Michael Andrés Lin

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I am a robotics researcher working at the intersection of controls, sensor design, and tactile perception. Previously, I worked in a startup where I built robot arms for industrial assembly. My experience, led me to pursue my research on understanding how we might improve robot performance to execute tasks under uncertainty. To achieve this, I design novel sensors for tactile exploration, develop probabilistic methods for perception, and apply model-driven control methods.

keywords: tactile sensing and perception, robotic manipulation and grasping

Education

PhD Mechanical Engineering - Robotics 2019-2023 (Expected)
Stanford University (Stanford, CA)
- Thesis Committee: Mark Cutkosky (advisor), Jeannette Bohg, Monroe Kennedy III

MS Mechanical Engineering - Robotics 2015-2017
Stanford University (Stanford, CA)
- Focus: Dynamics & Controls, Robotics, Mechatronics

BS Electrical Engineering and Computer Science 2011-2015
University of California - Berkeley (Berkeley, CA)
- EECS Honors

Professional Experience

Research Intern June 2022-Present
NVIDIA Seattle Robotics Lab (Seattle, WA)
Manager: Dieter Fox, Mentor: Yashraj Narang
- Investigating methods to improve physics simulation accuracy of robot manipulators with the goal of facilitating sim2real transfer of robot skills for contact-rich industrial assembly.
- Developing a framework for dynamics identification of an industrial robot arm (Franka Panda) which uses a differentiable dynamical model implemented in PyTorch to optimize for robot inertial and friction parameters. Successfully trained models that predict joint torques from a new dataset with 100k samples.
- Working towards submitting my work as a conference publication. This framework will help NVIDIA towards the goal of making physics simulation more realistic and using accelerated simulation to train robots with skills than produce value in manufacturing.

Graduate Research Assistant 2019-Present
Stanford University Biomimetics and Dexterous Manipulation Lab (Stanford, CA)
Advised by Mark Cutkosky, Ph.D.
- Investigated design of bio-inspired whisker sensor instrumented on robot manipulators to sense surroundings through very light contacts. Developing real-time Bayesian filtering methods to combine robot proprioception and forces on the whisker to estimate contact

locations to sub-millimeter accuracy. Successfully demonstrated perception of object location and shape when reaching in clutter.
- Investigated low-impedance robot gripper optimized for dynamic contact interactions with light objects. Leveraged the dynamics of the gripper to localize free-standing objects to sub-mm accuracy through contact measurements using Bayesian filtering.
- Developed a reactive controller for a robot arm to reach into constrained spaces. Demonstrated that using custom-made pneumatic-based tactile skin the arm is able to reach into spaces such as cabinets while applying low forces and avoiding collisions.

Graduate Teaching Assistant Winter & Spring Qtr 2022

Advanced Dynamics & Computation Graduate-level (Stanford, CA)
Instructor: Paul Mitiguy

- Teaching methods such as D'Alembert, Lagrange and Kane to efficiently formulate equations of motion for multi-body systems, as well as computational methods to simulate dynamical behavior.

Robotics Systems Engineer 2017-2019

Flexiv Robotics (Santa Clara, CA)

- Architected system design for a 7-DOF torque-controlled robot manipulator. Integrated joint sensors and actuators to enable robust, efficient, and ISO safety-compliant motion control.
- Designed and optimized a model-based Field Oriented controller for brushless DC Motor current control that outperformed competitive off-the-shelf motor controllers.
- Developed system testing procedures for problem solving through root-cause analysis and communicated findings to teammates effectively to drive design changes.
- Showcased the 7-DOF manipulator executing assembly and surface polishing tasks at automation trade fair Hannover Messe 2019.

Graduate Research Assistant 2015-2017

Stanford University - Biomimetics & Dexterous Manipulation Lab
Advised by Mark Cutkosky, Ph.D. and Bruce Daniel, M.D.

- Developed mixed-reality based navigation system for biopsy needle insertion to improve needle placement accuracy.
- Developed a shape-sensing needle (fiber optics sensing) to provide physicians with accurate real-time visualizations of the needle even under deflection.
- Conducted user studies on the guidance system that showed a 26% reduction in errors in when using needle shape information to assist in placing needle tip at a 2 mm target.

Undergraduate Research Assistant 2015-2017

Stanford University - CHARM Lab
Advised by Allison Okamura, Ph.D.

- Designed a hand-held variable stiffness haptic gripper used to teleoperate a laparoscopic surgical robot with the goal of reducing patient tissue damage during tissue handling.
- Demonstrated through user studies that rendering variable grip stiffness helps minimize the effective grip force users apply at the follower system (Raven II surgical robot system).

