

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 empirical study of bug-fix patterns in autonomous driving systems (ADS), analyzing **1,331 bug fixes** from two major open-source ADS projects, Apollo and Autoware.
- Introduced a novel **taxonomy** of **15 syntactic** and **27 semantic** bug-fix patterns, providing a structured framework for understanding and categorizing ADS bug repairs.
- Developed a modularization granularity **hierarchy**, mapping bug-fix patterns to ADS modules, sub-modules, algorithms, and code statements for systematic debugging and repair.
- Created a public **benchmark** of 1,331 bug-fix instances, offering researchers and practitioners valuable data for automated bug detection and repair in ADS.

• 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.
- Implemented **9 test oracles** and designed a **multi-objective optimization** genetic algorithm to detect system failures and configuration-induced violations.
- Introduced a duplicate violation eliminator, leveraging an **unsupervised machine learning** approach (i.e., clustering) to minimize redundant failure detections and identify truly unique violations.
- Evaluated on Apollo and Autoware, running 124,950 virtual tests over 990 hours, leading to the discovery of 1,818 unique violations across 9 violation types. Demonstrated superiority over existing approaches, achieving up to a **65.88% improvement** in unique violation detection compared to ConfVD and **74.19% reduction** in duplicate elimination.

• 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 vehicle (AV) software that leveraged the evolutionary algorithm and domain-specific constraints for **multi-objective optimization**, ensuring automated scenario generation while dynamically adapting obstacles to expose safety-critical situations.
- Implemented a **novel gene representation**, enabling obstacles to **evolve dynamically**, modifying attributes such as start and end location, type, speed, size, and mobility during test generation.
- Designed **5 test oracles** to assess AV safety and comfort violations, covering collision detection, speeding detection, unsafe lane change, fast acceleration, and hard braking.
- Executed 79,051 virtual tests on Baidu Apollo 7.0 using 4 high-definition city maps. Compared with state-of-the-art approaches (AV-FUZZER, AutoFuzz), demonstrating **4.95x** to **8.22x** more scenario generation efficiency and detecting **1,146** unique violations versus only 7 and 37 from competing techniques.

• Doppelgänger Test Generation for Revealing Bugs in Autonomous Driving Software

Autonomous Driving Systems | Search-Based Software Testing

Jun 2022 - Sep 2022

- Developed DoppelTest, a methodology where **multiple ADS instances** control all vehicles in a scenario, ensuring every violation is caused by ADS misbehavior, making it bug-revealing.
- Designed **smart obstacles**, ensuring traffic rule compliance and defensive driving to eliminate unrealistic, non-bug-revealing violations caused by unintelligent obstacles.
- Discovered **123 bug-revealing violations** in Apollo 7.0, categorized into 8 unique bug types, including failure to recognize slow dynamic obstacles and unsafe lane borrow decisions. Proposed and submitted a fix for one bug type discovered by DoppelTest, which was **accepted by Apollo developers**, demonstrating real-world impact.
- Achieved a **100% bug-revealing rate**, compared to baseline random testing, which generated over 1,100 violations but none that exposed actual ADS bugs. Executed 240 hours of testing, demonstrating runtime efficiency, with DoppelTest **reducing analysis time by 77.11%** compared to prior methods like scenoRITA.

• 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 that optimizes performance ranking in configurable systems by balancing measurement cost and ranking difference. Introduced three alternative objectives to effectively estimate ranking difference without requiring prior performance data, enabling an **unsupervised sampling** approach.

- Conducted experiments on **20** real-world datasets, demonstrating that MoConfig achieves better ranking accuracy while requiring fewer sampled configurations than the baseline.
- Validated MoConfig with four multi-objective optimization algorithms (NSGA-II, eMOEA, IBEA, and DBEA), finding that **NSGA-II** consistently performs well, ensuring reliable ranking predictions.
- Achieved up to **5x reduction in sampling cost**, showing that MoConfig maintains ranking accuracy while significantly lowering computational overhead compared to 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
47th IEEE/ACM International Conference on Software Engineering (ICSE 2025) Dec 2023
- **Student Volunteer** Conference
31st ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE 2023) Dec 2023
- **Student Volunteer** Symposium
Southern California Software Engineering Symposium (SuCSES 2023) May 2023

TALKS

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