Alex Richardson

Autonomous Vehicle Research Student

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Profile

4th year Computer Science graduate student investigating data driven Autonomous Vehicle (car) simulations and Autonomous Vehicle solutions for improving traffic flow. Extensive experience with Autonomous Vehicle hardware/software testbed design and implementation. The goal of my research is 1) Improve traffic flow using Autonomous Vehicle testbed deployments at scale, and 2) Create end-to-end Autonomous Vehicle learning frameworks completely driven by naturalistic data derived from Automous Vehicle testbeds.

Areas of Expertise

Embedded Software & Hardware - Data-Driven AV Simulations - Generative Dashcam Video Models - Pytorch-based Machine Learning - Web Dashboards

Professional Experience

PhD Student *Vanderbilt University - CIRCLES Project* **Nashville, TN, USA** *07/2022 - Present*

- Working with Dr. Jonathan Sprinkle.
- One of the Hardware and Software testbed designers for the CIRCLES November 2022 100+ car test. 100+ cars were deployed during rush hour on i24 with cruise controls remotely controlled by a web server to reduce traffic congestion.
- Designing and testing testbeds for other custom cruise control designs and naturalistic driving data collection.
- Investigating generative models for the purpose of data-driven AV simulation.
- Using Python, Pytorch, C++, Bash, and HTML/CSS/Javascript.

REU Student *CAT Vehicle 2021 (Autonomous Vehicle Lab)* **Tucson, AZ, USA** *05/2021 - 08/2021*

- First exposure to academic Autonomous Vehicles research under Dr. Jonathan Sprinkle.
- Created innovative docker containerized python program for reconstructing pairings and synchronization of dashcamera videos and car telemetric data. Tool saves 1 man-month of manual reconstruction on semi-annual data gathering.
- Used Docker, Python, OpenCV, High-Performance Computing, and Bash.

Design Studio Associate *Jeffrey S. Raikes School of Comp Sci & Mgmt* **Lincoln, NE, USA** *09/2019 - 05/2020*

- Team created a full-stack GPS tracking solution for items on construction sites.
- Personally responsible for programming hardware tracking sensors and integrating them with Azure IoT cloud API for our full-stack application. I also made needed performance improvements to the sensor SDK.
- Used C++, Python, MQTT, Azure IoT, Bluetooth, and Embedded Systems.

Software Engineering Intern *Microsoft Corporation* **Redmond, WA, USA** *05/2019 - 08/2019*

- Integrated onto the Bing search engine team, educating myself with corporate AI practices and norms.
- Created data analysis tool for Bing/Google/Yahoo search queries from Microsoft Edge usage data. The tool produces performance metrics for specified search queries on respective search engines.
- Used C#, .NET, Perl, Scope, and Azure Cosmos DB.

Teaching Assistant *University of Nebraska - Lincoln* **Lincoln, NE, USA** *08/2018 - 12/2020*

- Assisted with administering and grading Computer Science I & II, and Programming Languages and Concepts.
- Tutored students 1-on-1 and helped them reach their best potential.
- Taught C, Java primarily.

Software Engineering Intern *Northrop Grumman Corporation* **Bellevue, NE, USA** *05/2018 - 08/2018*

- Collaborated with the team for GAP CIE, a large-scale full-stack web application for generating daily briefings for military officers.
- Integrated onto a team of full time engineers using Agile method - all work directly went into production.
- Implemented an innovative Angular web component and partial back-end for handling the security classification of federal documents. Used Angular, Typescript, Java, HTML, and CSS.

Education

PhD - **Computer Science** *Vanderbilt University*   **Nashville, TN, USA** *2022 - Present*
GPA: 3.841. Relevant Classes: Advanced Machine Learning, Autonomous Vehicle Challenges, Distributed Systems Principles, AI for Cyber-Physical Systems, Autonomous Vehicles and Traffic, Machine Learning for Dynamical Systems.
BSc Computer Science *University of Nebraska - Lincoln*   **Lincoln, NE, USA** *2017 - 2022*
GPA: 3.95. Relevant Classes: Software Engineering in Robotics, Robotics: Algorithms and Applications, Deep Learning and Assured Autonomy, Introduction to Machine Learning, Introduction to Data Mining, Multiagent Systems, Differential Equations.

