Charles Vorbach

https://charliea0.github.io

Email : cvorbach@mit.edu
Mobile : +1 (914) 525-8764

Education

- **Massachusetts Institute of Technology** — Cambridge, MA
  Master of Engineering in Computer Science and Engineering; GPA 5.0/5.0 — *Expected June 2022*
- **Massachusetts Institute of Technology** — Cambridge, MA
  Bachelor of Science in Computer Science and Engineering; GPA 4.8/5.0 — *June 2021*

Experience

- **NVIDIA Driveworks: Autonomous Vehicle Motion Planning Team** — Santa Clara, CA
  Behavior Planning Thesis Co-Op — *June 2020 – Present*
  - Developed a HBJ Reachability based safety module for certifying vehicle will never be forced off of the road surface.
  - Isolated motion planning collision detector to single process node to enable safety certification.
  - Developing reachability-based extension of Safety Force Field module to certify traffic stop and wait condition obedience.
- **MIT Distributed Robotics Laboratory: Deep Drone Project** — Cambridge, MA
  Undergraduate/Graduate Research — *August 2020 - August 2021*
  - Trained Neural ODE Networks policies for quatrotors to perform visual understanding and motion planning tasks.
  - Built pipeline for generating and consuming large imitation learning datasets from naturalistic Unreal Engine simulations.
  - Helped prove that Continuous-Time Neural Networks are causal models and show they can outperform at causal understanding.
- **NVIDIA Driveworks: Autonomous Vehicle Motion Planning Team** — Santa Clara, CA
  Behavior Planning Intern — *June 2020 – August 2020*
  - Developed a simulated testing scheme for Automotive Safety Integrity Level certification of the NVIDIA Driveworks SafetyForceField collision-avoidance system.
  - Detected and fixed bugs in the SafetyForceField module, resulting in a 70% improvement in road test KPIs.
  - Developed a new module for aggregation of multiple redundant collision avoidance systems into an ensemble model.
- **MIT Driverless: Planning and Controls Team** — Cambridge, MA
  Subteam Lead — *September 2019 – Present*
  - 2019-2020 Planning and Controls Team Lead for MIT - TU Delft Formula SAE Driverless racing team.
  - Responsible for all controllers (LQR, Stanley, MPCC) and models (kinematic, dynamic) used on the race car.
  - Helped develop path planning strategies including lane detection and racing line generation.
  - Maintained embedded systems including vehicle CAN network, code-generated Matlab, and electrical integration.
- **MIT Formula SAE Electric Race Car: Software Team** — Cambridge, MA
  Controls Team Member — *September 2018 – June 2020*
  - Built vehicle's torque-vectoring controller using vehicle model with normal forces and nonlinear Pacejka tires.
  - Improved sensing with direct groundspeed measurement, real-time derivative filtering, and higher wheel-speed resolution.
  - Helped translate codebase to STM32 chip family and reimplement vehicle control unit using real-time operating system.
- **Ocado Technology: 10x Research and Development** — London, United Kingdom
  Mechatronics Engineering Intern — *June – August 2018*
  - Developed a testbed version of Ocado's robotic warehousing system for 10x research team.
  - Experimented with low-energy electropermanent magnetic gripping, contact sensing, and optical distance tracking.
- **MIT Space Systems Laboratory: International Space Station Astrobees** — Cambridge, MA
  Undergraduate Researcher — *Fall 2019*
  - Performed embedded software and sensor integration for MIT's ground test copies of the Astrobee robotic astronaut assistants onboard the ISS.
  - Helping to clear research projects before their deployment onboard the ISS.
  - Worked with ROS, Gazebo, Matlab code-generated C++, force allocation models, estimators, and PID control.
- **PepsiCo Demand Xccelerator: Shopper Insights and Capabilities** — White Plains, NY
  Data and Software Engineering Intern — *June – August 2017*
  - Developed web API and online dashboard for predicting new product performance using large-scale shopper datasets.

Skills and Interests

Relevant Coursework: Underactuated Robotics; Advances in Computer Vision; Artificial Intelligence; Principles of Autonomy; Design and Analysis of Algorithms; Software Construction; Computational Structures; Differential Equations; Linear Algebra;
Proficient With: Embedded C and C++; Python;
Interested In: Autonomous Systems; Robotics Control and Sensing; Computer Vision; Data Science and Visualization;

Publications

"Causal Navigation by Continuous-time Neural Networks". Charles Vorbach*, Ramin Hasani*, Alexander Amini, Mathias Lechner, Daniela Rus. Preprint, 2021. [link]