

Yutong Zhang

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EDUCATION

University of California San Diego

La Jolla, USA

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

Sep. 2022 – present

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

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

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

[†] equal contribution

[1] Fei Liu, **Yutong Zhang**, Xiao Liang, and Michael Yip. Dynamic Coupling of Rigid and Deformable Objects for Geometrically Constrained Trajectory Optimization.

IEEE Transactions on Robotics (T-Ro).

In Preparation

[2] **Yutong Zhang**[†], Fei Liu[†], 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[†], Xiao Liang[†], **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

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

UC San Diego, CSE 167 Computer Graphics

Jan. 2022 – Mar. 2022

UC San Diego, CSE 105 Theory of Computation

Mar. 2021 – Jun. 2021

SKILLS

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