ROBERT REN

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EDUCATION

University of Toronto Toronto, ON
Bachelor of Applied Science Sep 2020 – Present

- Major: Robotics Engineering Major and Artificial Intelligence Minor
- Selected awards: University of Toronto Excellence Award ($7,500 Research Grant), Dean's List (2020 Fall, 2021 Spring, 2023 Spring)

PUBLICATIONS

1. **SWTrack: Multiple Hypothesis Sliding Window 3D Multi-Object Tracking**
   Sandro Papais, **Robert Ren**, Steven Waslander
   ICRA, 2024.

2. **AvatarOne: Monocular 3D Human Animation**
   Akash Karthikeyan, **Robert Ren**, Yash Kant, Igor Gilitschenski
   WACV, 2024.

THESIS

Uncertainty-aware Joint Pose and Shape Optimization via Diffusion Models
Supervisor: Steven Waslander
In Progress.

RESEARCH EXPERIENCE

University of Toronto (Toronto Robotics + AI Lab) Toronto, ON
Supervisor: Professor Steven Waslander Aug 2023 – Present
Research Topic: 3D Multi-object Detection and Tracking

- Studied methods of improving object tracking robustness under occlusions.
- Conducted experiments on CenterPoint-based object detection and tracking pipelines.
- Implemented comprehensive data visualizations for the Waymo autonomous driving dataset.
- Published second-author paper "SWTrack: Multiple Hypothesis Sliding Window 3D Multi-Object Tracking".

University of Toronto (Toronto Intelligent Systems Lab) Toronto, ON
Supervisor: Professor Igor Gilitschenski Jan 2023 – June 2024
Research Topic: 3D Reconstruction, Inversion in Diffusion, Customized Diffusion Models

- Conducted research on accurate concept inversion and improved customization of subjects and styles for Stable Diffusion-based image generation models.
- Implemented new network modules and data loaders to improve the performance and efficiency of 3D human reconstruction models.
- Quantitatively and qualitatively enhanced previous state-of-the-art 3D human reconstruction methods.
- Published second-author paper "AvatarOne: Monocular 3D Human Animation".

University of Toronto (FORCOLAB) Toronto, ON
Advisor: Professor Shurui Zhou May 2022 – Sep 2022
Research Topic: Early Detection of Open-Source Software (OSS) Vulnerability

- Researched the disclosure patterns of OSS vulnerabilities on official vulnerability websites and social media, along with heuristics for predicting undisclosed software vulnerabilities.
- Designed and implemented a large-scale database with 10,000+ Twitter discussions on Common Vulnerabilities and Exposures (CVE).

EXTRACURRICULAR EXPERIENCE

aUToronto - University of Toronto's Autonomous Driving Team Toronto, ON
3D Object Detection Team Lead June 2024 – Present

- Construct LiDAR map for online scan matching to improve localization under GPS attenuation.

- Implemented LiDAR-Radar fusion to reduce false positive detections from classical point cloud clustering.
- Led the data labelling, 3D object detection neural network training and deployment on autonomous vehicle.

aUToronto - University of Toronto's Autonomous Driving Team Toronto, ON
Radar Object Detection Team Lead Sep 2023 – June 2024

- Implemented UDP-based radar driver to extract raw RDI and processed radar detections from the sensor.
- Reduced false positive 3D object detections by performing radar-lidar association and ellipsoidal fusion.
- Integrated radar detection into current object tracking pipeline to reduce ID switching.
- Employed Kalman-filter based radar + camera tracking method to account for the failure of LiDAR sensor.

aUToronto - University of Toronto's Autonomous Driving Team Toronto, ON
3D Object Detection Team Member Sep 2022 – May 2023

- Produced precise detection and classification for different objects in real-time autonomous driving scenarios.
- Designed and developed LiDAR-based object detection algorithms in Python. (CenterPoint, PointPillars, etc)
- Fine-tuned parameters for 3D point cloud clustering and background removal.

UTMIST – University of Toronto Machine Intelligence Student Team Toronto, ON
Project Developer – Smile Detector Sep 2021 – Apr 2022

- Developed a computer vision-based solution to rate pictures of smiles by analyzing vectors obtained from facial keypoint detector.
- Created graphical user interface(GUI) for real-time visualization of smile ratings

SELECTED AWARDS AND HONORS

- 2nd place in Daisy Intelligence Hackathon 2022
- 3rd place in Tsinghua University & UNDP AI Contest 2021

ADDITIONAL INFORMATION

Projects

- **SpatialPoker:** Monocular 6DoF Poker Card Detection and Tracking using Apple Vision Pro
- **ContactNet:** Multi-Target Multi-Camera Tracking System
- **AI • Care:** Real-time Fall and Fight Detection
- **Delivery Bot:** Automatic Robotic Package Delivery based on Kalman Filter and Bayesian Localization

Programming

- **Languages**: Python, C/C++, MATLAB
- **Tools**: PyTorch, TensorFlow, ROS2, Numpy, OpenCV