Shuxiang XIE

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SUMMARY

Research Interests: I am interested 3D reconstruction topics, with a strong focus on theoretical exploration and understanding of emerging 3D neural modeling techniques and development in optimization problem.

Research Experience: My background spans both classical Robotics areas, including SLAM and sensor fusion, as well as cutting-edge topics like implicit neural representations and flow matching. My recent work aims to bridge the gap between traditional topics and some rapidly evolving approaches, with the goal of developing efficient, concise, and theoretically sound 3D reconstruction methods.

EDUCATION

The University of Tokyo Oct 2020 - Apr 2026

Ph.D. Candidate under the supervision of Professor Takeshi Oishi Tokyo, Japan

Master's degree in Sep 2022, with a thesis titled "*Fast Structural Representation and Structure-aware Loop Closing for Visual SLAM*."

Shanghai Jiao Tong University Sep 2016 - Aug 2020

Bachelor of Science in Electrical and Computer Engineering (ECE) at University of Michigan, Shanghai Jiao Tong University Joint Institute (UM-SJTU JI) Shanghai, China

WORK EXPERIENCE

The National Institute of Advanced Industrial Science and Technology (AIST) Mar 2021 - Oct 2025

Reserach Assistant at Artificial Intelligence Research Center Tokyo, Japan

- Conducted research on Implicit Neural Representation, emphasizing its mathematical foundations and practical applications
- Researched large-scale 3D modeling and reconstruction using various sensor inputs and sensor fusion techniques
- Participated in the development of the latest generation of simultaneous localization and mapping (SLAM) system

PUBLICATION LIST

Pose Graph Topological Integrity for Map Validation in SLAM (submitted to RA-L, under review)

- Derive the heat diffusion (relative consensus) nature of error propagation in PGO
- Propose a pose graph topological metric PGTI to quantify the inconsistency between pose graph and explored space

G2fR: Frequency Regularization in Grid-based Feature Encoding NeRF (ECCV 2024)

- Conducted in-depth analysis of mathematical principles underlying grid-based implicit representations, such as Instant-NGP
- Explained the mechanisms of frequency regularization and proposed a generalized method, G2fR, applicable to various tasks

Robust LiDAR-Camera Calibration with 2D Gaussian Splatting (RA-L)

- Provide theoretical analysis on challenges in LiDAR-camera calibration using 2DGS, and propose novel methods to solve them

INF: Implicit Neural Fusion (IROS 2023)

- Applied implicit neural representations with diverse sensor inputs to achieve robust sensor fusion and calibration
- Leveraged the differentiability of implicit neural representations to align density fields generated from various sensors

Implicit Neural Fusion of RGB and Far-Infrared 3D Imagery for Invisible Scenes (IROS 2024)

- An extension of the previous work INF, focused on solving the modeling of invisible objects (eg. gas) using FIR sensors
- Derived and modified the volume rendering equation to account for invisible density distributions in 3D space

Fast Structure Representation and Structural-aware Loop Closing for visual SLAM (IROS 2022)

- Addressed the Perceptual Aliasing problem in the loop closing process of visual SLAM systems
- Developed a structural representation (SH-FS) monitoring the structural integrity and a structural-aware loop closing process

Geometric Posterior Transport for Pose Graph Optimization using Flow Matching (in preparation)

- Propose to learn a flow field that approximates the posterior transport in PGO, enabling denoising of pose graphs by integrating a learned velocity field conditioned on graph structure

AWARDS

MIRU Excellence Award Aug 2024

Recognized for excellence of work presented at MIRU 2024 (2/600+ presented papers) Kumamoto, Japan