Bohao Zhang

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EDUCATION

University of Michigan | Ph.D. in Robotics
Sep 2020 - May 2025 (anticipated) • Ann Arbor, MI

- Advisor: Dr. Ram Vasudevan

University of Michigan | B.S. in Computer Engineering
Sep 2018 - May 2020 • Ann Arbor, MI

- Minor in Mathematics

Shanghai Jiaotong University | B.S. in Electrical & Computer Engineering
Sep 2016 - Aug 2020 • Shanghai, China

PROFESSIONAL EXPERIENCE

University of Michigan | Undergraduate Research Assistant
Mar 2019 - Aug 2020 • Ann Arbor, MI

- Real-time motion planning & control on segways, robotic manipulators, and bipedal robots

TECHNICAL SKILLS

Programming Languages C/C++ • Matlab • CUDA • Python
Softwares Eigen • Pinocchio • IPOPT • MuJoCo • PyBullet • PyTorch
Hands-on Robot Platforms: Digit-v3 • Kinova-Gen3 • Fetch • Segway

PUBLICATIONS

- [**in preparation to T-RO**] **Bohao Zhang** , Ram Vasudevan. "Provably-Safe, Real-time Planning & Control For Bipedal Robots Using Reachability-Based Trajectory Design."
- [**submitted to RA-L**] Zachary Brei, Jonathan Michaux, **Bohao Zhang** , Patrick Holmes, Ram Vasudevan. "Serving Time: Real-Time, Safe Motion Planning and Control for Manipulation of Unsecured Objects." *arxiv.org/abs/2309.03111* (2023).
- [**submitted to T-RO**] Jonathan Michaux, Patrick Holmes, **Bohao Zhang** , Che Chen, Baiyue Wang, Shrey Sahgal, Tiancheng Zhang, Sidhartha Dey, Shreyas Kousik, Ram Vasudevan. "Can't Touch This: Real-Time, Safe Motion Planning and Control for Manipulators Under Uncertainty." *arxiv.org/abs/2301.13308* (2023).
- [**T-RO'21**] **Bohao Zhang*** , Shreyas Kousik*, Pengcheng Zhao*, Ram Vasudevan. "Safe, Optimal, Real-time Trajectory Planning with a Parallel Constrained Bernstein Algorithm." *IEEE Transactions on Robotics vol. 37, no. 3, pp. 815-830.* (2021).
- [**RSS'20**] Patrick Holmes, Shreyas Kousik, **Bohao Zhang** , Daphna Raz, Corina Barbalata, Matthew Johnson-Roberson, Ram Vasudevan. "Reachable Sets for Safe, Real-Time Manipulator Trajectory Design." *Robotics: Science and Systems* (2020).

RESEARCH EXPERIENCE (MOTION PLANNING, OPTIMIZATION, CONTROL)

Provably-Safe, Real-time Planning & Control For Bipedal Robots Using Reachability-Based Trajectory Design | University of Michigan
Sep 2021 - Present • Ann Arbor, MI

- Designed a new algorithm that offline generated a library of multiple-step gaits for a 36 DOF robot using nonlinear optimization
- Designed and implemented a passivity-based robust controller for fully actuated constrained systems in C++ to achieve bounded tracking error given model uncertainty
- Proposed a new method that generated whole-body reachable sets for real-time collision checking during online planning
- Allow bipeds to step over low obstacles for faster navigation in simulation

Real-Time, Safe Motion Planning and Control for Manipulation of Unsecured Objects | University of Michigan
Oct 2022 - Oct 2023 • Ann Arbor, MI

- Implemented an algorithm that provided safety guarantee of manipulating unsecured objects (for example, a glass cup on a plate) using a 7 DOF robotic arm
- Generated reachable sets of contact constraints, such as positive support force, friction cone, and ZMP constraints
- Designed and implemented algorithms in CUDA for generating reachable sets and online real-time planning

Autonomous Robust Manipulation via Optimization with Uncertainty-aware Reachability | University of Michigan

Oct 2021 - Oct 2023 • Ann Arbor, MI

- Designed and implemented a passivity-based robust controller for fully-actuated systems in C++ to achieve bounded tracking error given model uncertainty
- Performed reachability-based planning to achieve guaranteed-safe performance which enables collision avoidance and not violating torque limits
- Designed and implemented algorithms in C++/CUDA for generating reachable sets and online real-time planning that enables collision avoidance between a 7 DOF robotic arm and up to 40 obstacles

Real-Time, Certified, Chance-Constrained Motion Planning using the Parallel Bernstein Algorithm | University of Michigan

Jan 2021 - May 2021 • Ann Arbor, MI

- Applied parallel Bernstein algorithm to find the global optimum of the online optimization problem in real-time that enables vehicle lane changing
- Treated the vehicle reachable set as a probability distribution and formulated collision avoidance as chance constraints
- Implemented algorithms in C++/CUDA for online real-time planning

Safe, Optimal, Real-time Trajectory Planning with a Parallel Constrained Bernstein Algorithm | University of Michigan

Mar 2019 - May 2020 • Ann Arbor, MI

- Applied parallel Bernstein algorithm to find the global optimum of polynomial optimization problems for collision avoidance between obstacle point cloud and vehicle reachable sets represented as sum-of-squares polynomials
- Provided theoretical guarantee of convergence of the optimization problem
- Designed and implemented algorithms in C++/CUDA for online real-time planning

REVIEWING ACTIVITY

- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE Transactions on Machine Learning in Communications and Networking (TMLCN)
- IEEE Transactions on Robotics (T-RO)

AWARDS AND HONORS

- **Dean's List** | University of Michigan•2018, 2019
- **John Wu & Jane Sun Outstanding Scholarship** | Shanghai Jiaotong University•2016