

Ran Cheng

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An Intelligent Robotics Researcher

EDUCATION

McGill University, Computer Science

Master of Science in Computer Science

Montreal, Canada

May 2020

Relevant Coursework: Intelligent Robotics, Reinforcement Learning, Applied Machine Learning, Computer Vision

Coursera

Certifications

Online

Aug 2015 - Aug 2017

Completed Courses: Neural Network for Machine Learning (UToronto), Robotics: Specialization (UPenn), Machine Learning (Stanford)

Tongji University, School of Software Engineering

Bachelor of Engineer, Software Engineering; GPA: 3.89/4.0

Shanghai, China

Aug 2011 - Aug 2015

Honors and Awards: Outstanding Diploma thesis, National Aspiration Fellowship, Second Class Prize Fellowship, Social Activism Award, IBM Outstanding Contribution Award, Microsoft Imagine Cup, FTC (First Tech Challenge, a Robot Competition Conference) Technician

EXPERIENCE

Midea

Senior Staff Research Engineer (Team Lead), Supervisor: **Tao Sun**

Shanghai, China

April 2021 - Now

- **Neural Recon-Render:** Use sparse convolution to reconstruct 3D scene given a sequence of RGBD data and use Neural Radical Field to refine and render the high quality 3D scene.
- **Graph based life-long global loop closing for visual SLAM:** Apply Visual Transformer and Sparse Convolution to embed the scene and replace Bag-of-Word fashion of re-localization in global loop closing.
- **Very large-scale real-time indoor 3D object detection Dataset:** Label very large-scale sequential indoor 3D object dataset with RGBD data. Dataset will be open to the research community.

Inceptio

Senior Software Engineer, Supervisor: **Ruigang Yang**

Shanghai, China

Feb 2021 - April 2021

- **3D Object Detection:** Improved LiDAR based 3D object detection method [CenterPoint](#) by introducing hough voting layer for center regression.
- **Lidar-based Freespace Detection:** Convert the segmentation task of freespace detection into center point prediction to use the shared encoder of object detection, the two methods run in real-time.

Huawei Noah's Ark Research Lab

Research Engineer, Supervisor: **Bingbing Liu**

Markham, Canada

Jul 2019 - Feb 2021

- **Pointcloud Semantic Segmentation:** Our Sparse Semantic Segmentation Network now ranked **1st** on both [Semantic-KITTI benchmark](#) (single scan challenge, named as **AF2S3Net**, note that 5th **Kyber_HW** is also our work) and [NuScenes lidarseg benchmark](#).
- **Semantic 3D Scene Completion:** Proposed a [Minkowski-Engine](#) based Sparse Convolution Network to complete the 3D space from LiDAR point cloud, our method **S3CNet** (named as **Noah_Canada**) is currently **state-of-the-art** in [Semantic-KITTI benchmark](#).
- **Topological Graph Map:** Developed a whole pipeline to build 3D topological graph map, including curvature based intersection detector and road segmentation.
- **Real-time Curb Detection:** Proposed a real-time curb detection method to detect the sidewalk curb for autonomous driving car.

Mobile Robotics Lab, McGill University

Research Assistant, Supervisor: **Gregory Dudek, David Meger**

Montreal, Canada

Sep 2017 - Aug 2020

- **Deep Sparse Bundle adjustment:** Using depth estimator ([MonoDepth2](#)), as inverse depth prior for schur complement to optimize the pose without solve the pseudo-inverse of Hessian matrix. We applied [LBFGS](#) as optimizer backend.
- **NavGuideNet:** A **synthesized hierarchical neural network** for autonomous navigation in complex environment and variant landscapes (tested in field/underwater environments). Backbone **encoder** is **Resnet18**, **latent code** was concatenated with control signals and **decoder** is **de-convolution network** (transposed convolution).
- **Deep RL For Visual Navigation (Sim2Real):** introduce **latent space** in **CAD2RL** as attention layer to help policy converge faster, evaluated on multiple policy gradient based backends (**DDPG, A3C**) in continuous action space, simulated in **Microsoft AirSim**.

iLab Tongji/University of South California

Research Assistant, Supervisor: **Jianwei Lu, Laurent Itti**

Shanghai, China, Los Angeles, USA

Apr 2015 - Jul 2017

- **SLAM Fusion:** Vision (monocular) LiDar fusion with direct method (jointly optimize optical flow with Sparse Bundle Adjustment on ORB features) extra constraint from LiDar helps eliminating depth from null space.
- **Visual SLAM with Saliency:** joint optimizing the graph (G2O) with salient voting as extra binary edges.

