

# ANDREW SANG-JIN CHOI

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Website <https://quantumope.github.io>

Code <https://github.com/QuantuMope>

Google Scholar <https://tinyurl.com/quantumope>

## EDUCATION

Research Interests: **robotics, sim2real, physical simulation, robot learning & vision**

### Doctor of Philosophy, Computer Science

Sept. 2021 - Present

Major: Graphics & Vision | Minors: Robotics & Artificial Intelligence

GPA: 4.0/4.0

University of California, Los Angeles

Advisors: M. Khalid Jawed, Jungseock Joo, and Demetri Terzopoulos

### Master of Science, Computer Science

Sept. 2019 - June 2021

University of California, Los Angeles

GPA: 4.0/4.0

M.S. Thesis: *An Implicit Contact Method for Tying Discrete Elastic Knots*

### Bachelor of Science, Mechanical Engineering

Sept. 2014 - June 2018

University of California, Davis

GPA: 3.8/4.0

Senior Design: *Underactuated Shoe Tying Manipulator*

Top 6% in College of Eng.

## IN-PROGRESS FIRST AUTHOR PROJECTS

- Motion planning for robotic knot tying via simulation generated inverse unraveling (*co-first*)
- DisMech: an efficient and physically accurate simulator for controlling soft robots comprised of elastic rods (*first*)
- Active learning for efficient 3D reconstruction via NERF models (*co-first*)

## SUBMITTED & IN-PROGRESS PUBLICATIONS

- T-ASE 2023     **A. Choi\***, D. Tong\*, D. Terzopoulos, J. Joo, and M. K. Jawed. “Deep Learning of Force Manifolds from the Simulated Physics of Robotic Paper Folding”, *IEEE Transactions on Automation Science and Engineering*, 2023 (***submitted and on arXiv***)
- IJRR 2023     D. Tong, **A. Choi**, W. Huang, L. Qin, and M. K. Jawed. “Sim2Real Physically Informed Neural Controllers for Robotic Deployment of Deformable Linear Objects”, *International Journal of Robotics Research*, 2023 (***in revision and on arXiv***)

## PUBLICATIONS

- RA-L 2023     **A. Choi**, D. Tong, B. Park, D. Terzopoulos, J. Joo, and M. K. Jawed. “mBEST: Realtime Deformable Linear Object Detection Through Minimal Bending Energy Skeleton Pixel Traversals”, *IEEE Robotics and Automation Letters*, 2023
- EML 2023     D. Tong\*, **A. Choi\***, J. Joo, and M. K. Jawed. “A Fully Implicit Method for Robust Frictional Contact Handling in Elastic Rods”, *Extreme Mechanics Letters*, 2023
- JAM 2022     D. Tong, **A. Choi**, J. Joo, A. Borum, and M. K. Jawed. “Snap Buckling in Overhand Knots”, *Journal of Applied Mechanics*, 2022
- ICRA 2022     **A. Choi**, M. K. Jawed, and J. Joo. “Preemptive Motion Planning for Human-to-Robot Indirect Placement Handovers”, *IEEE International Conference on Robotics and Automation (ICRA)*, 2022
- WACV 2022     A. Vepa, **A. Choi**, N. Nakhaei, W. Lee, et al. “Weakly-Supervised Convolutional Neural Networks for Vessel Segmentation in Cerebral Angiography”, *IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, 2022
- JAM 2021     **A. Choi**, D. Tong, M. K. Jawed, and J. Joo. “Implicit Contact Model for Elastic Rods in Knot Tying”, *Journal of Applied Mechanics*, 2021

\* **Equal Contribution**

## PRESENTATIONS

- APS 2023     **A. Choi**, D. Tong, D. Terzopoulos, J. Joo, and M. K. Jawed. “Deep Learning Force Manifolds from the Physical Simulation of Robotic Paper Folding”, *Bulletin of the American Physical Society*, 2023

APS 2023	D. Tong, <b>A. Choi</b> , J. Joo, and M. K. Jawed. “An Implicit Simulation Framework to Handle Frictional Contact in Elastic Rods”, <i>Bulletin of the American Physical Society</i> , 2023
USNCCM17	G. Wang, D. Tong, <b>A. Choi</b> , and M. K. Jawed. “Computer Graphics Inspired Fast Simulation of Knots and Tangles”, <i>17th U.S. National Congress on Computational Mechanics (USNCCM17)</i> , 2023