Publications

OpenTwinMap: An Open-Source Digital Twin Generator for Urban Autonomous Driving   **Vanderbilt** *2025*
Venue: arXiv preprint. Authors: Alex Richardson, Jonathan Sprinkle.
Incorporating Ephemeral Traffic Waves in A Data-Driven Framework for Microsimulation in CARLA   **Vanderbilt** *2025*
Venue: arXiv preprint. Authors: Alex Richardson, Azhar Hasan, Gabor Karsai, Jonathan Sprinkle.
High-Level Scenario Management For Parallel Autonomous Vehicle Simulation   **Vanderbilt** *2025*
Venue: ICCPS Poster. Authors: Alex Richardson, Jonathan Sprinkle.
V2X-Enabled Communication for Traffic Operations via ROS   **Vanderbilt** *2025*
Venue: Workshop on Design Automation for CPS and IoT. Authors: Junyi Ji, Alex Richardson, Jonathan Sprinkle, Dan Work.
Stop-and-go wave super-resolution reconstruction via iterative refinement   **Vanderbilt** *2025*
Venue: arXiv. Authors: Junyi Ji, Alex Richardson, Derek Gloudemans, Gergely Zachár, Matthew Nice, William Barbour, Jonathan Sprinkle, Benedetto Piccoli, Dan Work.
Traffic control via connected and automated vehicles: An open-road field experiment with 100 cavs   **Vanderbilt** *2025*
Venue: IEEE Control Systems Magazine. Authors: Lee et al.
RL learning with communication latency with application to stop-and-go wave dissipation   **Vanderbilt** *2024*
Venue: IEEE IV. Authors: Alex Richardson, Xia Wang, Abhishek Dubey, Jonathan Sprinkle.
Libpanda apps: Managing the deployment and reuse of a cyber-physical system   **Vanderbilt** *2024*
Venue: DESTION. Authors: Matthew Bunting, Matthew W Nice, Alex Richardson, Jonathan Sprinkle, Daniel B Work.
Hierarchical speed planner for automated vehicles   **Vanderbilt** *2024*
Venue: IEEE Control Systems Magazine. Authors: Wang et al.
Traffic Control via Connected and Automated Vehicles   **Vanderbilt** *2023*
Venue: arXiv. Authors: Lee et al.
Enabling mixed autonomy traffic control   **Vanderbilt** *2023*
Venue: arXiv. Authors: Matthew Nice, Matt Bunting, Alex Richardson, Gergely Zachar, Jonathan W Lee, Alexandre Bayen, Maria Laura Delle Monache, Benjamin Seibold, Benedetto Piccoli, Jonathan Sprinkle, Dan Work.
Analysis of a runtime data sharing architecture over LTE for a heterogeneous CAV fleet   **Vanderbilt** *2023*
Venue: CPS-IoT Week. Authors: Alex Richardson, Matthew Walter Nice, Matt Bunting, Jonathan Lee, Rahul Bhadani, Daniel Work, Jonathan Sprinkle.
Intelligent Structuring and Semantic Mapping of Dash Camera Footage and CAN Bus Data   **Vanderbilt** *2022*
Venue: DI-CPS. Authors: Alex Richardson, Kate Sanborn, Jonathan Sprinkle.
Semantic Tagging of CAN and Dash Camera Data From Naturalistic Drives   **Vanderbilt** *2022*
Venue: ICCPS. Authors: Kate Sanborn, Alex Richardson, Jonathan Sprinkle

Presentations & Posters

High-Level Scenario Management For Parallel Autonomous Vehicle Simulation   **ICCPS** *2025*
Poster session. Outlining a framework for massive parallel Autonomous Vehicle Simulations with non-robust simulator software packages.
CAN-based Naturalistic Driving Data-Collection At Scale   **Transportation Research Board (TRB)** *2024*
Poster session. Presented my research plan for collecting at scale naturalistic driving data, using conventional dashcams and CAN-interfaces!
Analysis of a runtime data sharing architecture over lte for a heterogeneous cav fleet   **DI-CPS** *2023*
DI-CPS Paper presentation at CPS-IoT week 2023! Presented the paper of the same name.

ICCPS workshop paper presentation at CPS-IoT week 2022! Presented the paper of the same name.