

# Jesse Miller

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## EXPERIENCE

### Motional

Boston, MA

#### *Principal Robotics Control Engineer*

May 2024 – Present

- Designed, trained, and deployed a **PPO-based RL Planner** using PyTorch which outperformed the company's imitation learning based ML planner in comfort and safety in most scenarios in sim and on-vehicle.
- 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%** and designed regression tests and metrics for performance monitoring. Presented 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** formulated with FORCES Pro in Python and deployed in C++.
  - Collaborated to implement and **patent a novel Contingency MPC** approach for handling multi-modal predictions in trajectory optimizer.
  - Invented a novel algorithm for generating assertive lane change trajectories across planning control stack; deployed on AV.
  - Tuned controller performance on-vehicle, contributing to investor analysts' feedback that the ride was "**smoother than Waymo's**".
- Led Path Tracker Performance team (6 ppl) creating Python and SQL metric frameworks, automating release tests, and improving LQR tracking performance. Reduced rate of high cross-track error from **25 to 1 violation per 1K miles**.
- Collaborated with team to formulate and implement a **convex trajectory optimizer** using OSQP, reducing latency by 50%.
- 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% compared to physics based model.
- Primary code owner and developer for repo containing Python analysis scripts used for AV log visualization and debug, regularly used by 30+ people.

#### *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.
- Designed and coded 'Mock Planner' & 'Fault Injection' tools in C++ and Python used to stress test controller & 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 integration and sensor calibration, outfitting the Renault Zoe EVs with nuTonomy's AV compute stack.
- Streamlined AV closed course testing, curating a weekly KPI report on AV performance 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 tester using fiber optics, PXI, LabView, 3D printing, and control design to quantify a mechanism's performance.
- Designed tests and analyzed results to characterize the performance of various mechanisms relating to nuclear weapon safety.
- Modeled 3D multibody rigid body dynamic mechanism using Siemens LMS software and performed tests to verify the model.

### 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 and received the [Kelly Prize](#) for aerospace related research.
- 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

- Created a random forest machine learning predictor using Python and MySQL to predict the time it takes to pick an item off a shelf.
- Implemented the predictor service with a performance website, improving metrics used to assess employee performance.

## Innovative Scientific Solutions Inc.

Dayton, OH

### Engineering Co-op Student

January 2014 – August 2014

- **Invented** a unique idea to listen to the sounds produced by handwriting and understand what was written.
  - Developed and [coded a MATLAB program](#) to transcribe handwriting by only using a microphone.
  - [Presented my invention](#) in a **U.S. Air Force wide competition** against 37 other inventions.
  - **Won** the competition and received \$15,000 in research funding and a patent for the invention.
- Designed in NX Unigraphics and performed an experiment to test the effects of unsteady flow through an intercooler.
- Published and presented [a conference paper](#) based on these findings in 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. I 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. I 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. I 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. I 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. I co-designed and implemented a joint trajectory optimization formulation for safely and comfortably handling multimodal predictions.

## SKILLS & INTERESTS

**Languages:** Python, C++, MATLAB, SQL, LabVIEW, C

**Technologies:** PyTorch, FORCES Pro, Stable-Baselines3, OSQP, Ubuntu/Linux, Git, CMake, Bazel, L<sup>A</sup>T<sub>E</sub>X, Jupyter notebook, 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

## PROJECTS

### Gamified Vehicle Path Tracking | [GitHub](#)

- I 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. I 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)