Shaoshu Su

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Education

Doctor of Philosophy in Computer Science 2023.09 - 2028.06
State University of New York at Buffalo;
Research Topic: Machine Learning-based SLAM (Simultaneous Localization and Mapping), Visual Odometry (VO), Point Cloud Registration

Master of Science in Electrical Engineering 2019.09 - 2022.03
University of California, Riverside; GPA: 3.94/4.0
Selected courses: Advanced Linear Algebra, Advanced Probability Theory, Advanced Computer Vision, State and Parameter Estimation, Introduction to Deep Learning, Introduction to Robotics, Linear System Theory, Nonlinear Systems and Control

Bachelor of Science in Aerospace Engineering 2015.09 - 2019.06
Beijing Institute of Technology, Beijing, China; GPA: 3.7/4.0 (87/100) Ranking: Top 15% in 4 years; Top 3% in junior and senior year
Selected courses: Linear Algebra, Probability Theory, C Language Programming, Principle of Automatic Control, Theoretical Mechanics, Microcomputer Principle and Application, Guidance and Control of Aircraft, Principle of Optimizing Design, Aerial Robotics Design

Publications

- T. Fu, **S. Su**, C. Wang, "iSLAM: Imperative SLAM," Submitted to Conference on Robot Learning (**CoRL**), 2023
- **S. Su**, C. Hao, C. Weaver, C. Tang, W. Zhan and M. Tomizuka, "Double-Iterative Gaussian Process Regression for Modeling Error Compensation in Autonomous Racing," **Accepted** by International Federation of Automatic Control (**IFAC**), 2023
- **S. Su**, P. Zhu and W. Ren, "Multi-Robot Fully Distributed Active Joint Localization and Target Tracking," **Published** at IEEE Transactions on Control Systems Technology (**TCST**), 2023
- **S. Su**, and W. Ren, "Deep Reinforcement Learning Based Distributed Active Joint Localization and Target Tracking," Submitted to International Conference on Robotics and Automation (**ICRA**)
- **S. Su**, P. Zhu and W. Ren, "An Optimization Approach to Fully Distributed Active Joint Localization and Target Tracking in Multi-Robot Systems," **Published** at 2022 American Control Conference (**ACC**), 2022

Research Experience

iSLAM: Imperative SLAM 2023.03-2023.06
Submitted to Conference on Robot Learning (CoRL), 2023
Advisor:Chen Wang
Lab: Spatial AI and Robotics Lab, Department of Computer Science and Engineering, State University of New York at Buffalo

- We developed iSLAM, an innovative visual-inertial SLAM system incorporating imperative learning for enhanced accuracy. Imperative learning is a bi-level optimization problem, facilitating mutual learning and contribution between the system's front-end and back-end.
- We proposed a learning-based SLAM system comprising stereo VO, IMU pre-integrator, and PVGO module to demonstrate the effectiveness of the proposed imperative learning framework.
- Demonstrated the accuracy of iSLAM on KITTI and EuRoC datasets. Achieved remarkable performance improvements, up to 45%, on the VO network through self-supervised imperative learning.

Double-Iterative Gaussian Process Regression for Modeling Error Compensation in Autonomous Racing 2022.04-2022.11
Accepted by International Federation of Automatic Control (IFAC), 2023
Advisor: Masayoshi Tomizuka
Lab: Mechanical Systems Control Lab, Mechanical Engineering Department, University of California, Berkeley

- Proposed a double-GPR error compensation algorithm to compensate both the planner's model and controller's model with two respective GPR-based error compensation functions, therefore reduce model uncertainties in autonomous racing.
- Designed an iterative framework to re-collect error-rich data using the racing control system.
- Tested our method in the high-fidelity racing simulator Gran Turismo Sport (GTS). Result shows our iterative, double-GPR compensation functions improve racing performance and iteration stability in comparison to a single compensation function applied merely for real-time control.

Deep Reinforcement Learning Based Distributed Active Joint Localization and Target Tracking 2021.03-2021.09
Submitted to IEEE Robotics and Automation Society (ICRA)
Advisor: Wei Ren
Lab: Cooperative Vehicle Networks Lab, Department of Electrical and Computer Engineering, University of California, Riverside

- Proposed a Deep Reinforcement Learning-based distributed algorithm to solve the problem of multi-robot active joint localization and target tracking (AJLATT), where a team of robots mounted with sensors of limited field of view actively estimate their own and the target's states cooperatively.
- Reformulated the AJLATT problem as a Partially Observable Markov Decision Process (POMDP), which can be solved by the RL-based method.
- Modified existing reinforcement learning algorithm to accommodate the distributed multi-agent AJLATT problem, which shows a better performance compared with our previous proposed model-based algorithm and can work in more complex environments.

