Benjamin Cruse

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EDUCATION

Worcester Polytechnic Institute — Worcester, MA 2022–2026
Bachelor of Science (BS) in Robotics and Automation Engineering — May 2026
Master of Science (MS) in Robotics and Automation Engineering — Expected Aug 2026
Minor in Materials — Expected Sep 2026
Coursework: Motion Planning, Controls, Multi-Agent Systems, Dynamics, Safety Guarantees, Deep Learning

EXPERIENCE

Research Apprenticeship: Automata Lab — **May 2025 – Aug 2025**
(Blender, Isaac Sim, PyTorch, ROS 2, Docker)

Contributed to research supporting Belief Space Control of Safety-Critical Systems Under State-Dependent Measurement Noise.

- Built an end-to-end AWS DeepRacer perception/control testbed combining Blender synthetic data generation, PyTorch lane localization, ROS 2 control, Isaac Sim simulation, and physical hardware execution
- Generated controlled camera-image datasets across lane offsets and heading angles to shape and evaluate state-dependent perception error for belief-space safety-control research
- Integrated lane-position inference into a Dockerized ROS 2 pipeline, enabling the same closed-loop controller to run against both simulated Isaac Sim imagery and real DeepRacer hardware

RESEARCH

Minimum Auction Spanning Task Assignment Hierarchy (MASTAH) — **Aug 2025 – Aug 2026**
Master's Capstone

- Developed MASTAH, a decentralized Flexible Job Shop Problem (FJSP) task-assignment algorithm for heterogeneous multi-agent systems
- Propagates task requests through an artificial hierarchy where nodes maintain only a local system view, mirroring human organizations
- Searches local subtrees before expanding outward, using fitness auctions to select the best-suited local candidate
- Produced schedules with shorter makespans than greedy heuristics while completing faster than Tabu and MILP schedulers

Think Again: Augmenting Rigidly Safe Plans with General Safety Awareness Using LLMs — **Aug 2025 – Sep 2026**
In preparation for submission to IEEE ICRA

- Developed a hybrid Linear Temporal Logic (LTL)/Large Language Model (LLM) planner that preserves formal constraints while improving practical safety
- Converted LLM-generated hazard predictions into costs over weighted automata and navigation grids, prioritizing safer actions
- Implemented state-aware A* to balance path length, hazard exposure, and LTL task requirements
- Evaluated the system against baseline and LLM-based safety planners on simulated tasks and a Hello Robot Stretch 3

PROJECTS

Control Barrier Function Obstacle Avoidance on Ackermann Drive Robot — **Mar 2026 – Apr 2026**
(ROS 2, CBFs, LiDAR, SLAM)

- Demonstrated real-time obstacle avoidance on physical hardware using LiDAR-based perception and remote control computation
- Processed LiDAR scans to perform SLAM and detect nearby obstacles
- Applied Control Barrier Functions to enforce obstacle avoidance in an unknown environment
- Offloaded perception and control computation to a remote computer and streamed velocity commands to a physical AWS DeepRacer

Task and Motion Planning (TAMP) Pick-and-Place Arm — **Oct 2025 – Dec 2025**
(Genesis Sim, OMPL, PDDL)

- Defined PDDL domain for structure building scenarios and created solver to plan and replan tasks on the fly
- Combined a sampling-based kinematic planner (BIT*) with gradient-based final pose correction
- Simulated 7 DOF Franka Emika Panda Arm to construct block structures

Forward and Inverse Kinematics & Inverse Dynamics Pipeline — **Jan 2025 – May 2025**
(MATLAB, Numerical Optimization, RNE Algorithm)

- Created platform agnostic FK/IK pipeline with singularity-avoidance from ground up utilizing screw theory
- Generated inverse dynamics via Recursive Newton-Euler algorithm to compute joint torques for desired position, velocity and acceleration
- Validated on simulated UR5 with 2 kg tip load along a quintic trajectory generated between 10 desired configurations. Computed torques and joint positions for 3,000 interpolated poses in under 0.75 seconds

Quadrotor Intercept Controller — **Aug 2024 – Dec 2024**
(MATLAB, Optimal Control, Simulation)

- Designed a Linear Quadratic Regulator (LQR) controller for a quadrotor to intercept a UAV with unknown trajectory using linearized 12-state dynamics
- Enforced actuator limits of 3 N per rotor and modeled torque effects for realistic control authority
- Achieved consistent intercepts of targets within 0.1 m at speeds of up to 4.8 m/s inside a 10x10x10 m flight volume

TECHNICAL SKILLS

Robotics/Planning/Controls: Robot Control, MPC, LQR, PID, CLFs/CBFs, Dynamics, FK/IK, RNEA, SLAM, MCL, Sensor Fusion, EKF/UKF, MDPs/POMDPs, LTL/STL, Automata Theory, Task Planning, Motion Planning, Trajectory Optimization, PDDL, OMPL, Nav2
Perception/ML: Camera Calibration, Computer Vision, Data Processing, Dataset Curation, Automatic Data Labeling, OpenCV, PyTorch, CNNs, LSTMs, Transformers, Seq2Seq Models, Model Training & Inference
Modeling/Simulation: Blender, Onshape, Fusion 360, Isaac Sim, Genesis, RViz 2, Gazebo, URDF/SDF, KiCad
Languages/Tools: MATLAB, Python, C++, Java, Rust, Linux, Git, ROS & ROS 2, CMake, Docker, Docker Compose, Claude Code, Codex