UCLA

Research Assistant, Supervisor: **Yi Xing**

Los Angeles, USA

Jul 2015 - Jan 2016

- **Code Parallelization:** optimized their RNA analysis tool, [stable release ([rMATS 3.0.9](#))], binding the large matrix calculations with C11 (SSE/AVX vectorization, Intel) and CUDA

PROJECTS

- **Sparse AutoDiff Library:** Contribute to [MinkowskiEngine](#) with [StanfordVL lab](#). Developed and tested part of visualization (using [Open3D](#)), sparse tensor operator and semantic segmentation demo baselines.
- **Visual SLAM:** Comprehensively **re-implemented DSO** and annotated with exhaustive explains. ([github](#))
- **Deep Monocular Dense 3D Reconstruction:** Dense 3D reconstruction with **monodepth2** initialized Visual Odometry, leveraging traditional photometric consistency, occlusion discrepancy, and local geometrical-smooth assumptions to **optimize depth estimation** (LM method) and **register 3D map point clouds**.
- **Abstraction Augmented Deep RL:** Abstract rgb image with Unet shaped network to digest image in latent representation, and learn from latent inputs, average convergence time increased 27.3%, maximum reward (10M iterations) is 1.21 times than baseline model without abstraction augmentation, experiments conducted under self-collected dataset from AirSim simulator ([github](#))

PUBLICATIONS AND PATENTS

- **[US patent] GP-S3Net:** Graph based Panoptic Sparse Semantic Segmentation Network, **R. Cheng**, R. Razani, T. Enxu, E. Taghavi, B. Liu, **ICCV 2021** accepted
- **[US patent] (AF)²-S3Net:** Attentive Feature Fusion with Adaptive Feature Selection for Sparse Semantic Segmentation Network on Point Cloud, **R. Cheng**, R. Razani, E. Taghavi, B. Liu, **CVPR 2021** [arxiv](#)
- **[US patent]** Semantic-aided LiDAR-based Localization for Autonomous Vehicles, Yuan Ren, **R. Cheng**, C. Agia, B. Liu, **IEEE T-IV 2020** [journal accepted](#)
- **[US patent]** S3Net: A Sparse Semantic Segmentation Network for LiDAR Point Clouds, **R. Cheng**, R. Razani, B. Liu, **submitted to ICRA 2021** [paper](#)
- **[US patent]** Lite-HDseg: LiDAR Semantic Segmentation Using Lite Harmonic Dense Convolutions, **R. Cheng**, R. Razani, E. Taghavi, B. Liu, **submitted to ICRA 2021** [under review](#)
- Abstraction Augmentation for Deep Reinforcement Learning, **R. Cheng**, F. Shkurti, D. Meger, G. Dudek, **IROS 2021** [accepted](#)
- **[US patent]** S3CNet: A Sparse Semantic Scene Completion Network for LiDAR Point Clouds, **R. Cheng**, C. Agia, Y. Ren, X. Li, B. Liu, **CoRL 2020** [preprint](#)
- Depth prediction for Direct Visual Odometry, **R. Cheng**, C. Agia, D. Meger, G. Dudek, **CRV 2020** [paper](#)
- Navigation in the Service of Enhanced Pose Estimation, Travis Manderson, **Ran Cheng**, David Meger and Gregory Dudek, **ISER 2018**, [paper](#)
- Vision-Based Autonomous Underwater Swimming in Dense Coral for Combined Collision Avoidance and Target Selection, T. Manderson, J. Higuera, **R. Cheng**, D. Meger, G. Dudek, **IROS 2018**, [paper](#)
- **[US patent]** Integrated LiDAR Perception, Localization, Mapping Solution base on Semantic Segmentation, B. Liu, **R. Cheng**, Yuan Ren **patent submitted 2020**
- **[US patent]** Topological Graph HD Map, **R. Cheng**, Yuan Ren, B. Liu **patent submitted 2020**