Jesse Miller

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EXPERIENCE

Motional
Boston, MA

Principal Robotics Control Engineer — *May 2024 – Present*

- Spearheaded development and deployed a **PPO-based RL Planner** (PyTorch, Stable-Baselines3, C++) surpassing safety and comfort benchmarks set by prior imitation learning based ML planner in sim and on-vehicle ACC scenarios.
- **Led a cross-org Reflexive Planner project**, a low latency task for collision prevention critical to achieving the Driverless milestone. Coded features that **reduced the false-positive rate by 400%** (without impacting safety) and designed regression tests and metrics for performance monitoring. Reported results directly to **Motional's CTO**.
- Awarded Motional's monthly **"Mobilizer Award"** and consistently received "exceeds expectation" for every performance review.

Senior Robotics Control Engineer and Team Lead — *August 2020 – May 2024*

- Code-owner and developer for a **nonlinear trajectory optimization** based MPC formulated with FORCES Pro in Python and deployed in C++. Implemented dozens of features and gave thorough software and design reviews.
  - Collaborated to implement and **patent a novel Contingency MPC** approach for handling multi-modal predictions in trajectory optimizer, refactoring solver formulation to support joint optimization with minimal latency overhead.
  - Invented a novel algorithm for generating **assertive lane change** trajectories via "gap matching" behavior to signal intent. Redesigned the Planning/Control interface (C++) and added visualizations to support the new feature.
  - **Tuned MPC** weights and enhanced cost function, contributing to investor analysts' feedback that the ride was **"smoother than Waymo's"**. First tuned in open-loop sim to match human driving, later fine-tuning on vehicle.
- **Led Path Tracker Perfomance team** (6 ppl) creating Python/SQL metric frameworks and designing automated release tests. Reduced rate of LQR's high cross-track error events from **25 to 1 violation per 1K miles**.
- Collaborated to formulate and implement a **convex trajectory optimizer** (OSQP, C++, Eigen), linearizing objective and constraint terms. Reduced latency by 50% over NLP version.
- Developed MySQL metric dashboards for visualization, triage, and drilldown of controls related errors; monitored weekly by on-call engineer. Proactively caught and fixed bugs and latency regressions before they impacted the fleet.
- **Led Trajectory Formulation Team** for a quarter; defined the team's north star strategy, conducted one-on-ones, and oversaw successful demo deployment.
- Developed and patented an **ML based vehicle dynamics model** for simulation (LSTM in PyTorch) and deployed it in C++, reducing average displacement error by 40% over 8s compared to existing physics based model.
- Primary code owner and top contributor for repo containing Python analysis scripts used for AV log visualization and debug, regularly used by 30+ people. Adding log streaming support and improving deserialization speed by 100x.

Robotics Control Engineer III — *October 2018 – August 2020*

- Owner of a dynamic bicycle model based **path tracker module**, refactoring and integrating code during the company merger. Migrating formulation from Acados to Forces PRO and refactoring code to follow SOLID principles.
- Designed and coded "Mock Planner" and "Fault Injection" tools (C++, Python, IPC) used to stress test controller and for vehicle operator training.
- Mentored intern who explored trajectory optimizer solver modifications for improved latency and performance.

Autonomous Vehicle Engineer — *August 2017 – October 2018*

- Worked on vehicle hardware integration and sensor calibration, outfitting the Renault Zoe EVs with nuTonomy's AV compute stack. Troubleshooted and fixed issues such as an incorrectly wired GPS Serial cable using an oscilloscope.
- Streamlined AV closed course testing, curating a weekly KPI report on AV performance (Python) shared with C-suite.

Sandia National Labs
Albuquerque, NM

R&D Electromechanical Engineer and Technical Lead — *August 2016 – August 2017*

- Tuned a PID controller for a DC motor system using system identification and control design methods in MATLAB/Simulink.
- Developed a electromechanical test evaluation setup using fiber optics, PXI, LabView, 3D printing, and control design to quantify a mechanism's performance.
- Modeled and evaluated rigid multi-body equations of motion in 3D using Siemens LMS software.

Autonomous Sailboat Project
Ithaca, NY

Master's Thesis, Dynamics Subteam Lead — *January 2015 – May 2016*

- Created a simulation framework to model the 3D dynamics of a sailboat in MATLAB to determine the feasibility of autonomously sailing around the world.
- Wrote a thesis paper describing a novel 'rudder connected to sail' design to improve the directional stability of a robotic sailboat. Presented findings at a robotics seminar with advisor Andy Ruina at Cornell University.
- Provided recommended robotic sailboat design to CUSail project team at Cornell which they built and tested on

Cayuga Lake, verifying the simulation results.

