

Nathan Cusson-Nadeau

ncussonn@gmail.com | La Jolla, CA | (951) 227-9318 | Website



github.com/ncussonn



linkedin.com/nate-cn

SKILLS

- **Programming Languages & Libraries:** Python (JAXNumPy, OpenCV, CasADi, CVXPY), C, C++, MATLAB (Control Systems Toolbox), Rust, HTML
- **Control Techniques & Theory:** PID, LQR, LQG, MPC, CLFs, CBFs, Reachability Analysis
- **State Estimation:** MoCap, (Extended/Unscented) Kalman Filter, SLAM (VI-SLAM, FastSLAM), Particle Filter
- **Motion Planning & Search Algorithms:** Dijkstra's, A*, RRT*
- **Robotic Frameworks & Packages:** ROS1/ROS2, ROS1-to-2 Bridge, RVIZ, Gazebo

EDUCATION

University of California, San Diego La Jolla, CA
Master's of Science in Mechanical Engineering - Robotics & Controls Specialization September 2021 - July 2023

University of California, San Diego La Jolla, CA
Bachelor's of Science in Environmental Engineering | Provost Honors September 2013 - June 2017

WORK EXPERIENCE

Graduate Software Engineer Intern June 2022 - September 2022
General Atomics Aeronautical Systems Poway, CA

- Developed new **regression tests** for **world-leading UAS's** NGPS **autopilot** landing system using **Python, C**, and **SVN** for version control. This required an intimate understanding of how **Kalman Filtering** of proprietary sensor data was used for **precise state estimation** to enable **safe automated landing** in GPS-denied scenarios.
- Performed successful software-in-the-loop **unit testing** of the code using ground control station and drone flight simulator, validating **over 10 software requirements specifications** for the NGPS system.
- Presented final work to the **Vice President of Software Engineering** in a 15-minute presentation.

Application Engineer II October 2019 - December 2020
Emcor Services - Mesa Energy Systems Irvine, CA

- Designed **advanced building automation control systems** for notable clients such as NASA JPL, UCLA, Cal Tech, NBC Universal using **PID control, AutoCAD**, and **Microsoft Excel**, improving electrical efficiency by **over 5%**.
- **Automated** the laborious process of constructing BOMs using **VBA** and **AutoCAD** saving **\$10,000** or more.
- Developed standardized drawings to represent standard **microcontrollers, sensors, actuators**, and wiring, **resulting in increased readability and consistency** of engineering drawing submittals.

PROJECTS

Master's Thesis: Hardware Implementation of RefineCBF September 2022 - July 2023

Skills: Python, C++, ROS, Control Theory, Motion Capture

- Validated the applicability of the **bleeding-edge** algorithm [refineCBF](#) in **safety-critical control hardware-in-the-loop** settings using a **fully-autonomous differential-drive robot**.
- Individually developed a complete **ROS software package** using **Python, C++, YAML**, and **XML** for the [Safe Autonomous Systems Lab](#) in the Contextual Robotics Institute.
- Achieved **near-perfect state estimation (< 1mm)** of the robot's true pose using a **Vicon camera MoCap system**.

PROJECTS CONT.

Infinite-Horizon Stochastic Optimal Control

June 2022

Skills: Python, Optimal Control

- Implemented a **receding-horizon optimal control algorithm**, where a **differential-drive robot** is to **follow a reference trajectory while remaining safe** from obstacles in the presence of stochastic disturbance.
- Resulting algorithm **yielded 0 collisions** with a maximum reference tracking **error of about 10%**.

Search-Based Motion Planning

May 2022

*Skills: Python, Motion Planning, A**

- Implemented a novel **modified weighted A* search algorithm** to use as the motion planner for a pursuer in a pursuit-evasion game.
- Provided **dramatically improved computational tractability by up to 100x** with minor suboptimality in larger and more challenging configuration spaces.

Dynamic Programming

April 2022

Skills: Python, Optimal Control

- Used the **dynamic programming principle** to find the **optimal control policy** for an agent to traverse to a goal behind a locked door in a random grid-world environment with an **8 dimensional** state-space.
- Received **highest grade in the class** for implementation and report.

Particle Filter SLAM

February 2022

Skills: Python, SLAM, Particle Filter, LiDAR

- Implemented a **particle filter** for **SLAM** of an **autonomous car** using real **2D LiDAR** sensor data in a city.

Color Classification and Recycling Bin Detection

January 2022

Skills: Python, Machine Learning, OpenCV

- Trained a pixel classifier using **logistic regression** to identify colored trashcans in an assortment of images using the **OpenCV Python** library.
- Achieved **81% pixel classifier** and **100% recycling bin detection accuracy** on test sets.

CERTIFICATIONS

NCEES - Engineer in Training (EIT)

RELEVANT COURSES

Control Theory: Linear Systems, Linear Control Design, Nonlinear Systems, Nonlinear Control Design, Optimal Control

Robotics: Sensing & Estimation, Motion Planning & Learning

Probability & Statistics: Advanced Probability & Statistics for Data Science

MISCELLANEOUS

Languages: English (Native), French (Proficient), Spanish (Beginner)

Hobby Projects: Text-Based Dungeon Crawl Game in C++, Robotic Learning Platform

Extracurriculars: RoboGrads, Triton Robotics - AI Team

References available upon request.