incorporating algorithmic priors for robot learning, i.e., learning system dynamics from observations, and learning representations from high-dimensional space. **[C4]**
- Proposed spatio-temporal enhancement module for DEnKF to ensure the generalized performance on real robot within nonlinear systems. **[C3]**
- Deployed the differentiable filtering framework with smartwatch for ubiquitous robot control tasks, i.e., remote teleoperation, drone piloting. **[C6]**

Case Western Reserve University — *Cleveland, Ohio*

Research Assistant — *Aug. 2017 - Aug. 2019*

- Led social robot project "Woody and Philos" project, developed advanced algorithms in Computer Vision for broad. **[C2]**
- Real-time Human Facial Emotion Expression Recognition for Human-robot Interaction using deep learning and machine learning technique. (featured on Case Western Daily) **[C1]** **[J1]**
- Developed social robots–"Philos" & "Woody" from the kinematics to the high-level control. Investigated the potential of social robots as cognitive assessment applications for clinical trials in Autism Spectrum Disorder & Alzheimer's. (featured on ideastream)
- Collaborated on hardware and algorithm development for the vision-based Tangible Geometric Games- "e-Cube" for cognitive skills assessment.

CWRU & ASU — *Cleveland, Ohio & Tempe, Arizona*

Teaching Assistent — *2018 - 2019, 2023 - 2024*

- Served as the teaching assistant for EMAE250 (Computers in Mechanical Engineering), instructing students on numerical problem-solving using Matlab and providing guidance throughout the learning process.
- TA for CSE205 (Object Oriented Programming), instructing students on varied data structure and OOP tasks in Java.

Uber Technologies, Inc. *Xi'an, China*

Data Analyst *Jan. 2016 - Aug. 2016*

- Coordinated data analysis and fraud detection with the operation team. Conducted competitor tracking and advising on driver incentives.

Hitachi, Ltd. *Chengdu, China*

Design Engineer *June 2015 - Dec. 2015*

- Assisted in product development by analyzing cable and power converter sizing, heat release, and power supply design. Revised design parameters to meet customer requirements and national standards while optimizing manufacturing and logistical processes for cost reduction.

Publications

2024 **[S1],** Liu, X, Zhou, Y, Weigend, F, Sonawani, S & Ben Amor, H. "Diff-Control: A Stateful Diffusion-based Policy for Imitation Learning" *IEEE/RSJ IROS (under review)* — *IROS 2024*

2024 **[C6],** Weigend, F, Liu, X, Sonawani, S & Ben Amor, H. "iRoCo: Intuitive Robot Control from Anywhere using a Smartwatch" *IEEE International Conference on Robotics and Automation (ICRA)* — *ICRA 2024*

2023 **[W2],** Liu, X, Zhou, Y, Ikemoto, S & Ben Amor, H. "Multimodal Learning of Soft Robot Dynamics using Differentiable Filters" *CoRL 2023 Workshop on Learning for Soft Robots* — *CoRL 2023*

2023 **[C5],** Liu, X, Zhou, Y, Ikemoto, S & Ben Amor, H. "α-MDF: An Attention-based Multimodal Differentiable Filter for Robot State Estimation" *7th Conference on Robot Learning* — *CoRL 2023*

2023 **[W1],** Weigend, F, Liu, X, & Ben Amor, H. "Probabilistic Differentiable Filters Enable Ubiquitous Robot Control with Smartwatches" *IROS 2023 Workshop on Differentiable Probabilistic Robotics* — *IROS 2023*

2023 **[C4],** Liu, X, Clark, G, Campbell, J, Zhou, Y & Ben Amor, H. "Enhancing State Estimation in Robots: A Data-Driven Approach with Differentiable Ensemble Kalman Filters" *IEEE/RSJ IROS* — *IROS 2023*

2023 **[C3],** Liu, X, Ikemoto, S, Yoshimitsu, Y & Ben Amor, H. "Learning Soft Robot Dynamics using Differentiable Kalman Filters and Spatio-Temporal Embeddings" *IEEE/RSJ IROS* — *IROS 2023*

2021 **[J1],** Liu, X, Cheng, X & Lee, K. "GA and SVM based Facial Emotion Recognition using Geometric Features" *IEEE sensors Journal on Machine Vision and automated systems* — *IEEE sensors 2021*

2020 **[C2],** Hayosh D, Liu, X & Lee, K. "Woody: Low-Cost Open-source Humanoid Torso Robot" *IEEE 17th International Conference on Ubiquitous Robots (UR)* — *UR 2020*

2020 **[C1],** Liu, X & Lee, K. "Optimized Facial Emotion Recognition Technique for Assessing User Experience" *IEEE Games Entertainment and Medias Conference (GEM)* — *GEM 2020*

Skills

- **Programming**: Python, C/C++, Java; **Tools & Library**: PyTorch, TensorFlow, OpenCV, ROS, Matlab, MuJoCo, Unity, Docker, Git, Kubernetes;

References

Heni Ben Amor *Tempe, Arizona*

Associate Professor, Ph.D. Advisor *Arizona State University*

- School of Computing and Augmented Intelligence, Interactive Robotics Lab Tel: 480.965.2253, Email: hbenamor@asu.edu

Kiju Lee *College Station, Texas*

Associate Professor, M.S. Advisor *Texas A&M University*

- Engineering Technology and Industrial Distribution and Mechanical Engineering Tel: 979.458.6479, Email: kiju.lee@tamu.edu

Wenlong Zhang *Mesa, Arizona*

Associate Professor, Ph.D. Committee member *Arizona State University*

- School of Manufacturing Systems and Networks at the Ira A. Fulton Schools of Engineering Email: Wenlong.Zhang@asu.edu

Aykut Dengi *Tempe, Arizona*

CEO, Industry advisor *RadiusAI*

- Co-founder, Co-CEO, and Board Member, RadiusAI Tel: 480.540.1349, Email: aykut.dengi@radius.ai