

Yuntianyi Chen

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EDUCATION

- **Ph.D. Candidate in Software Engineering** Irvine, CA
University of California, Irvine Sep 2021 - Present
Donald Bren School of Information and Computer Sciences
 - **M.S. in Software Engineering (conferred en route to Ph.D.)** Irvine, CA
University of California, Irvine Dec 2024
Donald Bren School of Information and Computer Sciences
 - **Bachelor of Computer Science** Wuhan, China
Wuhan University Sep 2016 - Jun 2020
School of Computer Science

PUBLICATIONS

- [**ICSE 2026**] Yuqi Huai, Yuntianyi Chen, Ziwen Wan, Qi Alfred Chen, Joshua Garcia. “DeFT: Maintaining Determinism and Extracting Unit Tests for Autonomous Driving Planning”. In 48th IEEE/ACM International Conference on Software Engineering, ICSE 2026, Rio de Janeiro, Brazil, April 12-18, 2026. (**Accepted | To be published**)

[**FSE 2025**] Yuntianyi Chen, Yuqi Huai, Yirui He, Shilong Li, Changnam Hong, Qi Alfred Chen, Joshua Garcia. “A Comprehensive Study of Bug-Fix Patterns in Autonomous Driving Systems”. Proc. ACM Softw. Eng. 2, FSE (2025), 380–402.

[**FSE 2024**] Yuntianyi Chen, Yuqi Huai, Shilong Li, Changnam Hong, Joshua Garcia. “Misconfiguration Software Testing for Failure Emergence in Autonomous Driving Systems”. Proc. ACM Softw. Eng. 1, FSE (2024), 1913–1936.

[**TSE 2023**] Yuqi Huai, Sumaya Almanee, Yuntianyi Chen, Xiafa Wu, Qi Alfred Chen, Joshua Garcia. “scenoRITA: Generating Diverse, Fully Mutable, Test Scenarios for Autonomous Vehicle Planning”. IEEE Trans. Software Eng. 49, 10 (2023), 4656–4676.

[**ICSE 2023**] Yuqi Huai, Yuntianyi Chen, Sumaya Almanee, Tuan Ngo, Xiang Liao, Ziwen Wan, Qi Alfred Chen, Joshua Garcia. “Doppelgänger Test Generation for Revealing Bugs in Autonomous Driving Software”. In 45th IEEE/ACM International Conference on Software Engineering, ICSE 2023, Melbourne, Australia, May 14-20, 2023. IEEE, 2591–2603.

[**APSEC 2019**] Yongfeng Gu, Yuntianyi Chen, Xiangyang Jia, Jifeng Xuan. “Multi-Objective Configuration Sampling for Performance Ranking in Configurable Systems”. In 26th Asia-Pacific Software Engineering Conference, APSEC 2019, Putrajaya, Malaysia, December 2-5, 2019. IEEE, 150–157.

[**SOFL+MSVL 2019**] Yuntianyi Chen, Yongfeng Gu, Lulu He, and Jifeng Xuan. “Regression Models for Performance Ranking of Configurable Systems: A Comparative Study”. In Structured Object-Oriented Formal Language and Method - 9th International Workshop, SOFL+MSVL 2019, Shenzhen, China, November 5, 2019. Springer, 243–258.

EXPERIENCE

- **Autoware Foundation** Irvine, CA
Aug 2023 - Present
Collaborating Researcher | Open-Source Developer
 - **Configuration Architecture Refactoring:** Contributed to **10%** of all refactoring of Autoware ROS nodes. Developed a tool for automated configuration refactoring in Autoware ROS nodes, enabling developers to accelerate their workflow.
 - **Scenario Record Analyzer:** Developed an automated tool to detect **9** types of violations in driving scenario records.
 - **DevOps Dojo:** Joined the Autoware Open AD Kit working group for **DevOps Dojo** development, which aims to accelerate optimized hardware and software solutions for autonomous driving.
 - **Software Aurora (SORA) Lab - University of California, Irvine** Irvine, CA
Sep 2021 - Present
Graduate Student Researcher
 - **ADS Testing:** Conducted foundational research in autonomous driving systems, focusing on scenario generation and configuration testing to detect bug-revealing violations. Developed **4 open-source projects** shared with the community.
 - **Bug-Fix Pattern Benchmark:** Open-sourced a **benchmark** of **1,331** bug-fix instances for bug-fix pattern study in ADSes. Built an interactive tool to enable classification and collaborative labeling.
 - **SE4ADS Workshop Organization:** Helped organize the **first international workshop** of SE4ADS at **ICSE**, a top-tier conference in software engineering, promoting discussions on software engineering challenges in autonomous driving systems.
 - **Centre of Software Testing, Analysis and Reliability (CSTAR) - Wuhan University** Wuhan, China
Jul 2020 - Jul 2021
Research Assistant
 - **Transfer Learning:** Proposed a method that uses the labeled data of other projects to help optimize the target projects through feature-level transfer learning in the performance prediction, which can greatly reduce the data measurement cost.
 - **Performance Prediction and Optimization:** Developed a **multi-objective** configuration sampling method that optimizes performance ranking while reducing measurement cost, achieving up to **5x** reduction in sampling cost.

