

Chunyang Zhao

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EDUCATION

Nanyang Technological University, Singapore

Jan 2019 – Present

Ph.D. Robotics & AI (School of EEE)

Jan 2022 – Expected Aug 2026

📄 **Thesis:** A High-Fidelity Low-Bandwidth Teleoperation System for Urban Robotics

Advisors: Prof. Wang Danwei (*IEEE Life Fellow; Fellow, Academy of Engineering Singapore*) & Prof. Cheah Chien Chern

M.Sc. Computer Control and Automation

Jun 2019 – Jun 2020

📄 **Thesis:** Multi-Robot Semantic Mapping Based on Deep Learning Framework

Advisor: Prof. Wang Danwei; Co-advisor: Dr. Yue Yufeng (*now Full Professor, BIT*)

Exchange Final Year Project in Robotics

Jan 2019 – Jun 2019

📄 **FYP:** Semantic-based Mobile Robot 3D Mapping Using Deep Learning Algorithm

Advisor: Prof. Wang Danwei; Co-advisor: Dr. Yue Yufeng

Wuhan University, China

Sept 2015 – Jun 2019

B.E. Measurement and Control Technology and Instrumentation

WORK EXPERIENCE

Nanyang Technological University, Singapore

Aug 2020 – Present

Research Associate

PI: Prof. Wang Danwei

Fire-Scene Emergency Robotics

Nov 2025 – Present

- Integrating multi-modal SLAM platform (thermal imaging + 4D radar) for fire-scene localization and emergency response mapping.

Autonomous Systems & Teleoperation

Apr 2021 – Oct 2025

- Led autonomy software for a **4-ton Bucher Municipal road sweeper**: full Autoware Universe stack → delivered autonomous field demo at **13 km/h**.
- Developed **kpbs-level non-video teleoperation** using 3D Gaussian Splatting and persistent-transient environment modeling (2 first-author IROS papers, 2024 & 2025).
- Built **digital-twin simulation system** (CARLA/UE4) for pre-deployment autonomous vehicle validation at NTU and Cetran test sites.

Multi-Robot Mapping

Aug 2020 – Apr 2021

- Collaborative semantic mapping for multi-robot systems in defence applications.

Temasek Laboratories, National University of Singapore

Mar 2019 – Jul 2019

Research Intern

PI: Dr. Gao Zhi (*now Full Professor, WHU*)





- Evaluated and benchmarked stereo-inertial odometry pipelines; multi-sensor calibration for visual-inertial SLAM systems.

TECHNICAL SKILLS

</> Programming:

 C/C++  Python

⚙️ Robotics Stack:

 ROS/ROS2  Autoware Universe  Zenoh  ZeroMQ

🖥️ Simulation:

 UE 4/5  Gazebo  CARLA  AWSIM



⚡ ML & Inference:

 PyTorch  ONNX  TensorRT  MMDeploy

👁️ 3D & Perception:

 PCL  OpenCV  Open3D  MMDet3D  MMSeg  OpenPCDet






🔧 Engineering:

 Git  CMake  GDB  Linux  Bash/Zsh  Zellij

📦 Env & Packaging:

 Docker  Anaconda  uv

🛠️ Agentic Tools:

 Claude Code  OpenClaw  OpenCode  Roo Code  Codex

SELECTED PROJECTS

🚗 AESV (Autonomous Environmental Service Vehicles):

Apr 2024 – Jul 2025

- Served as **software leader and primary contributor**, building the AESV autonomy stack across **Hunter 2.0** and the **4-ton heavy-duty sweeper**.

