Roy Xing
Roboticist

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SKILLS

Programming	C++, C, Python, MATLAB, LaTeX, valgrind, gdb, Linux, git
Electronics | CAD	Microcontrollers, EagleCAD, Verilog, SolidWorks, OnShape, 3D Printing
Robotics | Controls | Simulators	ROS 1, ROS 2 OpenCV, PyTorch, Nonlinear Dynamics & Control, Dynamic Programming, Optimal Model-based Control, Linear Quadratic Regulators, Model Predictive Control, Trajectory Optimization, SLAM, Motion Planning, Reinforcement Learning, MuJoCo, Drake

EXPERIENCE

Sept 2021 – Aug 2024 | BU Robotics Lab (PI : Dr. John Baillieul) | Research Assistant

- Currently writing Centroidal MPC for Unitree G1 humanoid robot in MuJoCo gymnasium environment. Research goal is that of exploring loco-manipulation techniques that synthesize RL and model-based techniques with extensions to motion libraries.
- Currently researching extending model-based optimal control with RL for non-nominal environments via motion imitation of MPC iLQR.
- Conducted research into combining state-space control methods, such as LQR, with reinforcement learning approaches to leverage each of their advantages. The experiment resulted in the optimal control of an inverted pendulum on a cart in novel environmental parameters simulated in MuJoCo and trained with PyTorch.
- Implemented optical flow algorithms on AMRs with Python on ROS & run real-world experiments.
- Conducted mobile manipulation research on full body control for AMRs with mounted arms. Designed and programmed whole body control MPC (WBC-MPC) for mobile manipulator. Results accepted in successfully defended undergraduate thesis.

Clearpath UGV Jackal | Dingo-O Mobile Manipulator | Kinova Gen3 LITE arm | Unitree G1 Humanoid

Jan 2022 – Apr 2022 | BU Robotics Lab (PI : Dr. Roberto Tron) | Research Assistant

- Implemented motion planning algorithms on AMRs. Ran real-world experiments and data collection for sample-based path planning with bearing measurements. Resulting the in the pre-print with coauthorship, "Sample-Based Output-Feedback Navigation with Bearing Measurements."

Clearpath UGV Jackal

Oct 2019 – Aug 2021 | MassRobotics | Robotics Assistant Lab Manager | Robotics Developer & Tech

- Programmed AMRs & the Toyota human service robot (HSR) to use SLAM to map out the office space and motion planning trajectories for live demonstrations for partners and investors. Resulted in more engagements with visitors.
- Setup, programmed, and maintained various industrial & cobot robot arms for live demonstrations in ROS 1. Resulted in demos for force-sensor feedback for human-robot interaction (HRI).
- Designed and built robot gripper end effectors for various manipulators for startup residents.
- Consulted for ROS 1 and ROS 2 by residents to aid in robot system design and deployment. Also aided university residents in hardware configuration and design for HRI.

Toyota HSR | UR10 | UR10e UR5e | Rethink Sawyer | Mitsubishi Assista

Jan 2021 – Aug 2021 | Thinking Robots | Robotics Intern

- CAD work on novel tethered AMR solution for UV sanitization for the COVID-19 pandemic. Also programmed the cascaded PID controller for control of the tether system, resulting in a successful proof of concept for the NSF grant.
- CAD work and design for add-on extension for social robotics' chassis, enabling future add-ons and support modules.

Temi v3 Personal Robot | UV Sanitizing AMR

Sept 2018 – Aug 2019 | Dynamic Robotics Laboratory (PI : Dr. Jonathan W. Hurst) | Research Assistant

- Conducted research on the physical principles of legged locomotion through dynamic analysis and biomechanics research with MATLAB modeling. Resulting in novel modeling for foot impact dynamics that can theoretically achieve minimal transient forces during heel strike.
- Worked with and maintained legged robot, Cassie v2 from lab spin-off Agility Robotics, for real-world experiments on reinforcement learning control policies.
- Implemented MPC (Model Predictive Control) in MATLAB and Python meant for walking control of an LIP (linear inverted pendulum) locomotion model.

Agility Robotics Cassie | Agility Robotics Digit v1

June 2018 – Sept 2018 | **Booz Allen Hamilton | Air Force Division Systems Operations Intern**
- Wrote code for organizational operation system and performed code reviews for other parts of the said management system. Resulted in a successful scheduling system for consulting contracts.