SELECTED PROJECTS

• DeFT: Maintaining Determinism and Extracting Unit Tests for Autonomous Driving Planning

Autonomous Driving Systems | Simulation-based Testing | Failure Reproduction

Sep 2023 - Jul 2025

- Proposed **DeFT**, a deterministic frame-based testing framework that extracts module-level tests for ADS planning from **non-deterministic** system-level scenario tests, preserving reproducibility and reducing test flakiness.
- Implemented Time-Sensitive Input Search and Trajectory Validation engines to reconstruct planning inputs from message bus logs, achieving **100%** deterministic reproduction of **658** collision failures across 8 ADS test generators.
- Demonstrated substantial efficiency gains—**43.69%–77.64%** reduction in time-to-reproduce failures—while maintaining real-time responsiveness with **zero runtime overhead** compared to traditional carving-based testing.

• A Comprehensive Study of Bug-Fix Patterns in Autonomous Driving Systems

Autonomous Driving Systems | Empirical Software Engineering | Bug-Fix Pattern

Jul 2023 - Sep 2024

- Conducted the first large-scale empirical study of **1,331 bug fixes** across two major open-source autonomous driving systems, Apollo and Autoware, revealing diverse bug-fix behaviors and module-level trends.
- Introduced a novel **taxonomy of 15 syntactic and 27 semantic bug-fix patterns** and a corresponding **modularization hierarchy**, mapping fixes from system modules down to algorithms and code statements.
- Built a public **benchmark dataset** of 1,331 ADS bug-fix instances to advance research on automated bug detection, repair, and reliability improvement in autonomous driving software.

• Misconfiguration Software Testing for Failure Emergence in Autonomous Driving Systems

Autonomous Driving Systems | Search-Based Software Testing | Software Configuration

Aug 2022 - Mar 2024

- Developed **ConfVE**, the first automated configuration testing framework for autonomous driving systems (ADS), enabling the discovery of bug-revealing violations without modifying existing scenario-generation techniques.
- Designed a **multi-objective optimization** genetic algorithm with **9 test oracles** and an **unsupervised clustering-based duplicate eliminator** to detect and eliminate duplicate configuration-induced violations efficiently.
- Evaluated ConfVE on Apollo and Autoware with 124,950 virtual tests over 990 hours, uncovering **1,818 unique violations** across 9 types and outperforming baselines by up to **65.88%** in unique violation detection and **74.19%** in duplicate reduction.

• scenoRITA: Generating Diverse, Fully Mutable, Test Scenarios for Autonomous Vehicle Planning

Autonomous Driving Systems | Search-Based Software Testing | Unsupervised Machine Learning

Dec 2022 - May 2023

- Developed **scenoRITA**, a search-based test generation framework for autonomous vehicles, leveraging evolutionary algorithms and domain constraints for **multi-objective optimization** to generate safety-critical scenarios.
- Introduced a novel gene representation for dynamic obstacle evolution—modifying position, type, speed, and size—and incorporated **5 test oracles** to detect safety and comfort violations including collisions, speeding, and unsafe maneuvers.
- Executed **79,051 virtual tests** on Baidu Apollo 7.0 across 4 HD maps, achieving **4.95×–8.22×** higher scenario generation efficiency and uncovering **1,146 unique violations**—far surpassing prior approaches.

• Doppelgänger Test Generation for Revealing Bugs in Autonomous Driving Software

Autonomous Driving Systems | Search-Based Software Testing

Jun 2022 - Sep 2022

- Developed **DoppelTest**, a multi-instance testing methodology where all vehicles are controlled by autonomous driving systems (ADS), ensuring every violation is truly **bug-revealing** and not caused by external randomness.
- Designed **smart obstacles** that comply with traffic rules and defensive driving, eliminating unrealistic or non-bug-revealing violations and improving scenario realism and reliability.
- Discovered 123 bug-revealing violations in Apollo across 8 bug types, achieving a **100%** bug-revealing rate while reducing analysis time by **77.11%** over scenoRITA; identified bug fixes were **accepted** by developers, demonstrating real-world impact.

• Multi-Objective Configuration Sampling in Configurable Systems

Multi-objective Optimization | Performance Prediction | Software Configuration

Jun 2019 - Aug 2019

- Developed **MoConfig**, a multi-objective configuration sampling method optimizing performance ranking in configurable systems by balancing cost and ranking difference via an **unsupervised approach** with three objectives.
- Validated MoConfig using four multi-objective optimization algorithms (NSGA-II, eMOEA, IBEA, DBEA) on **20 real-world datasets**, demonstrating superior ranking accuracy with fewer sampled configurations.
- Achieved up to a **5× reduction in sampling cost** while maintaining high ranking accuracy, confirming MoConfig's efficiency and robustness over existing approaches.