- Customized and deployed Autoware Universe core stack on both platforms: **HD-map pipeline**, **localization** (NDT scan matching + EKF fusion), **LiDAR perception** (TensorRT-accelerated LiDAR CenterPoint + muSSP-based min-cost-max-flow data association + EKF tracking), and **planning**; supported control bring-up.
- Developed platform-specific **sensor-model** and **vehicle-interface** packages to integrate sensor preprocessing pipelines and chassis communication into Autoware across both platforms.
- Built a multi-level communication bridge (**ros1_bridge** + **Fkie Multi Master** + **ZeroMQ**) connecting the ROS2 Autoware stack to ROS1 drive-by-wire interfaces across separate computers.
- Developed a **vehicle-command conversion layer** and supported **accel/brake map calibration** (accel/brake map CSVs) to integrate the Autoware control module with the sweeper.
- Led the development of a **digital-twin based autonomous simulation system** in a customized CARLA simulator (UE4-based) for NTU Carpark P and Cetran, combining static site twins (mesh/3D Gaussian scene assets + HD/SD maps) with dynamic scenario simulation (vehicles, pedestrians, and weather) for validation before field testing.
- Established a staged **testing workflow** spanning simulation-to-field and **Hunter 2.0-to-4-ton sweeper** rollout, with each cycle feeding stack/interface tuning.
- Delivered **autonomous field demos** as main software contributor at NTU Carpark P (**Hunter 2.0**) and Cetran (**4-ton heavy-duty sweeper**); during autonomous demo runs, the sweeper reached up to **13 km/h**.
- Contributed pre-research on **curb segmentation** (Cylinder3D, MMDetection3D) and semantic-segmentation based **HD-map automation** for future extension.

🏆 Amex Dreamer (1st Place, AMEX GenAI Hackathon 2025, American Express Singapore) Oct 2025

- Contributed to an **MCP-based orchestration flow** connecting profile upload, transaction query, context enrichment, prompt generation, and media generation services.
- Implemented a **demo text-to-image-to-video workflow** with **Gemini 2.5 Flash Image (Nano Banana)** and **Wan 2.1**: transaction records → narrative prompts → image moments → short memory clips.
- Used generated image keyframes as **anchor inputs to Wan 2.1** for image-to-video handoff, preserving character and scene consistency in demo clips.

PUBLICATIONS

📊 17 publications | 2 first-author IROS | 3 journal • 14 conference

🔗 IEEE Xplore

📖 Journal Articles (3)

- 2023** Yuanzhe Wang, **Chunyang Zhao**, Jiahao Liang, Mingxing Wen, Yufeng Yue, Danwei Wang. *Integrated Localization and Planning for Cruise Control of UGV Platoons in Infrastructure-Free Environments.* **T-ITS**
 UGV Platoon Cruise Control | Infrastructure-Free Localization | NLOS Trajectory Planning
- 2021** Yufeng Yue, Mingxing Wen, **Chunyang Zhao**, Yuanzhe Wang, Danwei Wang. *COSEM: Collaborative Semantic Map Matching Framework for Autonomous Robots.* **T-IE**
 Multi-Robot Relative Localization | Semantic Map Matching | EM Data Association
- 2020** Yufeng Yue, **Chunyang Zhao**, Zhenyu Wu, Chule Yang, Yuanzhe Wang, Danwei Wang. *Collaborative Semantic Understanding and Mapping Framework for Autonomous Systems.* **T-Mech**
 Collaborative Probabilistic Semantic Mapping | Heterogeneous Sensor Fusion | UAV-UGV Distributed Mapping

📄 Conference Papers (14)

