

Tao Pang

✉ pangtao@csail.mit.edu • 🌐 pangtao.xyz

I am a roboticist at the Boston Dynamics AI Institute (BDAIL). I'm interested in enabling robots to intelligently and dexterously manipulate objects and their surroundings with rich contact that mirrors human cadence. In particular, I work on (i) efficient global planning for contact-rich manipulation by leveraging the structure of contact models, and (ii) imitation learning from planner-generated data. I believe the efficiency gained from model-based reasoning is crucial for producing the large-scale datasets needed to develop robotics foundation models capable of robust, generalizable and dexterous interactions.

Education

- **Massachusetts Institute of Technology** 09/2016 - 01/2023
PhD in Mechanical Engineering.
 - Thesis: Planning, Sensing, and Control for Contact-rich Robotic Manipulation with Quasi-static Contact Models.
 - Advisor: Prof. Russ Tedrake.
- **National University of Singapore** 08/2014 - 05/2016
M.Eng., Electrical and Computer Engineering.
 - Thesis: Design, Prototyping and Autonomous Control of Gasoline-engine Variable-pitch Quadcopter.
 - Advisor: Prof. Ben M. Chen.
- **National University of Singapore** 08/2008 - 05/2012
B.Eng (First Class Honors), Mechanical Engineering.
 - GPA: 4.89/5, with second major in mathematics.
 - Thesis: a CUDA-based Conjugate Gradient Solver for Finite Element Analysis.
 - Advisor: Prof. LIM Kian Meng.

Research Experience

- **Research Scientist** 02/2023 - Present
Roboics and AI Institute (formerly Boston Dynamics AI Institute).
 - Approximate globally optimal planning for contact-rich mobile manipulation.
 - Behavior cloning from planner-generated data.
- **Research Assistant** 09/2016 - 01/2023
Robot Locomotion Group, MIT CSAIL.
 - Developed a model-based contact-rich planning algorithm which can generate dexterous manipulation plans for a 16DOF anthropomorphic hand in under 1 minute of wall-clock time on a laptop.
 - Developed a convex, differentiable quasi-dynamic rigid body contact dynamics model, facilitating planning through contact.
 - Designed and implemented a joint-torque-based contact force estimation and control pipeline for the Kuka iiwa arm. The controller would keep an egg intact if the arm accidentally ran into it.
- **Associate Scientist** 04/2013 - 08/2016
Unmanned Systems Research Group, National University of Singapore.
 - Designed and built a 10kg gasoline-powered variable-pitch quadrotor which can remain airborne for up to 3 hours.
 - Provided mechanical design feedback and assistance to various projects in the group.
- **Summer Research Undergraduate Fellowship (SURF)**. 05/2010 - 08/2010
California Institute of Technology.
 - Designed and implemented a path planning algorithm for the Axel robot, a tethered Mars rover prototype.
 - Advisor: Prof. Joel W. Burdick.