• Regression Models for Performance Ranking of Configurable Systems: A Comparative Study

Supervised Machine Learning | Performance Prediction | Software Configuration

May 2018 - Jul 2019

- Conducted a comparative study on **4 regression methods** (CART, SVR, GPR, GBRT) for performance ranking in configurable systems, evaluating their effectiveness on **21 evaluation scenarios** across **16 real-world systems**.
- Demonstrated that CART and GBRT **outperform** other methods in performance ranking, achieving better minimum actual ranks (MAR) in the majority of scenarios. Showed that SVR and GPR require fewer sampled configurations, **reducing the cost** of performance ranking but at the expense of ranking accuracy.
- Implemented an iterative sampling strategy, effectively reducing the number of required performance measurements, leading to up to a **50% reduction in sampling effort** compared to exhaustive methods.

SERVICES

Organization

- **Web & Publicity Chair** Workshop
Sep 2024
1st International Workshop on Software Engineering for Autonomous Driving Systems (ICSE-SE4ADS 2025)
- **Local Arrangements Chair** Workshop
Apr 2021
The Workshop of Intelligent Real-time Methods and Technologies of Quality Improvement based on Co-programming

Program Committee

- **Program Committee Member** Workshop
Sep 2024
1st International Workshop on Software Engineering for Autonomous Driving Systems (ICSE-SE4ADS 2025)
- **Program Committee Member** Artifacts Evaluation
Sep 2024
47th IEEE/ACM International Conference on Software Engineering (ICSE 2025)
- **Program Committee Member** Artifacts Evaluation
May 2024
31st ACM Conference on Computer and Communications Security (CCS 2024)
- **Program Committee Member** Artifacts Evaluation
Mar 2024
21st International Conference on Software Architecture (ICSA 2024)

Reviewer

- **Reviewer x 2** Journal
Nov 2024 & Oct 2025
IEEE Transactions on Software Engineering (TSE)
- **Reviewer x 2** Journal
Apr 2025 & Aug 2025
IEEE Transactions on Intelligent Transportation Systems (T-ITS)
- **Reviewer x 3** Journal
Jul 2024, Dec 2024, & May 2025
ACM Transactions on Software Engineering and Methodology (TOSEM)
- **Reviewer** Artifacts Evaluation
Jan 2025
47th IEEE/ACM International Conference on Software Engineering (ICSE 2025)
- **Reviewer** Workshop
Nov 2024
1st International Workshop on Software Engineering for Autonomous Driving Systems (ICSE-SE4ADS 2025)
- **Reviewer** Artifacts Evaluation
May 2024
31st ACM Conference on Computer and Communications Security (CCS 2024)
- **Reviewer** Artifacts Evaluation
Mar 2024
21st International Conference on Software Architecture (ICSA 2024)
- **Reviewer** Journal
Jan 2024
IEEE Robotics and Automation Letters (RA-L)
- **Delegate Reviewer** Conference
Oct 2023
41st IEEE International Conference on Robotics and Automation (ICRA 2024)
- **Sub-Reviewer** Conference
Dec 2022
20th IEEE International Conference on Software Architecture (ICSA 2023)
- **Sub-Reviewer** Journal
Nov 2019
27th IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER 2020)

Volunteer

- **Student Volunteer** Conference
Dec 2023
47th IEEE/ACM International Conference on Software Engineering (ICSE 2025)
- **Student Volunteer** Conference
Dec 2023
31st ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE 2023)
- **Student Volunteer** Symposium
May 2023
Southern California Software Engineering Symposium (SuCSES 2023)

TALKS

- **Conference Paper Presentation** Trondheim, Norway
Jun 2025
*"A Comprehensive Study of Bug-Fix Patterns in Autonomous Driving Systems"
The ACM International Conference on the Foundations of Software Engineering (FSE 2025)*
- **Conference Paper Presentation** Hangzhou, China
Nov 2019
*"Regression Models for Performance Ranking of Configurable Systems: A Comparative Study"
The Annual Conference on Software Analysis, Testing and Evolution (SATE 2019)*

HONORS AND AWARDS

- ACM SIGSOFT CAPS Award in 2024 & 2025
- NSF Student Travel Award in 2023 & 2025
- Chair's Award, University of California, Irvine, in 2021
- Scholarship for Outstanding Students (Top 5%), Wuhan University, in 2016-2017, 2017-2018, & 2018-2019
- Chinese Undergraduate Computer Design Contest (Provincial Level, Second Prize) in 2018