Ruihan Xu (Multy)

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EDUCATION

University of Michigan – Ann Arbor   **Ann Arbor, Michigan**
Bachelor of Science in Computer Science Honor Degree   *Aug 2022 - Dec 2024*
- **GPA**: 4.0/4.0
- **Honors/Award**: University Honor (Dean list) for 3 semesters
- **Course Highlights:**
  - Graduate level: Self-Driving Vehicle, Mobile Robotics, Continuous Optimization Methods, Human-Robot Interaction
  - Undergraduate level: Machine Learning, Computer Vision, Autonomous Robot, Natural Language Processing
- Research Assistance – Laboratory for PROGRESS (L4P) led by Professor Chad Jenkins

RESEARCH EXPERIENCE & PUBLICATION

Zero-Splat: Zero-Shot Gaussian Splatting for Single View 3D Object Reconstruction   **11/2023 – Current**
- Designed and tuned Encoder-Decoder style neural network architecture that take image as input and estimate Gaussian parameters to reconstruction Gaussian Splatting for 3D object, current model achieves categorical object reconstruction.
- Adopted method from Normalized Object Coordinate Space (NOCS) to preprocess the data to better suit on-robot camera applications.
- Proposed a change to network architecture recently to use generative and diffusion method for 3D Gaussian Splatting based on Point-E by Open AI.
- Conducted literature review in Gaussian splatting, generative model, 3D reconstruction to finalize the research topic with Ph.D. student.
- Led the project with the help from Ph.D. student and present during weekly lab meeting to the professor and lab members.

Stein Variational Belief Propagation for Multi-Robot Coordination [arXiv][video][Website]   **07/2023 – 01/2024**
- Facilitated the creation of a message passing method (MBot Bridge) between robots (MBot) using WebSocket allowing the robot to sequentially update their message/belief for other robots.
- Devised an MPC-style velocity controller for the robot to follow the trajectory published in MBot Bridge to realize Stein Variational Belief Propagation (SVBP) developed in simulation.
- Conducted real-world experiment with 3 MBots in 4 different designed environments with obstacles to test SVBP algorithm and record 30 experiment videos for performance analysis.
- Paper accepted to RAL (Robot Autonomous Letter) as the third author.

SURE (Summer Undergraduate Research Experience) – MBot Development   **05/2023 – 08/2023**
- Developed a new image recognition function using OpenCV with an improved computer vision algorithm to extract shapes from sticky notes, being used for a project for an undergraduate robotics course.
- Fixed message-passing issue in LCM to let SLAM and autonomous navigation algorithm adapt to the new robot firmware.
- Created testing script in C for new robot firmware to calibrate odometry, lidar reading, and PID control.

U of R Summer Research Project – Multispectral Imaging Processing on Culture Heritage   **05/2022 – 08/2022**
- Mastered the math of SVD (Singular Value Decomposition), PCA (Principal Component Analysis), and linear regression with a focus and application on training image recognition and reconstruction using MATLAB.
- Designed an algorithm to sample images under light with multiple spectrums and reconstruct the material reflectance spectrum to reveal the hidden detail that cannot be seen by the human eye by applying SVD, and PCA.

WORK EXPERIENCE

University of Michigan Robotics Department   **Michigan, US**
Instruction Aide   08/2023 – 12/2023
- Creating and modifying course projects, particularly the MBot project for autonomous navigation with computer vision algorithms.
- Facilitate Lab session each week by teaching project specific programming skills and providing help to students with difficulties

STEM PROJECTS

UMDrive: Towards Robust and Safe SLAM on Real-World Scenarios – UM ROB 530   **03/2024 – 05/2024**
- Created real-world outdoor video dataset with various weather condition, camera poses reconstructed by SFM (structure from motion) using Colmap
- Evaluate several state-of-the-art visual SLAM models for in-door 3D reconstruction on outdoor dataset augmented with noise.

Monocular Camera 3D Object Detection for Autonomous Vehicle – UM ROB 535   **10/2023 – 12/2023**
- Finetuned the 3D detection model based on MonoCon and adopted data augmentation for images presented in foggy environment.
- Produced 4 pages of CVPR paper format report with detail comparison and analysis with other similar detection model.

Human-Object Interaction (HOI) Detection – UM EECS 442   **10/2023 – 12/2023**
- Led team of 4 to create a neural network that detect possible interaction between human and object in an image.
- Devised the PyTorch dataloader for the VCOCO data set for training.
- Implemented and fine-tuned the neural network pipeline using YOLOv8 with additional convolutional layers, and Multi-layer Perceptron (MLP).

A Review for Human-Robot Handover – UM ROB 599   **08/2023 – 12/2023**
- Produced 8 pages IEEE conference paper format review paper by reviewing more than 40 papers on Human-Robot Handover problem.
- Devised a toy example using neural network to detect human handover action.
- Idea been adopted as a formal research project by the professor.

Islandr – Web Design for Students Organizations   **08/2019 – 06/2020**
- Programmed email system and daily bulletin webpage using html, css, MySQL, Flask, and Python.
- Launched the website in school by presenting the prototype to everyone in the school in the assembly hall.

Blue Turtle – Computer Vision Based Depression Monitoring and Prevention– Summer Hackathon   **07/2019 – 08/2019**
- Led team of three and created a machine learning algorithm for detecting potential depression through people's facial expressions using Python TensorFlow library, and Microsoft Azures.
- Designed an autonomous robot with Lidar that goes around campus using ROS.
- Awarded as the 8 best projects in the competition for the degree of technical completion and social value.

LEADERSHIP

Blue Record E-board   **08/2023 – Current**
- Led team of 20 to form bands to perform at major university shows, and organized practice sessions, workshop, recording sessions.
- Organized large event "Blue Record Music Festival" with 250 attendances and over 50 performers.

First Robotics Competition   **12/2017 – 08/2021**
- As Co-founder, vice president, programming lead (Team 6394 & 7280), train new members.
- Programmed computer vision for object detection for robot automation in grabbing, ball shooting, motion planning using raspberry Pi, Java, Python and OpenCV.

TECHNICAL SKILLS

- Programming language: Python, C++/C, MATLAB, Java.
- Machine Learning: PyTorch, TensorFlow, OpenCV
- Robot Control: MPC, vehicle dynamics, trajectory optimization with CasADI in Python
- Robotics system and simulation: ROS, Gazebo, Moveit!
- Web development: PHP, MYSQL, Script, Python, HTML, CSS