

# Yushan Han

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## Professional Summary

I'm a fifth-year PhD candidate in Applied Mathematics at UCLA, under the guidance of Prof. Joseph Teran. My primary research focus lies at the intersection of physics-based simulation and machine learning, with a special emphasis on the simulation of human soft tissues. My recent works include numerically solving nonlinear partial differential equations, computing biomechanically correct muscle inverse dynamics, and training neural networks for real-time correctives on character rigs. Additionally, I'm a research intern at Epic Games, where I am actively involved in the development of Chaos Flesh within the Unreal Engine framework.

## Education

- **Ph.D. in Applied Mathematics** - University of California, Los Angeles, Expected June 2024
  - Research interest: physics-based simulation, numerical solver for PDEs, machine learning, biomechanics
  - Relevant courses: applied ODEs and PDEs, advanced numerical analysis, fluid mechanics, machine learning
- **B.S. in Mathematics** - University of California, Irvine, September 2015 – June 2019
  - Mathematical finance concentration, minor in statistics, honor in Mathematics, GPA: 3.77
  - Relevant courses: C++, python, statistical methods, financial derivatives, probability, economics, linear algebra

## Work Experience

- **Research Intern** - Epic Games, June 2021 – Present
  - Devised a novel neural network pipeline for real-time (1000X faster than simulation) character rig corrections for improving metaverse realism on human muscle contractions/interactions, volume preservation, and collisions.
  - Implemented multi-layer FEM human soft tissue simulation and biomechanics-based muscle activation solvers.
  - Proposed a novel muscle contraction constitutive model and decoupled passive/active networks for skin deformations.
  - Developed an analytic real-time (90 fps) spring model for adding secondary physics dynamics, e.g., inertia. (See Publication 2)
  - Implemented game engine physics solvers (to be released under Chaos Flesh framework, Unreal Engine 5.5).
- **Graduate Teaching Assistant** - UCLA, January 2021 – Present
  - Teaching assistant for Numerical Analysis, Algorithms, Mathematical Imaging, and Machine Learning.
- **Graduate Research Intern** - Lawrence Berkeley National Lab, June 2020 – September 2020
  - Incorporated conditional random field models in CNNs for rock tomography image segmentation.

- Improved unsupervised segmentation results qualitatively and reduced hollow regions obtained by traditional CNNs by 90%.

## Skills & Abilities

- Proficient in C++, Python, MATLAB, Houdini, Maya, Unreal Engine.

## Publications

- First author paper under review
- Y. Chen, Y. Han, J. Chen, S. Ma, R. Fedkiw, and J. Teran, "Primal Extended Position Based Dynamics for Hyperelasticity," in *Proceedings of the ACM SIGGRAPH Conference on Motion, Interaction and Games*, 2023. DOI: 10.1145/3623264.3624437.
- S. Gagniere, Y. Han, Y. Chen, D. Hyde, A. Marquez-Razon, J. Teran, and R. Fedkiw, "A Robust Grid-Based Meshing Algorithm for Embedding Self-Intersecting Surfaces," *Computer Graphics Forum*, 2023. DOI: 10.1111/cgf.14986.
- A. Marquez Razon, Y. Chen, Y. Han, S. Gagniere, M. Tupek, and J. Teran, "A Linear and Angular Momentum Conserving Hybrid Particle/Grid Iteration for Volumetric Elastic Contact," *Proceedings of the ACM on Computer Graphics and Interactive Techniques*, 2023. DOI: 10.1145/3606924.
- Y. Jin, Y. Han, Z. Geng, J. Teran, and R. Fedkiw, "Analytically Integratable Zero-restlength Springs for Capturing Dynamic Modes unrepresented by Quasistatic Neural Networks," in *ACM SIGGRAPH 2022 Conference Proceedings*, 2022. DOI: 10.1145/3528233.3530705.

## Awards

- NSF MENTOR Fellowship - \$34,000, September 2019 – September 2020.
- Howard Tucker Award, University of California, Irvine, June 2019.

## References

Available upon request.