Amazon Robotics North Reading, MA

Data Analyst and Performance Intern *May 2015 – August 2015*
- Built and deployed a random forest ML predictor to forecast pick times (Python, MySQL), enhancing employee performance metrics and saving the company millions, remaining in use years post-internship.

Innovative Scientific Solutions Inc. Dayton, OH

Engineering Co-op Student *January 2014 – August 2014*
- **Invented** and developed a MATLAB program to transcribe handwriting using only a microphone, **winning $15,000** in research funding from a **U.S. Air Force competition** against 37 others.
- Designed and conducted an experiment to test the effects of unsteady flow through an intercooler, resulting in a published and presented paper at the SAE 2014 Aerospace Conference.

EDUCATION

Cornell University, College of Engineering | Ithaca, NY *August 2015 – May 2016*

Master of Engineering in Robotics, Controls, and Dynamics *GPA: 4.17/4.0*
- Outstanding Achievement Award: Given to top two MechE Masters students with the **highest academic standing**.
- Kelly Prize: Excellence in aerospace engineering, received for research on a novel robotic sailboat design.
- **Relevant Courses:** Autonomous Mobile Robots, Robot Motion, Feedback Control, Multivariable Control Theory, Advanced Dynamics.

Cornell University, College of Engineering | Ithaca, NY *August 2011 – May 2015*

Bachelor of Science in Mechanical Engineering *Major GPA 4.24/4.0 | Cumulative GPA: 4.15/4.0*
- Sibley Prize: Awarded to the two mechanical engineering graduating seniors with the **highest overall GPA**.
- Frank O. Ellenwood Prize: Awarded to the M.E. students with the **highest GPA** in heat and power courses.

SELECT PATENTS

- **Autonomous Driving Mode Engagement**, US patent US20230159063A1, March 25, 2023. Developed a method for comfortable and safe transition from manual to autonomous vehicle control.
- **Control Architectures for Autonomous Vehicles**, US patent US11794775B2, October 24, 2023. Collaborated to develop and implement novel trajectory optimization based control methods.
- **ML Based Vehicle Dynamic Simulator Model** (patent pending), Docket No. I2023099, May 24, 2023. Helped design and deploy an LSTM model trained on vehicle dynamics.
- **Shortened Contingency Horizon MPC With a Terminal Car-Follow Constraint** (patent pending), Docket No. I2023017, January 27, 2023. Designed and implemented a sparse contingency trajectory optimization formulation that improved solve-time while maintaining recursive safety guarantees.
- **Autonomous Vehicle with Contingency Consideration in Trajectory Realization** (patent pending), Application No US18164652, February 6, 2023. Co-designed and implemented a joint trajectory optimization formulation for safely and comfortably handling multimodal predictions.

SKILLS & INTERESTS

Languages: Python (3.x), Modern C++ (14, 17, 20), MATLAB, SQL, LabVIEW, C

Technologies: PyTorch, FORCES Pro, Stable-Baselines3, OSQP, Ubuntu/Linux, Git, CMake, Bazel, LaTeX, Jupyter Notebook, ROS, Simulink, OpenCV, Raspberry Pi, Arduino, SolidWorks, Blender

Continued Education: Deep Reinforcement Learning CS285, Underactuated Robotics MIT 6.832, Udemy Design Patterns in C++

Interests: Acoustic guitar, ping pong, badminton, tennis, skiing, auditing classes

PROJECTS

Gamified Vehicle Path Tracking | *GitHub*
- Implemented a variety of tunable path tracking algorithms (e.g. LQR, Stanley, Pure Pursuit) in Python, wrapped in a gamified dynamic vehicle simulator. The user draws a b-spline path guiding the vehicle through a series of obstacles. The user can interactively tune the controllers and view Jupyter Notebooks with derivations of the algorithms.

Balancing Robot | *GitHub*
- A balancing cart-pole type robot, using cascaded PID control and complementary filter for state estimation. Designed and built the hardware and electronics and wrote the software.

Additional Projects: Tutorial Comparing RL (PPO) vs LQR for a Double Integrator (Python, Stable-Baselines3), Autonomous Sailboat 3D Dynamics Simulator (MATLAB), Color Following Robot with Articulated Camera (Python, OpenCV), Aesthetically Rendered Double Pendulum Simulation (Blender/Python API), WriteHear: Transcribe handwriting from sound (MATLAB), Bouncing Ball Simulation (C++), 2D Geometric Shooter Game (Python)