Academic Publications

Google Scholar: https://scholar.google.com/citations?user=n20ytXgAAAAJ

Refereed Journal & Conference Articles

1. **Michael A. Lin**, Emilio Reyes, Jeannette Bohg and Mark R. Cutkosky. Whisker-Inspired Tactile Sensing for Contact Localization on Robot Manipulators. 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE, 2022.
2. Hojung Choi, Dane Brouwer, **Michael A. Lin**, Kyle Yoshida, Carine Rognon, Benjamin Stephens-Fripp, Allison M. Okamura, Mark Cutkosky. Deep Learning Classification of Touch Gestures Using Distributed Normal and Shear Force. 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE, 2022.
3. **Michael A. Lin**, Rachel Thomasson, Gabriela Uribe, Hojung Choi, and Mark R. Cutkosky. Exploratory Hand: Leveraging Safe Contact to Facilitate Manipulation in Cluttered Spaces. IEEE Robotics and Automation Letters 6, no. 3 (2021): 5159-5166.
4. Alexander M. Gruebele, **Michael A. Lin**, Dane Brouwer, Shenli Yuan, Andrew C. Zerbe, and Mark R. Cutkosky. A Stretchable Tactile Sleeve for Reaching Into Cluttered Spaces. IEEE Robotics and Automation Letters 6, no. 3 (2021): 5308-5315.
5. **Michael A. Lin**, Alexa F. Siu, Jung Hwa Bae, Mark R. Cutkosky, and Bruce L. Daniel. Holoneedle: augmented reality guidance system for needle placement investigating the advantages of three-dimensional needle shape reconstruction. IEEE Robotics and Automation Letters 3, no. 4 (2018): 4156-4162.
6. Stephanie L. Perkins, **Michael A. Lin**, Subashini Srinivasan, Amanda J. Wheeler, Brian A. Hargreaves, and Bruce L. Daniel. A mixed-reality system for breast surgical planning. In 2017 IEEE International Symposium on Mixed and Augmented Reality (ISMAR-Adjunct), pp. 269-274. IEEE, 2017.
7. Jung Hwa Bae, Christopher J. Ploch, **Michael A. Lin**, Bruce L. Daniel, and Mark R. Cutkosky. Display of needle tip contact forces for steering guidance. In 2016 IEEE haptics symposium (HAPTICS), pp. 332-337. IEEE, 2016.
8. **Michael A. Lin**, Samuel B. Schorr, Iris Yan, and Allison M. Okamura. The effect of manipulator gripper stiffness on teleoperated task performance. In 2015 IEEE World Haptics Conference (WHC), pp. 494-499. IEEE, 2015.

Patent Applications

1. Bruce L. Daniel, Brian A. Hargreaves, **Michael A. Lin**, Christoph Leuze, Stephanie Liu Perkins, Serena Zhang. Novel system for in situ visualization of solid tumors and sentinel nodes within the patient's body [*submitted December 2021*].
2. Alexander Gruebele, **Michael A. Lin,** Daniel Brower, Mark R. Cutkosky. A Stretchable Tactile Sleeve for Reaching into Cluttered Spaces. U.S. Patent Application 63/168091, filed March 30, 2021.
3. Stephanie Liu Perkins, Bruce L. Daniel, Brian A. Hargreaves, **Michael A. Lin**, Christoph Leuze. System for visualizing tumor location and extent within opaque tissues. U.S. Patent Application 63/162408, filed March 17, 2021.

4. **Michael A. Lin**, Jung Hwa Bae, Subashini Srinivasan, Mark R. Cutkosky, Brian A. Hargreaves, and Bruce L. Daniel. Real-time Three Dimensional Display of Flexible Needles Using Augmented Reality. U.S. Patent Application 15/786,952, filed May 3, 2018.

Skills

Robot System - Robot Arm Manipulation, Robot Operating System, Physics Simulation (PyBullet, MuJoCo, NVIDIA Isaac Gym)

Machine Learning - Deep Reinforcement Learning, Deep Learning Models for Visual and Sequential data (CNN, RNN, LSTM), Gaussian Process Regression

Coding - Python, C++, C (Low level), MATLAB, C#

Embedded Systems - State machines, SPI, I2C, UART, EtherCAT, BLE

Hardware - Motor control, circuit design & testing, CAD modeling

Honors & Awards

- Best Poster Award (of 113 posters) at Stanford Bio-X IIP Symposium, 2017
- National Science Foundation Graduate Research Fellowship (NSF GRFP), 2015
- Stanford School of Engineering Fellowship, 2015
- 1st place NATCAR competition (autonomous RC car racing)