Hyung Ju Terry Suh

Website: hjrobotics.net

Research Statement

My research interest lies in enabling robots with human-like dexterity and intelligence in manipulation. Through this technology I aim to broaden the spectrum of capabilities we have on automating physical tasks in the real world. To achieve this capability, I am searching for elegant solutions for perception, planning, and control through contact-rich dynamics that are frequent in real-world manipulation. In search of these solutions, I am broadly interested in bringing tools from rigorous model-based / mathematical disciplines (simulation, control, optimization, statistics) to understand, interpret, and improve recent empirical advances in machine learning (reinforcement learning, computer vision).

EDUCATION

Massachusetts Institute of Technology	Cambridge, USA
• Ph.D. Candidate in Electrical Engineering and Computer Science	Sep 2019 - June 2025 (Exp.)
Advisor: Russell L. Tedrake	
Massachusetts Institute of Technology	Cambridge, USA
S.M. in Electrical Engineering and Computer Science	Sep 2019 - June 2022
Advisor: Russell L. Tedrake	
Thesis Title: Predictive Models for Visuomotor Feedback Control in Object Pile Manipulation	
California Institute of Technology	Pasadena, USA

B.S. in Computer Science and Mechanical Engineering (Double Major) GPA: 4.1/4.3, Thesis Advisor(s): Joel W. Burdick, Aaron D. Ames Thesis Title: Design and Planning of Flying-Driving Hybrid Robot

• Korean Minjok Leadership Academy

Honors & Awards

- Best Paper Award of the Year, IEEE RAS TC on Model-Based Optimization in Robotics, 2022 For work on "Do Differentiable Simulators Give Better Policy Gradients?"
- Outstanding Paper Award, International Conference on Machine Learning (ICML), 2022 For work on "Do Differentiable Simulators Give Better Policy Gradients?"
- Henry Ford II Scholar Award, Caltech, 2018 Awarded for highest academic record within major, cash award of \$5000.
- Jack E. Froelich Memorial Award, Caltech, 2018 Awarded for most outstanding promise for a creative professional career. Cash award of \$1500.
- Kwanjeong Foundation Full Tuition Scholarship Full scholarship of \$55000 per year for the duration of undergraduate studies.

INDUSTRY EXPERIENCE

Boston Dynamics AI Institute, Dexterous Mobile Manipulation Team Cambridge, USA Summer Research Intern with Dr. Tao Pang May 2023 - Aug 2023 • Developed multi-query algorithms for global planning through contact-rich dynamics. • Implemented a ellipsoidal calculus toolbox using Semi-Definite Programming (SDP).

Toyota Research Institute, Robot Manipulation Team

Summer Research Intern with Dr. Naveen Kuppuswamy

- Developed algorithms for compliant feedback control of a visuotactile sensing mechanism.
- Established theoretical characterization of visuotactile sensors as a generalization of series elastic actuators.

NASA Jet Propulsion Laboratory, Robotics Section

Undergraduate Researcher with Dr. Adrian Stoica

- Implemented SLAM and autonomous navigation using ROS with Kinect, IMU, GPS, and 3D Vision sensors.
- Modified posture detection aglortihm to translate video motion to humanoid writing notation.

Republic of Korea Army, Intelligence

- Sergeant, Analyst
 - Software development for classified analysis.

Sep 2013 - June 2019

Cambridge, USA

May 2021 - Sep 2021

La Canada Flintridge, USA Sep 2017 - Sep 2018

> Korea Sep 2014 - May 2016

SKILLS

- Programming Languages: Python, C++, MATLAB
- Software & Packages: Drake, PyTorch, ROS, OpenCV
- **Design & Modeling:** Solidworks, ANSYS, Simulink
- Machine Prototyping: CNC Mill, Lathe, 3D Printing, Water Jetting, Laser Cutting, Fast Prototyping

JOURNAL PUBLICATIONS

* indicates equal contribution.

- 1. Global Planning for Contact-Rich Manipulation via Local Smoothing of Quasidynamic Contact Models T. Pang*, H.J. Terry Suh*, L. Yang, R. Tedrake Transactions of Robotics (T-RO), 2023
- 2. Do Differentiable Simulators Give Better Policy Graidents? H.J. Terry Suh*, M. Simchowitz, K.Zhang, R. Tedrake In Review at Journal of Machine Learning Research (JMLR), 2023
- 3. Bundled Gradients through Contact via Randomized Smoothing H.J. Terry Suh*, T. Pang*, R. Tedrake IEEE Robotics and Automation Letters (RA-L) 7(2), 4000-4007, 2022. Presented at ICRA.

