

# Yumeng He

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## RESEARCH INTERESTS

My research interests are in computer vision, computer graphics, and robotics, with a focus on image, video, and 3D/3DGS generation and understanding, physics-based simulation, real-to-sim pipelines, and policy learning.

## EDUCATION

### University of Southern California

*Master of Science*

Aug 2024 – May 2026  
*Los Angeles, CA, USA*

- Cumulative GPA: 3.83/4.0
- Computer Science major
- Selected Coursework: Computer Graphics, Computer Animation and Simulation, 3D Graphics and Rendering

### University of Toronto St. George Campus

*Honours Bachelor of Science with High Distinction*

Sep 2019 – May 2024  
*Toronto, ON, Canada*

- Cumulative GPA: 3.71/4.0
- Computer Science and Mathematics double major
- Selected Coursework: Calculus I & II, Linear Algebra I & II, Ordinary Differential Equations, Abstract Mathematics, Complex Variables, Number Theory, Machine Learning, Artificial Intelligence

## PUBLICATIONS AND MANUSCRIPTS

- [1] **Yumeng He**, Ying Jiang, Jiayin Lu, Yin Yang, Chenfanfu Jiang. *SPARK: Sim-ready Part-level Articulated Reconstruction with VLM Knowledge*. arXiv, 2025.
- [2] Ying Jiang, Jiayin Lu, Yunuo Chen, **Yumeng He**, Kui Wu, Yin Yang, Chenfanfu Jiang. *Birth of a Painting: Differentiable Brushstroke Reconstruction*. arXiv, 2025.
- [3] Zhenlian Miao, Guangzhu Chen, Xiaojuan Liao, Jiu Dai, **Yumeng He**. *Self-supervised dual-layer 2D normalizing flow method for industrial anomaly detection*. Applied Soft Computing (ASOC), 2024.

## RESEARCH EXPERIENCE

### USC Graphics | Master Thesis

*Supervisor: Prof. Jernej Barbič*

Aug 2025 – present  
*Los Angeles, CA, USA*

- Enhancing traditional Kirchhoff–Love shell models by introducing a novel elastic energy formulation that accurately captures stretching, compression, and bending, while overcoming KL shells' inability to reproduce Poisson effects

### UCLA AIVC Lab | Visiting student

*Supervisor: Prof. Chenfanfu Jiang*

Jun 2025 – present  
*Los Angeles, CA, USA*

- Leading research on end-to-end articulation-aware 3D mesh generation, designing a pipeline that synthesizes multi-part objects from text or image conditions while mitigating over-segmentation via per-part image-guided local attention
- Performing joint optimization post-generation to infer plausible URDFs, enabling deployment in embodied simulation environments and supporting per-part texturing for visual realism and downstream manipulation compatibility

### USC RESL Lab | Research Assistant

*Supervisor: Prof. Gaurav S. Sukhatme*

Jul 2025 – present  
*Los Angeles, CA, USA*

- Designed a few-shot robotic manipulation task that uses Model Predictive Control to optimize material parameters for physically accurate simulation
- Led the Real2Sim pipeline for this project, building a digital twin from a single RGB D image of a cluttered tabletop scene with object segmentation, mesh reconstruction, and pose, scale, and placement estimation, and importing the reconstructed scene into ManiSkill3 for simulation

### CDUT | Research Assistant

*Supervisor: Prof. Guangzhu Chen*

May 2023 - Aug 2023  
*Remote*

- Faced with unlabeled industrial defects on MVTec AD and tasked to raise unsupervised detection/localization accuracy, proposed SS-DualFlow: a dual-layer 2D normalizing-flow that maps features to a Gaussian base to curb information loss and inserts an Exponential Space Attention module to focus on anomaly-salient regions. Result: image-level AUROC = 99.38% and pixel-level AUROC = 98.38% on MVTec AD; co-authored the Applied Soft Computing (2024) paper.

## RELEVANT PROJECTS

### Incompressible Fluid Simulation: A Comparison | C++, OpenGL

Spring 2025

- Implemented and benchmarked four 2D incompressible fluid solvers, including Stable Fluids, Smoothed Particle Hydrodynamics (SPH) , Particle In Cell (PIC) and Affine Particle In Cell (APIC) on identical scenarios, reporting performance-vs-accuracy trade-offs.

### Collision Detection with Penalty Method and IPC | C++

Spring 2025

- Built a physically accurate 3D jello cube simulator using a mass-spring system with structural, shear, and bend springs to model real-world deformation under force
- Implemented penalty-based collision detection to handle interactions with static obstacles, including inclined planes and spheres, ensuring realistic response under contact
- Upgraded basic collision logic with Incremental Potential Contact (IPC), reducing interpenetration to below  $1e - 4$  relative gap across 1,000+ simulation steps, effectively achieving zero visible penetration and stable behavior

### Inverse Kinematics with Skinning | C++

Spring 2025

- Implemented Linear Blend Skinning and Dual Quaternion Skinning for 3D character deformation with smooth, realistic joint articulation
- Built an end-to-end FK–IK pipeline, supporting forward kinematics for pose propagation and inverse kinematics under joint constraints
- Developed and compared multiple IK solvers, including pseudoinverse least squares and damped least squares via Tikhonov regularization, improving numerical stability

### Motion Capture Interpolation | C++

Spring 2025

- Implemented four interpolation schemes (incl. linear & Bézier) with both Euler- and quaternion-based rotations to reconstruct and smooth optical mocap, mitigating gimbal lock and interpolation artifacts
- Generated natural, continuous transitions across keyframes for high-dimensional skeletal animation

### Ray Tracing | C++, Rendering

Fall 2024

- Built a modular ray tracer with Phong shading, shadow rays, and recursive reflections, supporting both spheres and triangle meshes
- Added supersampling, soft shadows via area lights, and Möller–Trumbore intersection, achieving realistic visuals while balancing quality and performance

## INDUSTRY EXPERIENCE

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### Software Developer Intern | Full Time

Aug 2022 – Aug 2023

*HCL Canada Inc.*

Toronto, ON, Canada

- Automated build and deployment pipelines using Jenkins, accelerating production releases and minimizing manual errors by eliminating key bottlenecks in CI/CD
- Containerized microservices for x86\_64 (xLinux) and IBM PowerPC (pLinux) architectures, enabling architecture-agnostic builds and consistent, scalable deployments
- Integrated SonarQube into the pipeline, authored a usage guide and presented it to cross-functional teams, and improved code quality by resolving 3 critical bugs and 308 code smells, including 4 blockers and 41 major issues

## COMMUNITY SERVICES

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- Member of Society of Women Engineers (SWE)
- Mentor for Viterbi Graduate Mentorship Program
- Mentor for Women in Engineering Mentorship
- Mentor for Viterbi Graduate Mentorship Program

2025 - 2026

Fall 2025

Fall 2025

Summer 2025

## INVITED TALKS

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- *MPC Is All You Need.* [Co-presented]. USC SLURM Lab, hosted by Prof. Daniel Seita

Aug 2025

## AWARDS & HONORS

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- Dean's List Scholar
- Ranked in the top 25% of contestants in the Galois Contest
- Ranked in the top 25% of contestants in the Cayley Contest
- Ranked in the top 25% of contestants in the Canadian Intermediate Mathematics

2020 - 2024

2017

2017

2016

## TECHNICAL SKILLS

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- **Programming Tools:** Linux, Windows, MacOS, C++, Python, HTML, CSS, JavaScript, MySQL, R, OpenGL, GLSL, Eigen, Docker, Jenkins, Gradle, Ant, Shell, Git, Github Actions