QIANXIN QU

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EDUCATION

China University of Mining & Technology, Beijing   **Sep 2019 -Jun 2023**
B.Eng in Computer Science and Technology   Overall GPA:3.5/4.0, Average Score: 85/100(ranking ~20%)
Selected Courses: C/C++ Programming, Data Structures & Algorithms, Artificial Intelligence, Computer Vision

School of Vehicle and Mobility, Tsinghua University   **Sep 2022 - Present**
Joint Training with the State Key Laboratory of Automotive Safety and Energy

RESEARCH INTERESTS

- **3D computer vision**：Registration/Calibration, Perception, SLAM.
- **Autonomous Driving**：Cooperative Perception, V2X, End-to-End Driving
- **Application of MLLMs & VLA**：Scene Understanding, Robot Manipulation.

PUBLICATIONS

[1] **Qu, Q.***, Zhang, X.*,.Xiong, Y.†*, Xia, C., Song, Z., & Li, J. . V2X-Reg++: A Real-time Global Registration Method for Multi-end Sensing System in Urban Intersections. *IEEE Transactions on Intelligent Transportation Systems (T-ITS), 2025.* (Accepted, JCR Q1, IF:8.4)

[2] **Qu Q.***, Xiong Y*., Zhang G., Wu X., Gao X., Gao X., Li H., Guo S., Zhang G.†. (2024) V2I-Calib: A Novel Calibration Approach for Collaborative Vehicle and Infrastructure LiDAR Systems. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024.* (Oral, Top Robotics Conference)

[3] Zhang, X., Xiong, Y.†, **Qu, Q**., Zhu, S., ... & Li, J. . Automated Extrinsic Calibration of Multi-cameras and LiDAR. *IEEE Transactions on Instrumentation and Measurement (T-IM), 2023*. (Published, JCR Q1, IF:5.9, Student First Author)

[4] Xiong, Y., Zhang, X.†, Gao, X., **Qu, Q**., Wang, R., Liu, J., ... & Li, J. . Cooperative Visual-LiDAR Extrinsic Calibration Technology for Intersection Vehicle-Infrastructure: A review. *IEEE Internet of Things Journal (IoT-J), 2025*. (Published, JCR Q1, IF:8.9, Student First Author)

[5] Xiong, Y., Zhang, X.†, Gao, W., Wang, Y., Liu, J., **Qu, Q**., ... & Li, J. . GF-SLAM: A novel hybrid localization method incorporating global and circular arc features. *IEEE Transactions on Automation Science and Enginnering (T-ASE), 2024*.(Published, JCR Q1, IF:6.4)

Under Review:

[6] **Qu, Q.**, Xia C., Song, Z., Zhang, G., Zhou, S.†, Niu Z. . CoSTr: a Fully Sparse Transformer with Mutual Information for Pragmatic Collaborative Perception (Under Review for ICRA 2026)

[7] Song, Z., Xia C., **Qu, Q.**, Yu, H., Zhou, S.†, Niu Z. UniMM-V2X: MoE-Enhanced Multi-Level Fusion for End-to-End Cooperative Autonomous Driving (Under Review for AAAI 2026)

[8] Ying, J., Zhang, X.†, **Qu, Q.**, Li, L., ... & Li, J. . WAMoE3D:Weather-aware Mixture-of-Experts for MLLM-based 3D Scene Understanding in Autonomous Driving. (Under Review for TCSVT, JCR Q1, IF: 8.3)

[9] Zhang, G., **Qu, Q.**, Sun, Y.† . A Survey on Hybrid Parallelism Techniques for Large Model Training. (Accepted by Chinese Journal of Computers*, Flagship journal of the China Computer Federation, CCF-A*）

PATENT

[10] Li, J., **Qu, Q.**, Lin, R., ...& Zeng, W. (Date of Grant: 2025-03-04) "Method and System for Employment Relation Extraction from Business Cards" Chinese Patent CN114220112B. (Granted).

[11] Zhang, X., Xiong, Y., **Qu, Q.**, Wu, X., & Guo, S. (Date of Publication: 2024-12-06). "Method and Apparatus for Extrinsic Calibration between Vehicle-Mounted and Roadside LiDARs"Chinese Patent Application CN119087408A. (Pending).

RESEARCH EXPERIENCE

1. Application of Multi-modal Large Language Models for Autonomous Driving   Feb. 2025 - Present
- Contributor | Tsinghua University | Prof. Xinyu Zhang and Prof. Jun Li
- **Description:**
  • This project explores the potential of MLLM to address the long-tail problem in autonomous driving.
- **Key Responsibilities:**
  • Co-authored *a survey on MLLM-driven scene understanding* in autonomous driving, focusing on *cross-modal feature alignment* challenges and methodologies. *(pending finalization).*
  • Assisted in establishing an MLLM-based scene understanding benchmark for adversarial weather by defining data *annotation specifications*, constructing *pre-annotation pipelines using large models*, and evaluating SOTA models (*e.g., OmniDrive*) on custom datasets.