CONFERENCE & WORKSHOP PUBLICATIONS

- 1. How Does Noising Data Affect Learned Contact Dynamics? H.J. Terry Suh, M. Simchowitz, T. Pang, R. Tedrake IROS 2023 Workshop: Learning Meets Model-based Methods for Manipulation and Grasping
- 2. Fighting Uncertainty with Gradients: Offline Reinforcement Learning via Diffusion Score Matching H.J. Terry Suh, G. Chou, H. Dai, L. Yang, A. Gupta, R. Tedrake Conference on Robot Learning (CoRL), 2023
- 3. SEED: Series Elastic End-Effectors in 6D for Visuotactile Tool Use H.J. Terry Suh, N. Kuppuswamy, T. Pang, P. Mitiguy, A. Alspach, R. Tedrake International Conference on Intelligent Robots and Systems (IROS), 2022
- 4. Do Differentiable Simulators Give Better Policy Gradients? H.J. Terry Suh, M. Simchowitz, K. Zhang, R. Tedrake International Conference on Machine Learning (ICML), 2022, Long Talk, Outstanding Paper Award
- 5. Pathologies and Challenges of Using Differentiable Simulators in Policy Optimization for Contact-rich Manipulation H.J. Terry Suh, M. Simchowitz, K. Zhang, T. Pang, R. Tedrake ICRA 2022 Workshop: RL for Manipulation
- 6. The Surprising Effectiveness of Linear Models for Visual Foresight in Object Pile Manipulation H.J. Terry Suh, R. Tedrake

Algorithmic Foundation of Robotics XIV (WAFR), 347-363, 2020

- 7. Energy-Efficient Motion Planning for Multi-Modal Hybrid Locomotion H.J. Terry Suh, X. Xiong, A. Singletary, A.D. Ames, J.W. Burdick IEEE International Conference on Intelligent Robots and Systems (IROS), 2020
- 8. Towards a Humanoid-Oriented Movement Writing A. Stoica, H.J. Terry Suh, S.M. Hewitt, S. Bechtle, A. Gruebler, Y. Iwashita IEEE International Conference on Systems, Man, and Cybernetics (SMC), 2017

Media Coverage & Invited Talks

- 1. AI Helps Robos Manipulate Objects with their whole bodies: A. Zewe, MIT News, 2023
- 2. Smoothing Techniques for Optimal Control of Highly Contact-Rich Systems: WILLOW & Gepetto Team, 2023
- 3. Do Differentiable Simulators Give Policy Gradients?: AMBER Lab, Caltech, 2023
- 4. A Model-Based Interpretation of RL for Contact-Rich Systems Through the Lens of Randomized Smoothing: Machines in Motion Laboratory, NYU, 2022
- 5. Optimization through Contact Dynamics: A Stochastic Perspective: Hyundai Vision Conference, 2022
- 6. Soft Robots that Grip with the Right Amount of Force: R. Gordon, MIT News, 2022
- 7. Manipulating the Future: A. Belanger, MIT News, 2022

SERVICE

- Lead Organizer for Workshop on Leveraging Models for Contact-Rich Manipulation, IROS 2023:
- Lead Organizer for MIT Embodied Intelligence Seminar, 2023-24:
- Reviewer, 31 manuscripts:
 - **Robotics**: T-RO (1), IJRR (1), RA-L (2), IROS (1), ICRA (4), CoRL (3)
 - Machine Learning: ICML (4), AAAI (3), NeurIPS (6), ICLR (4), L4DC (2)

Teaching & Mentoring Experience

- Mentored Undergraduate Research: Shao Yuan Chew Chia (Harvard), Anika Cheerla (MIT)
- Mentored Master's Research: Michelle Tan (MIT)
- Teaching Assistant, MIT 6.881, Robotic Manipulation
- Teaching Assistant, Caltech ME72, Engineering Design Laboratory Teaching Assistant, Caltech ME14, Mechanical Design and Prototyping
- Teaching Assistnat, Caltech CS11: Computer Language Shop (C++)