RI-ZHAO (ROGER) QIU

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EDUCATION

University of Illinois at Urbana-Champaign *August 2021 – May 2023 (Expected)*
M.S. in Computer Science
Advisors: Prof. Kris Hauser and Prof. Yuxiong Wang
Graduate Research Assistantship: May 2021 to Now

University of Illinois at Urbana-Champaign *August 2017 – May 2021*
B.S. in Statistics and Computer Science with highest distinction (GPA 3.94/4.00)
B.S. in Mathematics, Applied Mathematics Concentration with highest distinction
Thesis: An Efficient GPU-based Volumetric Semantic Reconstruction System for Mobile Robots
Selected Honors: Edmund J. James Scholar (2018 – 2021); Dean's List (2017 – 2021)

RESEARCH INTERESTS

My research interests lie in the intersection of robotics and computer vision, where I develop **robotics perception** algorithms that **continually learn in an open world** and are **downstream-aware** (i.e., efficient and planner-friendly for mobile robots) to solve fundamental challenges in creating embodied robot agents.

Topics: 2D/3D Segmentation, Scene Understanding, Continual Learning, Low-shot Learning

RESEARCH MANUSCRIPTS

Qiu, R., Chen, P., Sun, W., Wang, Y., Hauser, K.: GAPS: Few-Shot Incremental Semantic Segmentation via Guided Copy-Paste Synthesis. Under Review for International Conference on Learning Representations (ICLR). 2023.

Qiu, R.*, Sun, Y.*, Marques, J. M. C., Hauser, K.: Real-time Semantic 3D Reconstruction for High-Touch Surface Recognition for Robotic Disinfection. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). 2022.

SERVICES

Reviewer for International Conference on Learning Representations (ICLR) 2023
Student volunteer for Robotics: Science and Systems (RSS) 2022

SELECTED EXPERIENCE

Intelligent Motion Lab and Yuxiong's Lab (Champaign, IL) 2021 – Now
Graduate Research Assistant *Advisors: Prof. Kris Hauser & Prof. Yuxiong Wang*

- Focus on designing perception algorithms for open-world robotics, where robots can learn continually with few supervision or self-supervision in the test-time deployment environment
- Research led to a paper under review for ICLR, where we design a guided data synthesis process to cope with the long-tailed distribution of base classes and novel classes (see ELESA below)
- Designed an interactive continual learning system for tele-operating robots, CLSys (see below), where we consider practical constraints such as training budget and streaming samples. The project is being prepared for submission.
- Helped mentor undergraduate students on research projects

Illinois Intelligent Motion Lab (Champaign, IL) Summer 2020
Undergraduate Researcher (Summer REU) *Advisor: Prof. Kris Hauser*

- To help fight the COVID-19 pandemic, we developed perception algorithms for autonomous disinfection robots, which allow robots to clean like human cleaners by prioritizing disinfecting high-touch surfaces (e.g., door knobs)
- By incorporating semantic awareness, our combined perception-planning system achieves up to 20% more disinfection coverage than the previous state-of-the-art disinfection trajectory planners under the same time budget
- To meet the real-time constraint for mobile robots, we implemented an efficient 3D reconstruction system based on TSDF voxel hashing from scratch. Our system runs real-time (30fps) on Nvidia Jetson TX2 platforms

- Work was accepted to IROS2022 and extended to a general semantic reconstruction library, SRecon (see below)

Megvii Research Nanjing (Nanjing, China) Summer 2019
Computer Vision Engineering Intern *Leader: Prof. Xiu-Shen Wei*

- Constructed AutoML pipeline with one-shot neural architecture search method to find optimized network architectures for use on edge-computing platforms such as Nvidia Jetson TX2
- Implemented an efficient population-based Auto-Augmentation algorithm for object detection. Our algorithm costs only 1/100 GPU hours to achieve a similar performance gain compared to previous RL-based methods

Illini RoboMaster Club (Champaign, IL) Fall 2017 – Spring 2019
Autonomous Team Lead *Club Advisor: Prof. Mark Hasegawa-Johnson*

- Co-founded the club and led 50 students to build robots to participate in the DJI RoboMaster competition
- Won the 2nd prize among tens of international teams in the 2018 competition and a **$3,000 grant** from DJI (2 out over 100 teams) in recognition of our well-designed open-source perception-control stack

SELECTED PROJECTS

CLSys: Continual Learning System for Tele-operating Robots

- Designed and implemented a practical continual segmentation system for tele-operating robotics, which continually learns to segment objects in an open-set manner with minimal user supervision
- Proposed a semi-supervised method to exploit spatial-temporal locality and generate diverse training data, which contributes over 30% relative improvement in segmentation IoU of novel categories
- Investigate the effect of streaming and non-deterministic order of data arrival to catastrophic forgetting, which are overlooked in literatures. Working on training schedulers and data samplers to resolve these issues.

ELESA: An Extendible Continual Few-shot Segmentation Framework

- Designed and implemented a deep learning framework for data-efficient online segmentation learning
- Proposed a guided training data synthesis process for few-shot continual segmentation, which leads to over 60% relative improvement than previous state-of-the-art continual segmentation method
- Our framework scales to various online learning settings and supports serialization into an online learning tool
- Apply Sacred and YAML for reproducibility; FLASK is used to build a user-friendly front-end for the tool

SRecon: Real-time Semantic Reconstruction via GPU-Based Voxel Hashing

- Developed SRecon, an open-source real-time multi-class semantic TSDF reconstruction system for mobile robots
- Implemented CUDA kernels for real-time graphics ray casting and semantic TSDF voxel updates
- Studied common semantic integration methods (e.g., Bayesian update) to balance accuracy and memory usage
- Integrated OpenVSLAM for localization and Klampt for robot trajectory planning

Autonomy System for Illini RoboMaster Robots

- Design a perception module with OpenCV and PyTorch to allow autonomous interaction with other robots
- Apply filtering for trajectory prediction to compensate system latency and mispredictions
- Collaborated closely with the mechanical and embedded system teams to refine results on a system level

SKILLS

Programming Languages · C/C++ · Python · LaTeX · CUDA · R · RISC-V assembly

Tools · ROS · Simulink · Blender · PyTorch · MXNet · OpenGL · OpenCV · Taichi

Other Interests · Photography

OTHER ACTIVITIES

Grader, CS498 (Intelligent Robotics), Spring 2021
Course Assistant, CS233 (Computer Architecture), Spring 2019 – Spring 2020
Intern, College of LAS International Program, Spring 2018 – Fall 2020
Autonomous Team Member, IRIS (Illinois Robotics in Space) Club, Fall 2017 – Fall 2018
IGL Scholar, Illinois Geometry Lab, Spring 2018