John Chrosniak

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EDUCATION

University of Virginia, School of Engineering & Applied Science — **Charlottesville, VA**
Master of Science, Computer Science – GPA: 3.96/40 — *December 2023*
Certificate, Cyber-Physical Systems

University of Virginia, School of Engineering & Applied Science — **Charlottesville, VA**
Bachelor of Science, Computer Engineering & Computer Science – GPA: 3.91/4.0 — *May 2022*
Minor, Engineering Business

LEADERSHIP EXPERIENCE

Cavalier Autonomous Racing Team — **Charlottesville, VA**
Perception Team Lead — *March 2021 - Present*
- Orchestrated the design, development, and deployment of the object detection, tracking, and trajectory prediction stack for a full-scale autonomous racecar competing in the Indy Autonomous Challenge
- Trained and deployed a LiDAR object detection neural network using PyTorch and TensorRT to detect opponent vehicles

University of Virginia Solar Car Team — **Charlottesville, VA**
Embedded System Team Lead — *May 2020 – July 2022*
- Spearheaded PCB and RTOS design for a distributed embedded architecture that interfaces the motor, battery pack, and other components of a full-scale, solar-powered racecar via CANbus
- Helped lead the team to compete in its first race in over 20 years

WORK EXPERIENCE

University of Virginia Dept. of Computer Science — **Charlottesville, VA**
Machine Learning Head Teaching Assistant — *August 2022 - December 2023*
- Reinforce students' understanding of AI/ML theory and practice through office hours and grading
- Mentor students throughout a semester-long project where they use AI/ML to benefit the Commonwealth of Virginia

ENSCO, Inc. — **Springfield, VA**
Research Intern — *May 2023 - August 2023*
- Designed and deployed a LiDAR processing algorithm to survey the topography of railroad crossings
- Built a LiDAR calibration library using scan matching and Bayesian optimization to synchronize multiple sensors

Leidos, Inc. — **Arlington, VA**
Autonomous Systems Engineer Intern — *June 2021 - August 2021*
- Created a software development suite in Java to support communication within a fleet of autonomous mobile robots
- Developed an automated setup platform for hardware-in-the-loop simulation across a network of edge devices

RESEARCH EXPERIENCE

Combining AI & Physics for Vehicle Dynamics Modeling – [Preprint] — *Fall 2023*
- Pioneered a physics-informed neural network capable of estimating time-variant coefficients for a physics-based vehicle model using observations of the vehicle's motion
- Introduced a constraining mechanism to ensure estimated coefficients always lie within their physically-meaningful range
- Tools: [Python, PyTorch, ROS2, Comet ML]

RACECAR Autonomous Racing Dataset – [Code], [IROS Paper] — *Spring 2023*
- Developed a multi-threaded library to convert ROS2 bag files to the nuScenes dataset format for community release
- Facilitated collaboration from six international universities to release the first autonomous racing dataset
- Tools: [C++, ROS2, ROSBag API, OpenCV, PCL, Docker]

Trajectory Prediction of Formula Racing Cars – [Code], [ICRA Workshop Paper] — *Spring 2021*
- Trained an LSTM neural network to estimate the future trajectory of opponent Formula race cars using historical observations of motion
- Designed a filtering algorithm to simulate visual occlusion for a virtual camera in the Deep Racing simulator
- Tools: [Python, PyTorch, UDP, Shapely]

PROJECTS

Real-Time Cube Crusher – [Code], [Video] *Spring 2023*
- Developed the RTOS, graphics, and state machine for a cube crusher video game run on the TM4C microcontroller
- Tools: [C, ARM Assembly]

Point Cloud Augmentation – [Code] *Spring 2023*
- Analyzed the impact of LiDAR perturbations on state-of-the-art 3D object detection neural networks when trained on data from the KITTI and RACECAR datasets
- Tools: [Python, PyTorch, PCL]

Autonomous Mobile Robot Search & Rescue – [Code], [Video] *Fall 2022*
- Demonstrated autonomous navigation in an unknown and cluttered environment while using LiDAR to detect objects of interest and simultaneously construct a map of the object's surroundings
- Tools: [Python, C++, ROS, PCL]

Free Throw Fixer Wearable Device – [Code] *Fall 2022*
- Leveraged IMU data collected from an Android smartwatch to train an LSTM recurrent neural network capable of predicting free throw outcomes by observing shooting form
- Tools: [Python, Java, TensorFlow]

AIPD: Enforcing Traffic Violations with Autonomous Vehicles – [Code] *Spring 2022*
- Created a proof of concept demonstration of how autonomous vehicles could effectively enforce traffic laws without the need for traffic stops using the nuScenes dataset
- Tools: [Python, ROS, ROSBag API, OpenCV, Qt]

Anti-Theft Package Delivery System – [Firmware], [Hardware], [Web App] *Fall 2021*
- Designed the embedded software and hardware for a prototype package delivery system that allows users to generate single-use passcodes and view video footage from deliveries on a web application
- Tools: [Raspberry Pi, C++, Python, AWS S3, OpenCV, Flask, KiCad]

Semantic Segmentation of Agricultural Fields – [Code] *Fall 2020*
- Deployed a semantic segmentation model to identify agricultural regions at risk of polluting the Chesapeake Bay watershed using satellite images
- Tools: [Python, Tensorflow, Keras, GeoPandas, Rasterio]

THESES

[1] J. Chrosniak, "Deep Dynamics: Vehicle Dynamics Modeling With a Physics-Informed Neural Network for Autonomous Racing," Master's thesis, University of Virginia, School of Engineering and Applied Science, 2023. [Online]. Available: https://doi.org/10.18130/0qav-fv52

[2] J. Chrosniak, "Bouncer Locking System; Internet of Risky Things: Investigating the Social Construction of IoT Devices," University of Virginia, School of Engineering and Applied Science, Tech. Rep., 2022. [Online]. Available: https://doi.org/10.18130/ppe1-at69

PRESENTATIONS

- [2023] **ROSCon**, 'ROSBag2nuScenes: Share the Bags, Spread the Joy - Autonomous Vehicle ROS Datasets Deploy', Oct 2023, New Orleans, LA – [Recording]
- [2023] **Link Lab Research Day**, 'Deep Dynamics: Merging Physics & AI for Agile Autonomous Racing', Oct 2023, Charlottesville, VA
- [2022] **University of Virginia**, 'Machine Learning in Autonomous Vehicles', Dec 2022, Charlottesville, VA

SKILLS SUMMARY

- **Languages:** Python, C/C++, MATLAB, Java, Assembly (x86/ARM), CUDA
- **Tools:** PyTorch, TensorFlow, Keras, PCL, OpenCV, TensorRT, AWS, Docker, Travis-CI, Git, MySQL
- **Frameworks:** ROS, ROS2, Django, Flask, MbedOS
- **Platforms:** Linux, STM32, MSP432, Arduino, Raspberry Pi, Jetson
- **Domain Areas:** Machine Learning, Object Detection/Tracking, Kinematics/Dynamics, Motion Prediction