## ACADEMIC EXPERIENCES

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<b>Graduate Student Researcher</b> UCLA, Structures-Computer Interaction Lab Advisors: Mohammad Khalid Jawed & Jungseock Joo & Demetri Terzopoulos, UCLA	Los Angeles, California Jan. 2020 - Present
<ul style="list-style-type: none"> <li>• Perform research in the general intersection of robotics, simulations, and learning with a focus on sim2real problems.</li> <li>• Key research areas include #1) developing physically accurate simulations for deformable materials / soft robots, #2) developing sim2real solutions for robotic manipulation of deformable materials, and #3) developing automated robotic solutions for 3D reconstruction of objects / scenes.</li> </ul>	
<b>Teaching Assistant for CS32: Introduction to Computer Science II (In-Person)</b> UCLA, Computer Science Department Instructor: David Smallberg, UCLA	Los Angeles, California Jan. 2022 - March 2022
<ul style="list-style-type: none"> <li>• Taught students how to employ object-oriented programming to build large programs as well as a variety of fundamental data structures and algorithms in C++.</li> <li>• Held office hours and led discussion sessions consisting of 43 students.</li> <li>• Received a TA evaluation score of 8.0/9.0 with 19/43 (44.2%) survey participation.</li> </ul>	
<b>Teaching Assistant for CS31: Introduction to Computer Science I (Online)</b> UCLA, Computer Science Department Instructor: Howard Stahl, UCLA	Los Angeles, California Summer of 2022
<ul style="list-style-type: none"> <li>• Taught students fundamental concepts and principles of CS as well as general programming principles in C++.</li> <li>• Held office hours and led discussion sessions consisting of 85 students.</li> <li>• Received a TA evaluation score of 8.6/9.0 with 9/85 (10.6%) survey participation.</li> </ul>	
<b>Robotics Senior Design Presentation</b> Meijo University, Robotics Department Advisor: Jason K. Moore, UC Davis (now at TU Delft)	Nagoya, Japan Summer of 2018
<ul style="list-style-type: none"> <li>• Fully funded trip to present the design theory and findings of underactuated shot tying robot manipulator to robotics students and professors of Meijo University.</li> <li>• Acted as a mentor to students completing their own robotics senior design projects. Provided technical guidance and feedback and partook in culture exchange programs.</li> </ul>	
<b>Undergraduate Researcher</b> UC Davis, Green Technology Lab Advisor: Masoud Rahman, UC Davis	Davis, California April 2017 - June 2018
<ul style="list-style-type: none"> <li>• Performed economic analysis on different energy management techniques for various battery systems.</li> <li>• Modeled the energy parameters of residential and commercial communities using behavioral survey data, load data, PV generation data, etc. to calculate optimal battery sizing.</li> </ul>	

## INDUSTRY EXPERIENCES

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<b>Graduate Robotic Software Intern</b> Vecna Robotics, Research & Advanced Development Division Advisors: Siddharth Chhaptar & Magnus Snorrason	Waltham, Massachusetts Summer of 2021
<ul style="list-style-type: none"> <li>• Created an end-to-end robotic solution for autonomous refueling of self-driving warehouse vehicles using a 4DOF serial robot manipulator. Achieved a 99.6% success rate for a client specification of 98%.</li> <li>• Created hydrogen fuel cell nozzle pose estimation and plane segmentation module using Aruco and RANSAC.</li> <li>• Carried out motion trajectories using velocity control and inverse Jacobian method for the inverse kinematics.</li> <li>• Designed the control flow pipeline, control &amp; recovery states, and algorithms for the refueling action.</li> <li>• Created autonomous testing pipeline and GUI for the autonomous refueling framework with the robot arm and mobile vehicle communicating to each other through server connection.</li> <li>• Researched and implemented an open-source eye-in-hand hand-eye calibration module using dual quaternions for 4DOF manipulators.</li> </ul>	

- Created URDF models through Xacro for omnidirectional mobile forklift.
- Derived omnidirectional kinematics and created ROS plugin for Gazebo simulations. Solved inverse kinematics using a constraint-based optimization approach.

### Control Systems Engineer

Brock Solutions

Los Angeles, California

Nov. 2018 - July 2019

- Programmed and debugged the programmable logic controllers (PLCs) that control the various actuators and sensors of the automated LAX baggage handling systems.
- Maintained human machine interfaces that display live system status in a high-stakes real time environment.
- Interfaced with real-time database applications to manage critical production information for airline clients.

### R&D Engineering Intern

World Surf League (Kelly Slater Wave Company)

Advisor: Adam Fincham, USC

Culver City, California

Summer of 2017

- Collected and stored data from test runs that led to the world's first artificial 6-foot barreling surf wave.
- Installed, programmed, and maintained pressure sensors, strain sensors, cameras, drones, and velocimeters.
- Performed force calculations for safety structures and managed the ordering of necessary materials/tools.

## HONORS & ACHIEVEMENTS

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1. <b>Senior Design Robotics Television Broadcast</b>	CBS/NBC, 2018
2. <b>Meijo University Travel Grant</b>	UC Davis, 2018
3. <b>Magna Cum Laude</b> <i>Top 8% in College of Eng.</i>	UC Davis, 2018
4. <b>UC Davis / Meijo University Annual Robotics Competition Winner</b>	UC Davis, 2018
5. <b>Engineering Dean's List</b> <i>Top 16% in College of Eng. 10 out of 12 quarters</i>	UC Davis, 2014 - 2018
6. <b>H. and G. Smith Undergraduate Scholarship</b> <i>Based on scholastic potential</i>	UC Davis, 2015

## SKILLS

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<b>Programming Languages</b>	C/C++, Python, Java, MATLAB
<b>Software Tools and Environments</b>	ROS, Linux, Bash, Git/Github, L <sup>A</sup> T <sub>E</sub> X, Unity
<b>Libraries</b>	NumPy, OpenCV, MoveIt, SciPy, SymPy, PyTorch, TF2/Keras
<b>Prototyping</b>	Arduino, Beaglebone, Raspberry Pi, 3D Printing, SOLIDWORKS
<b>Spoken Languages</b>	Bilingual English & Korean, Spanish (Limited Working Proficiency)

## COURSEWORK

**Math & Probability:** Linear Algebra, Differential Equations, Probabilistic Systems Analysis

**Robotics & Engineering:** Electrical Circuits & Systems, Dynamics, Mechanical Design, Automatic Control of Engineering Systems, Simulation & Design of Mechatronic Systems, Measurement Systems, Vehicle Stability, Kinematics of Robotic Systems, Computational Robotics, Deformable Simulations for Soft Robotics

**Computer Science & Machine Learning:** Data Structures, Software Construction, Computer Organization, Operating Systems Principles, Programming Languages, Computer Network Fundamentals, Algorithms & Complexity, Machine Learning Algorithms, Machine Learning in Genetics, Pattern Recognition, Deformable Models in Computer Vision, Reinforcement Learning, Artificial Life in Computer Graphics & Vision, Human-centered AI