

# Yutong Zhang

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## EDUCATION

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### University of California San Diego

La Jolla, USA

*M.S. in Computer Science; GPA: 4.00/4.00*

*Sep. 2022 – Mar. 2024*

### University of California San Diego

La Jolla, USA

*B.S. in Computer Science and Mathematics; GPA: 3.95/4.00*

*Sep. 2018 – Jun. 2022*

## RESEARCH INTEREST

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My current research interest centers around modeling complex dynamics with computational physics models. I have a broad interest in autonomous robot manipulation through optimization and an intense curiosity about integrating data-driven learning techniques for enhanced robustness. I want to explore using differentiable programming as an efficient tool for developing integrated robotic systems with perception, simulation and control.

## RESEARCH EXPERIENCE

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### Advanced Robotics and Controls Lab

La Jolla, USA

*Student Researcher, advised by Prof. Michael Yip*

*Mar. 2021 – present*

- Developed visualization tools in C++ and OpenGL to visualize threads, ropes, and robot arms.
- Wrote modules to synchronize robot joint status from ROS topics to the visualization program.
- Created a differentiable position-based dynamics simulator for thin-shell, volumetric, and rope-like deformable objects in Python and PyTorch.
- Applied the differentiable simulator to autonomous cloth manipulation. Formulated the task as a trajectory optimization problem constrained by safety thresholds to prevent undesired collision.
- Collaborated on the real-to-sim problem of modeling soft tissues in robot surgery. Utilized the differentiable simulator for online optimization of physical parameters to reduce the error.
- Currently parallelizing the simulator with the NVIDIA Warp library to accelerate the computation.

## PUBLICATIONS

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<sup>†</sup> equal contribution

[1] Nikhil Uday Shinde<sup>†</sup>, Xiao Liang<sup>†</sup>, Fei Liu, **Yutong Zhang**, Florian Richter, Sylvia Herbert and Michael C. Yip. JIGGLE: An Active Sensing Framework for Boundary Parameters Estimation in Deformable Surgical Environments  
*Robotics: Science and Systems (RSS)*, 2024.

 [\[arXiv\]](#).

[2] **Yutong Zhang**<sup>†</sup>, Fei Liu<sup>†</sup>, Xiao Liang, and Michael Yip. Achieving Autonomous Cloth Manipulation with Optimal Control via Differentiable Physics-Aware Regularization and Safety Constraints.  
*IEEE International Conference on Robotics and Automation (ICRA)*, 2024.

 [\[arXiv\]](#),  [\[video\]](#).

[3] Fei Liu<sup>†</sup>, Xiao Liang<sup>†</sup>, **Yutong Zhang**, Yuelei Li, Shan Lin, and Michael C. Yip. Real-to-Sim Deformable Object Manipulation: Optimizing Physics Models with Residual Mappings for Robotic Surgery.  
*IEEE International Conference on Robotics and Automation (ICRA)*, 2024.

 [\[arXiv\]](#).

## PROJECTS

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### Differentiable PBD Simulation

*Lead Developer*

- Developed an end-to-end differentiable position-based simulator for deformable objects in Python.
- Designed several trajectory optimization experiments for cloth manipulation with safety constraints.
- Embedded the simulation into the real-to-sim registration framework to optimize parameters online.
- Combining the framework with articulate body simulation to uniformly solve robot dynamics.

### ARC Particle Sim

 [Report](#)

*Co-Developer*

- Developed a cross-platform visualization and simulation program in C++ and OpenGL.
- Visualized captured rope data in time sequence with second-order interpolation.
- Designed interactive GUI controls for visualization theme and playback frame rate.
- Implemented modules to synchronize joint angles from ROS topics to visualize the robot arm.

### The Meoze Runner

 [Homepage](#),  [Code](#)

*Graphics Developer*

- Developed a multiplayer 3D game in C++ and OpenGL with 6 teammates.
- Worked on graphics modules to manage mesh data and render with texture mapping.
- Implemented an efficient 2D oriented bounding box collision checking utility for the game server.
- Wrote Python scripts to export collision data from level designs done in Blender to the game server.

### Monte Carlo Path Tracer

 [Report](#)

*Developer*

- Developed a Monte Carlo Path Tracer in C++ and the NVIDIA OptiX framework.
- Wrote various BRDFs including Phong model, GGX microfacet model and Disney Principled BRDF.
- Implemented Russian Roulette techniques and multiple importance sampling to reduce noises.
- Extended an additional Photon Mapping pass to produce better caustics for transparent objects.

## TUTORING EXPERIENCE

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UC San Diego, CSE 167 Computer Graphics

*Jan. 2022 – Mar. 2022*

UC San Diego, CSE 105 Theory of Computation

*Mar. 2021 – Jun. 2021*

## SKILLS

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**Programming Languages:** *Experienced in* C, C++, Python; *Familiar with* MATLAB, Java, Scheme

**Frameworks & Libraries:** CUDA, Eigen, OpenGL, ImGui, Warp, NumPy, SciPy, PyTorch, PyVista

**Software Tools:** Git, ROS, Bash, Linux, CMake, Docker, LaTeX, Blender, Houdini