Michael Andrés Lin

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Research Interests

I am building robots more capable of effectively perceiving the environment through novel sensor designs and state estimation algorithms. Specifically, I have developed low inertia robot end effectors, and compliant and distributed pneumatic and whisker sensors instrumented on a robot manipulator that facilitate rich contact interactions. Through Bayesian inference methods, I integrate contact measurements into useful representations of the environment.

keywords: tactile sensing and perception, robotic manipulation and grasping, manipulation in unstructured environment

Education

PhD Mechanical Engineering - Robotics 2019-2022 (Expected)
Stanford University (Stanford, CA)
- Thesis Committee: Mark Cutkosky (advisor), Jeannette Bohg, Monroe Kennedy III

MS Mechanical Engineering 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

Graduate Research Assistant 2019-Present
Stanford University Biomimetics and Dexterous Manipulation Lab (Stanford, CA)
Advised by Mark Cutkosky, Ph.D.
- Investigating design of bio-inspired whisker sensor instrumented on robot manipulators to sense surroundings through very light contacts. Developing Bayesian filtering methods to combine robot proprioception and forces on the whisker to estimate contact locations. Aiming to use this sensing method to reach and navigate constrained spaces using haptic feedback.
- Developed a 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 Particle Filtering.
- Developed a pneumatic-based tactile sensing skin for large surface distributed pressure sensing and implemented reactive controllers to reach into constrained spaces while maintaining low forces.

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 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**, 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.
2. 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.
3. **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.
4. 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.

5. 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.
6. **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

Coding - C++, Python, C (Low level), MATLAB, C#
Libraries & Toolkits - PyBullet, PyTorch, OpenCV, Qt-5, ROS, MoveIt!, Gazebo, RBDL, Unity
Embedded Systems - State machines, SPI, I2C, UART, EtherCAT, BLE
Hardware - Motor control, circuit design & testing, CAD modeling, rapid prototyping

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)