

# Michael Andrés Lin

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## Education

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### Stanford University

*PhD candidate, Mechanical Engineering - Robotics*

Principal Investigator: Dr. Mark Cutkosky

**Stanford, CA**

*2019 – Present*

### Stanford University

*M.S. Mechanical Engineering, GPA: 3.87*

Concentration: Embedded Systems, Robotics, Dynamics

**Stanford, CA**

*2015 – 2017*

### University of California, Berkeley

*B.S. Electrical Engineering and Computer Science, GPA: 3.79 with Honors*

Concentration: Signals and Systems, Embedded Systems

**Berkeley, CA**

*2011 – 2015*

## Research Experience

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### Biomimetics and Dexterous Manipulation Lab

*Graduate Researcher, Advisors: Mark Cutkosky, Ph.D.*

**Stanford, CA**

*September 2019 – Present*

Project: Investigating methods to enable robots to use the sense of touch to explore and manipulate in cluttered and unstructured environments such as house-hold environments (in collaboration with Toyota Research Institute).

- Designed robot hands with light-weight fingers that afford to make contact with objects quickly and, thus, perform tasks faster under uncertainty.
- Developed a particle filtering algorithm that allows a robot to use contact with objects to determine their location to sub-millimeter accuracy.
- Developed a robust pneumatic tactile skin and integrated it with an industrial robot arm to reach into constrained spaces such as fridges and use sensory feedback to react to contacts safely.
- Implemented a potential field controller to allow a robot arm (Universal Robot UR5) equipped with a custom 2-DOF wrist to reach into constrained spaces while using a robot skin to sensing contacts with the environment and navigate safely.

*Graduate Researcher, Advisors: Mark Cutkosky, Ph.D., Bruce Daniel, M.D.     September 2016 – January 2018*

Project: Develop augmented-reality guidance system for needle biopsy. Improved insertion accuracy by displaying in real-time a holographic view of biopsy needle as inserted in patient tissue.

- Developed a new method of using Mixed-reality (Microsoft HoloLens) to visualize a biopsy needle during insertion relative to internal patient anatomy in order to assist physicians during surgery. Integrated needle strain sensing to allow for real-time update of needle shape and tip location.
- Used world-anchored camera tracking system (OptiTrack) and implemented registration procedures to find the relative transform between reference frame of user eyes, needle and patient.
- Conducted user studies on needle insertion in phantom tissue to quantify the improvement in needle placement accuracy when using the AR system compared to traditional procedure.

### CHARM Lab

*Undergraduate Researcher, Advisor: Allison Okamura, Ph.D.*

**Stanford, CA**

*May 2014 – August 2014*

- Designed a hand-held actuated haptic gripper for teleoperation of the Raven Surgical Robot system (open source surgical robot). The device is capable of rendering programmed grip stiffness and command gripper position to the surgical robot.
- Integrated gripper into the teleoperation controller using Robot Operating System (ROS).
- Conducted subject experiment to study effects of gripper stiffness on user performance during robotic surgery.

## Work Experience

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### Flexiv Robotics (startup)

*Senior Robotics Systems Engineer*

**Santa Clara, CA**

*January 2018 – August 2019*

Worked on developing a torque-controlled 7 degrees-of-freedom robotic arm for use in industrial manufacturing. Responsible for designing torque controllers to drive each joint, developing safety-compliant firmware and system integration.

- o Designed and implemented model-based Field Oriented control for brushless motors running at 50 KHz that outperformed off-the-shelf motor controllers.
- o Improved joint control fidelity by implementing friction compensation using disturbance observer as well as torque ripple compensation using spatial filters.
- o Developed the embedded program that controls each joint and integrates multiple joints into the robot arm system. This included designing the event-driven state machine, system-level communication interface (EtherCAT), local communication protocol (SPI, UART) and fast sensor sampling and actuator control.
- o Created automation and testing scripts/procedure for stream-lining joint fabrication and validating electrical and mechanical designs.

## Publications

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### Journal Papers.....

1. (In Review) **M. A. Lin\***, R. Thomasson, G. Uribe, H. Choi, M. R. Cutkosky, "Exploratory Hand: Leveraging Safe Contact to Facilitate Manipulation in Cluttered Spaces," Robotics and Automation Letters 2021
2. (In Review) A. M. Gruebele, **M. A. Lin**, D. Brouwer, S. Yuan, A. Zerbe, M. R. Cutkosky, "A Stretchable Tactile Sleeve for Reaching into Cluttered Spaces," Robotics and Automation Letters 2021
3. **M. A. Lin**, A. F. Siu, J-H Bae, M. R. Cutkosky and B. L. Daniel, "HoloNeedle: Augmented-reality Guidance System for Needle Placement Investigating the Advantages of 3D Needle Shape Reconstruction," Robotics and Automation Letters 2018

### Conference Papers and Abstracts.....

1. **M. A. Lin**, J-H Bae, S.Srinivasan, S. L. Perkins, C. Leuze, B. Hargreaves, M. R. Cutkosky and B. L. Daniel "MRI-guided Needle Biopsy using Augmented Reality," Presented at International Society for Magnetic Resonance in Medicine 25th Annual Meeting and Exhibition (ISMRM 2017)
2. S. L. Perkins, **M. A. Lin**, S.Srinivasan, A. J. Wheeler, B. A. Hargreaves and B. L. Daniel "A Mixed-Reality System for Breast Surgical Planning," 2017 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)"
3. J-H Bae, C. Ploch, **M. A. Lin**, B. L. Daniel and M. R. Cutkosky, "Display of Needle Tip Contact Forces for Steering Guidance," Presented at Haptics Symposium 2016
4. **M. A. Lin**, S. B. Schorr, I. Yan, A. M. Okamura, "The effect of manipulator gripper stiffness on teleoperated task performance," Presented at Haptics Symposium 2015

## Skills

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**Software:** (*proficient*) C/C++, Python, ROS, MATLAB, Git

(*familiar*) Javascript, Java, Perl

**Hardware:** Circuit design and layout, CAD (Solidworks/OnShape), Rapid Prototyping (3D printing, laser cutting)

**Spoken Languages** Spanish (native), Mandarin Chinese (fluent), Japanese (limited)

## Teaching Experience

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### Introduction to Microelectronic Circuits

**Berkeley, CA**

*Teaching Assistant*

*Fall 2013 & Spring 2015*

- o Taught fundamentals of circuits and their application in hands-on lab projects.
- o Instructed students on differential amplifiers, AC/DC converters, active and passive filters. Laboratory assignments included hands-on circuit prototyping on breadboards and computer-aided analysis with SPICE.

## Honors and Awards

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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
Best Hardware Hack at Hackers@Berkeley Hackathon	2012

*Updated on November 5, 2020*