- 2025** ★ **Chunyang Zhao**, Zeyu Zhou, Haoran Liu, Dogan Kircali, Huan Yang, Chang Boon Low, Yuanzhe Wang, Danwei Wang. *Tele-GS: 3D Gaussian Scene Representation for Low-Bandwidth Teleoperation.* **IROS** [\[Paper\]](#)
 Low-Bandwidth Teleoperation | LiDAR-Fused 3DGS | Kbps-Level Telepresence
- 2024** ★ **Chunyang Zhao**, Zeyu Zhou, Haoran Liu, Dogan Kircali, Guoyi Chi, Hongming Shen, Yuanzhe Wang, Danwei Wang. *Towards Kbps-level Vehicle Teleoperation via Persistent-Transient Environment Modelling.* **IROS** [\[Paper\]](#) [\[Demo\]](#)
 Non-Video Teleoperation | Persistent-Transient Environment Model | Digital-Twin Telepresence
- Huan Yang, Guoqiang Liu, **Chunyang Zhao**, Mingxing Wen, Yuanzhe Wang. *Real-Time GNSS Spoofing Detection for Autonomous Vehicles: An Attention-Based Autoencoder Approach.* **ICARCV**
 GNSS Spoofing Detection | IMU-LiDAR-GNSS Cross-Checking | Attention Autoencoder
- Yichen Zhou, Mingxing Wen, Xun Chen, **Chunyang Zhao**, Jiajie Guo, Jun Zhang, Yufeng Yue, Yingchong Ma. *Towards Safe and Efficient Last-Mile Delivery: A Multi-Modal Socially Aware Navigation Framework for Autonomous Robots on Pedestrian-Crowded Sidewalks.* **CIS-RAM**
 Sidewalk Delivery Robot | 3D Pedestrian Detection & Motion Prediction | Social-Force Planning
- Zhenyu Wu, Wei Wang, **Chunyang Zhao**, Yufeng Yue, Jun Zhang, Hongming Shen, Danwei Wang. *MM4MM: Map Matching Framework for Multi-Session Mapping in Ambiguous Environments.* **ICRA**
 Multi-Session Map Merging | Magnetic-Field Place Recognition | Perceptually-Degraded Environments
- 2023** Yuanzhe Wang, **Chunyang Zhao**, Haoyi Wang, Jun Zhang, Danwei Wang. *Secure Localization of Autonomous Articulated Vehicles: Attack Detection and Recovery.* **ITSC**
 Articulated Vehicle Localization | Multi-Sensor Cross-Checking | DoS/Spoofing Recovery
- Jun Zhang, Huayang Zhuge, Yiyao Liu, Guohao Peng, Zhenyu Wu, Haoyuan Zhang, Qiyang Lyu, Heshan Li, **Chunyang Zhao**, Dogan Kircali, Sanat Mharolkar, Xun Yang, Su Yi, Yuanzhe Wang, Danwei Wang. *NTU4DRadLM: 4D Radar-Centric Multi-Modal Dataset for*

Localization and Mapping. **ITSC**

4D Radar-Centric SLAM Dataset Thermal-LiDAR-Camera Six-Sensor Suite Adverse-Weather Robustness

2022 Mingxing Wen, Yunxiang Dai, Tairan Chen, **Chunyang Zhao**, Jun Zhang, Danwei Wang. *A Robust Sidewalk Navigation Method for Mobile Robots Based on Sparse Semantic Point Cloud*. **IROS**

LiDAR-Only Sidewalk Navigation Point-Wise Semantic Segmentation Day-Night Robustness

Yufeng Yue, **Chunyang Zhao**, Yuanzhe Wang, Yi Yang, Danwei Wang. *Aerial-Ground Robots Collaborative 3D Mapping in GNSS-Denied Environments*. **ICRA**

UAV-UGV Collaborative Mapping GNSS-Denied Environments Multi-Resolution Map Fusion

Shutong Jin, Zhenyu Wu, **Chunyang Zhao**, Jun Zhang, Guohao Peng, Danwei Wang. *SectionKey: 3-D Semantic Point Cloud Descriptor for Place Recognition*. **IROS**

LiDAR Place Recognition Semantic-Geometric Descriptor Viewpoint-Invariant Loop Closure

2020 Yufeng Yue, **Chunyang Zhao**, Mingxing Wen, Zhenyu Wu, Danwei Wang. *Collaborative Semantic Perception and Relative Localization Based on Map Matching*. **IROS**

Multi-Robot Relative Localization Probabilistic Semantic Association EM Map Matching

Yufeng Yue, **Chunyang Zhao**, Ruilin Li, Chule Yang, Jun Zhang, Mingxing Wen, Yuanzhe Wang, Danwei Wang. *A Hierarchical Framework for Collaborative Probabilistic Semantic Mapping*. **ICRA**

Hierarchical Collaborative Mapping Distributed Bayesian Fusion EM Voxel Association

2019 Yufeng Yue, Ruilin Li, **Chunyang Zhao**, Chule Yang, Jun Zhang, Mingxing Wen, Guohao Peng, Zhenyu Wu, Danwei Wang. *Probabilistic 3D Semantic Map Fusion Based on Bayesian Rule*. **CIS-RAM**

Multi-Robot Semantic Map Fusion Bayesian Label & Occupancy Update Decentralized Map Sharing

Ji Hong, Zhi Gao, Tiancan Mei, Yifan Li, **Chunyang Zhao**. *UAV-based Traffic Flow Estimation and Analysis*. **ICCA**

UAV Traffic Monitoring Spatiotemporal Vehicle Detection Optical-Flow Classification

LANGUAGES

Chinese (Native) • English (Fluent)