Multi-Robot Fully Distributed Active Joint Localization and Target Tracking 2020.06-2022.03
Published at IEEE American Control Conference (ACC)
Published at IEEE Transactions on Control Systems Technology (TCST)
Advisor: Wei Ren
Lab: Cooperative Vehicle Networks Lab, Department of Electrical and Computer Engineering, University of California, Riverside

- Studied the problem of multi-robot active joint localization and target tracking (AJLATT). Each robot designs its motion strategy to gain better self-localization and target tracking estimation performance while avoiding collisions by using only the information from itself and its one-hop communicating neighbors.
- Proposed two fully distributed algorithms that help each robot design motion strategies to achieve better localization and target tracking performance.
- Implemented Monte Carlo simulations to demonstrate our algorithms' feasibility to solve the AJLATT problem in the fully distributed manner.

Projects

PyPose: A Library for Robot Learning with Physics-based Optimization 2023.06
Instructor: Chen Wang

- Participating in the development of the dataloader and trajectory estimation evaluation module for multiple datasets including TartanAir, KITTI and EuRoC.

Language Modeling with LSTM 2020.05
Instructor: Samet Oymak

- Completed a language modeling task to predict the next word in the sentence using the PTB dataset using the Vanilla LSTM algorithm.
- Implemented two dropout methods to LSTM, achieving a better performance than the Vanilla LSTM over PTB dataset.

RGB-D Camera Based Target Detection and Active Tracking 2020.05-2020.06
Instructor: Samet Oymak

- Designed a perception-tracking framework to detect moving a target with unknown future motion and then follow that target with a TurtleBot robot.
- Trained and applied the YOLOv3 object detection network to detect a moving target in real-time with an RGB camera in ROS Gazebo Simulation Environment.
- Obtained the distance and bearing measurements between the robot and the target based on the location information provided by the YOLOv3 algorithm as well as depth information from the depth camera.
- Implemented Extended Kalman filter (EKF) to estimate the target's state based on the measurement from the RGB-D Camera.
- Designed a target tracking algorithm to drive the robot to track and follow a moving target with unknown behavior.

Robot Trajectory Planning for a Ball-Kicking Game with Real-World TurtleBot 2019.12
Instructor: Konstantinos Karydis

- Implemented A* algorithm to achieve path planning in a complex environment with obstacles.
- Applied polynomial trajectory to smooth the path and apply the PID controller to drive the robot to track the desired trajectory.
- Validated the feasibility of our algorithm with the real-world TurtleBot robot in the Ball-Kicking Game which requires both high-speed movements as well as accurate trajectory tracking performance.

Work Experience

Research Scientist 2022.11 - Now
Department of Computer Science and Engineering, State University of New York at Buffalo
Topic: Learning-based SLAM Systems, Point Clouds Registration

Visiting Scholar 2022.03 - 2022.11
Department of Mechanical Engineering, University of California, Berkeley
Topic: Double-Iterative Gaussian Process Regression for Modeling Error Compensation in Autonomous Racing

Research Assistant 2021.06 - 2022.03
Department of Electrical and Computer Engineering, University of California, Riverside
Topic: Multi-Robot Fully Distributed Active Joint Localization and Target Tracking

Service

Reviewer

- Conference on Computer Vision and Pattern Recognition, CVPR, 2023
- International Journal of Robotics Research, IJRR, 2023
- IEEE Robotics and Automation Letters, RA-L, 2023
- IEEE Transactions on Industrial Informatics, TII, 2023

Skills

Programming: C/C ++, Python, MATLAB, Assembly Language.

Software & Platforms: PyTorch, TensorFlow, ROS

Algorithms:
Path Planning: Dijkstra, A*, LPA*, D* Lite
Reinforcement Learning: DDPG, TD3, SAC, MADDPG
Other Learning Methods: GPR, LSTM, Yolov3, Resnet

Mechanical Design: AutoCAD, 3D Modeling Design software (Soildworks, Inventor, CATIA), CAE software (ANSYS, Abaqus, Fluent), MSC Adams, 3DMax

Language: Chinese, English, German (DSH-2 Certificate)

Honors and Awards

- First-Class Scholarship for the top 3% students, Thrice, Beijing Institute of Technology 2017.09,2018.03,2019.03
- Second-Class Scholarship for the top 15% students , Beijing Institute of Technology, 2018.09