June 2016 – Sept 2016 | **Aptima Inc. Human Centered Engineering | Computer Vision and Robotics Intern**
- Wrote OpenCV C++ programs to detect people and vehicles from drone footage. Resulted in 70% accuracy without using machine learning approaches.
- Designed and programmed ROS control nodes for taking brain wave EEG signals to control the movement of a robot arm. Resulted in the successful simple manipulation of a block on a table with a manipulator via thought inputs.

Surveillance Drones | Kinova JACO Arm

EDUCATION

Sept 2018 - Sept 2019	Oregon State University [Honors College] [GPA : 3.97/4.00] [BS : Electrical and Computer Engineering with a focus in Robotics (Minor in CS and Maths)]
Sept 2021 - Jan 2024	Boston University [GPA : 3.80/4.00] [BS : Electrical Engineering][Magna Cum Laude]
Sept 2024 - Present	New York University [GPA : 4.00/4.00] [PhD : Electrical Engineering]

PUBLICATIONS, FELLOWSHIPS, & AWARDS

>Preprint : M. Bahreinian, M. Mitjans, R. Xing, & R. Tron. "Sample-Based Output-Feedback Navigation Bearing Measurements." (2022)
>Paper acknowledgments, "Visual Navigation Using Sparse Optical Flow and Time-to-Transit" (2021)
>Paper acknowledgments, "Eliminating Peak Impact Forces by Customizing the Passive Foot Dynamics of Legged Robots" (2019)
>Journal acknowledgments, "Mitigating Peak Impact Forces by Customizing the Passive Foot Dynamics of Legged Robots" (2019)
>NYU School of Engineering PhD Fellowship (2024)
>Boston University Dean's List (2021-2024)
>Oregon State University Dean's List (2018-2019)
>Oregon State University Presidential Scholarship (2018)
>AFCEA (Armed Forces Communications and Electronics Association) Fellowship Award (2018)
>Letter of Commendation by Commonwealth of MA Speaker of the House for Achievement in STEM
>Official Citation by MA State Senate for STEM excellence for winning the RWDC State Championship and National Challenge Merit Award

SELECTED PERSONAL PROJECTS

ODRI BIPEDAL ROBOT : Ongoing Project : recreating the open-source ODRI bipedal robot. 3D printing the shells, modifying the BLDC motors for the belt-driven actuator design, programming the microcontrollers, soldering together the custom PCBs for motor control and main computing unit, and programming the PyBullet simulation walking MPC-based controllers and learning trajectory optimization. Currently porting over simulation to MuJoCo and testing motor controllers' performance.

WHEELED BIPED : Created a small 3D-printed bipedal wheeled robot from servo motors for the leg joints and BLDC motors for the wheels. A teensy 4.0 microcontroller is used to control the actuators, running the LQR and cascaded PID algorithms for balancing and leg length control respectively. A Raspberry Pi 4 runs a C++ program for remote directional inputs over WiFi.

FURUTA PENDULUM : Designed and modeled a 3D-printed Furuta pendulum with OnShape. The BLDC motor is controlled with a Moteus motor controller that is commanded by a computer that applies the feedback controller. The LQR controller was derived from a simulated model in Mujoco.

6 DOF ROBOT ARM : Designed and modeled a small manipulator with the ability for force sensing and current control via smart DYNAMIXEL actuators. Programmed simple inverted kinematics Python script to do position control.

FETCH & TURTLEBOT3 : Small AMRs programmed to use OpenCV to detect objects of certain colors, use SLAM to navigate to target objects, and with a custom-made arm grab the object and return it to the user.

VOLUNTEERING & COMMUNITY ENGAGEMENT

- IEEE International Symposium on Multi-Robot & Multi-Agent Systems 2023 Volunteer
- RoboBoston : STEM Day. Career Fair, Robot Block Party 2023 Volunteer
- Robotics Summit & Expo 2023 Volunteer
- RoboBoston : STEM Day, Career Fair, Robot Block Party 2022 Volunteer
- Robotics Summit & Expo 2022 Volunteer
- MassRobotics Jumpstart Fellowship Program 2022 Teacher & Volunteer
- MassRobotics Jumpstart Fellowship Program 2021 Teacher & Volunteer
- Robotics Summit & Expo 2018 Volunteer

References are available upon request from the following :

- Dr. John Baillieul (Distinguished Professor) | Boston University
- Joyce Sidopoulos (COO) | MassRobotics
- Dr. Jonathan Hurst (CRO & Professor) | Agility Robotics & OSU