- Proposed an adaptive fusion framework for the LLaMA architecture, utilizing a *Weather-aware Mixture-of-Experts (WAMoE)* module to dynamically fuse camera, LiDAR, and radar features, coupled with *LoRA-based fine-tuning* to enhance perception and reasoning capabilities in adverse weather. *(Under review at IEEE TCSVT [8]).*
- *Led an exploratory study on 3D Foundation Models (VGGT)* for semantic scene understanding in extrinsic-free settings, investigating their potential for generating language-free semantic representations from fused multi-agent data. *(To be submitted to CVPR 26)*

2. Multi-Agent Cooperative Perception for V2X Environments   May. 2024 - July 2025
- Key Collaborator | Tsinghua University | Prof. Xinyu Zhang and Prof. Jun Li
- Project Description:
- This research aims to enhance multi-agent perception capacity in connected vehicle (V2X) environments.
- Key Responsibilities:
- Participated in the creation of a real-world cooperative perception dataset and benchmark, by leveraging the spatio-temporal alignment framework [11][1][2] for the data acquisition platform and assisting with the subsequent data pipeline including *cleaning, annotation, API design, and benchmark construction.*
- Proposed a communication-efficient cooperative perception network. utilizing *mutual information* for feature compression and *sparse attention* to fuse BEV features from multiple agents. Achieved state-of-the-art (SOTA) performance while reducing communication bandwidth by 10%. *(Under review at ICRA 2026 [6]).*
- Applied *Mixture of Experts (MoE)* architecture to an end-to-end cooperative driving framework. This approach reduced collision rates by 52.0% on the DAIR-V2X benchmark. *(Under review at AAAI 2026 [7]).*

3. Cross-source Sensor Data Registration for V2X Scenarios in Urban Intersections   Oct. 2023 - Nov. 2024
- Project Leader | Tsinghua University | Prof. Xinyu Zhang and Prof. Jun Li
- Description:
- This research focuses on the foundational challenge of spatio-temporal alignment for multi-agent systems in dynamic V2X environments.
- Key Responsibilities:
- Co-authored a survey on sensor calibration in multi-agent V2X systems, published in *IoT-J [4]*. My primary contribution was redefining V2X calibration by linking it to the cooperative perception tasks and authoring the key chapters on this novel concept.
- Proposed a paradigm for V2X calibration that analytically constructs *3D geometric constraints via SVD algorithm* and reformulates the task as a *first-order optimal transport problem,* achieving *state-of-the-art (SOTA)* performance on the DAIR-V2X and V2X-Sim datasets and leading to two *related first-author papers [1] [2].*
- Built the codebase from scratch and restructured it for several times. Collected benchmark methods and designed experiments to validate the approach. https://github.com/MassimoQu/v2i-calib.
- Engineered the spatio-temporal alignment for a multi-sensor data acquisition system (Camera, LiDAR, 4D Radar, GPS/IMU), implementing hardware-trigger-based PPS/PTP time synchronization and a registration solution protected by a *Chinese invention patent [11].*

4. Robust Calibration and Localization for Autonomous Vehicles   Dec. 2022 - Dec. 2023
- Key Contributor | Undergraduate Thesis | Tsinghua University | Prof. Xinyu Zhang and Prof. Jun Li
- Project Description:
- This project focused on two key challenges for vehicle autonomy: 1) correcting sensor extrinsic parameter drift and 2) mitigating localization drift during signal outages.
- Key Responsibilities:
- Improved the image and point cloud *line feature extraction module* using LSD algorithm and depth discontinuities, as well as enhanced the *cross-modal line feature-based extrinsic optimization module using g2o*, achieving state-of-the-art performance on the KITTI dataset. (*T-IM Paper[3]. CODE*)
- Implemented an *adaptive SLAM system with EKF/Particle Filter switching* to correct for drift during signal outages, maintaining positioning error within 3 cm in feature-sparse environments. (*T-ASE Paper [5])*
- Assisted in the real-world validation and deployment of the calibration algorithm with industry partners like Meituan, MOGOX and SAIC Motor, leading to its successful commercial licensing.

SKILLS

Programming: Python, C/C++, LaTeX, Java, Matlab, Shell
Software: ROS/ROS2, Pytorch, CARLA, Mujoco, IssacSim, Solidworks
Languages: Native in Mandarin, Proficient in English, Basic in Italian.

HONORS & AWARDS

• Excellent Student Cadre	2020
• School Scholarship (top 10%)	2020,2021
• Third Prize in the National Competition of Group Programming Ladder Tournament,	2021