Selected Publications

- **Dexterous Contact-Rich Manipulation via the Contact Trust Region** [website] 2025
*H.J.T. Suh**, *T. Pang**, *T. Zhao*, *R. Tedrake*
Under Review.
- **Physics-Driven Data Generation for Contact-Rich Manipulation via Trajectory Optimization** [website] 2025
L. Yang, *H.J.T. Suh**, *T. Zhao**, *B. Grasdal*, *T. Kelestemur*, *J. Wang*, *T. Pang*, *R. Tedrake*
Under Review.
- **Is Linear Feedback on Smoothed Dynamics Sufficient for Stabilizing Contact-Rich Plans?** [pdf] 2025
Y. Shirai, *T. Zhao*, *H.J.T. Suh*, *H. Zhu*, *X. Ni*, *J. Wang*, *M. Simchowitz*, *T. Pang*
IEEE International Conference on Robotics and Automation (ICRA).
- **Should We Learn Contact-Rich Manipulation Policies from Sampling-Based Planners?** [pdf] 2024
H. Zhu, *T. Zhao*, *X. Ni*, *J. Wang*, *K. Fang*, *L. Righetti*, *T. Pang*
Under Review.
- **Planning-Guided Diffusion Policy Learning for Generalizable Contact-Rich Bimanual Manipulation** [pdf] 2024
X. Li, *T. Zhao*, *X. Zhu*, *J. Wang*, *T. Pang*, *K. Fang*
- **Global Planning for Contact-Rich Manipulation via Local Smoothing of Quasi-dynamic Contact Models** [pdf] [MIT News] 2023
*T. Pang**, *H.J.T. Suh**, *L. Yang*, *R. Tedrake*
IEEE Transactions on Robotics (TR-O).
Honorable Mention for the IEEE TR-O King-Sun Fu Memorial Best Paper Award.
- **Bundled Gradients through Contact via Randomized Smoothing** [pdf] 2022
*H.J.T. Suh**, *T. Pang**, *R. Tedrake*
IEEE Robotics and Automation Letters (RA-L).
- **SEED: Series Elastic End Effectors in 6D for Visuotactile Tool Use** [pdf] [MIT News] 2022
H.J.T. Suh, *N. Kuppuswamy*, *T. Pang*, *P. Mitiguy*, *A. Alspach*, *R. Tedrake*
IEEE International Conference on Intelligent Robots and Systems (IROS).
- **Easing Reliance on Collision-free Planning with Contact-aware Control** [pdf] 2022
T. Pang, *R. Tedrake*
IEEE International Conference on Robotics and Automation (ICRA).
- **A Convex Quasistatic Time-stepping Scheme for Rigid Multibody Systems with Contact and Friction** [pdf] 2021
T. Pang, *R. Tedrake*
IEEE International Conference on Robotics and Automation (ICRA).
- **Identifying External Contacts from Joint Torque Measurements on Serial Robotic Arms and Its Limitations** [pdf] 2021
T. Pang, *J. Umenberger*, *R. Tedrake*
IEEE International Conference on Robotics and Automation (ICRA).
- **A Robust Time-Stepping Scheme for Quasistatic Rigid Multibody Systems** [pdf] 2018
T. Pang, *R. Tedrake*
IEEE International Conference on Intelligent Robots and Systems (IROS).
- **Design and Implementation of a Variable-pitch Long-endurance Gasoline-engine Quadrotor** [pdf] 2016
T. Pang, *F. Lin*, *K. Peng* and *B.M. Chen*
IEEE International Conference on Control and Automation (ICCA).

Selected Awards & Honors

- **Honorable Mention for the IEEE TR-O King-Sun Fu Memorial Best Paper Award** 2023
For work on "Global Planning for Contact-Rich Manipulation via Local Smoothing of Quasi-dynamic Contact models".
- **First Prize.** 2014
International Micro Air Vehicle (IMAV) Competition, Delft, Netherlands.
 - 1st place out of 12 teams from 7 countries.
 - In charge of mechanical design of the quadrotor and on-board components such as camera gimbals.

- **Overall Champion Award (Gold), Best Performance Award (Gold), Most Creative Award (Bronze).** 2014
Singapore Amazing Flying Machine Competition, Singapore.
 - Category E: Unconventional Aircraft.
 - Most renowned aerial robot competition in Singapore.
 - Designed the mechanical structure of a tail-sitter aircraft capable of transition between VTOL and fixed-wing modes.
- **Lee Kuan Yew Gold Medal, IES Gold Medal, Exxonmobil Medal.** 2012
National University of Singapore.
 - Student with the highest GPA in Mechanical Engineering during their period of study.
- **Lee Kwok Hong Memorial Medal and Prize.** 2012
National University of Singapore.
 - Best student in the areas of dynamics and computational mechanics.
- **Undergraduate Scholarship.** 2008-2012
National University of Singapore.
 - Full undergraduate tuition and stipend.

Media Coverage

- **AI helps robots manipulate objects with their whole bodies:** A.Zewe, MIT News. 2023
- **Soft robots that grip with the right amount of force:** R. Gordan, MIT News. 2022

Service

- Organizer for Workshop on Leveraging Models for Contact-Rich Manipulation, IROS 2023
- Reviewer, 29 manuscripts.
 - Robotics: TR-O(3), RA-L(10), RSS(3), ICRA(7), IROS(4).
 - Machine Learning: L4DC(2).

Teaching Experience

- **Teaching Assistant** Fall 2018 & 2019
First & second offerings of MIT 6.800/6.843, Robotic Manipulation.
 - Designed from scratch programming problem sets for basic topics in robotics, including kinematics, point cloud registration, force control and sampling-based motion planning.
 - Designed and supervised robot labs where students are asked to put a rubber brick inside a closed cabinet with the Kuka iiwa robot arm.