Towa Shixun Huang

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Research Interests

I am interested in the intersection of graphics, scientific computing, and robotics, aiming to develop computational tools that combine mathematical structure with machine learning. My interests include structure-preserving model reduction, physics-based simulation, and neural architectures informed by optimization, PDEs, convexity, and symmetry. Broadly, I hope to design reliable and generalizable algorithms that advance simulation and numerical computation across scientific and engineering domains.

Education

University of Toronto **Toronto, Ontario**

Bachelor of Science in Mathematics and Computer Science *Sep. 2022 – Jun. 2026*

- Major in **Mathematics** and **Computer Science**, Minor in **Statistics**
- **CGPA: 3.89/4.00**

Experience

Dynamic Graphics Project Lab **Apr. 2025 – Present**

UTEA Undergraduate Student Researcher | ***Supervisors**: Eitan Grinspun, Yue Chang* *Toronto, ON*

- Developed a convex-inspired reduced model for full-space deformable simulations, achieving stable and reliable performance under large deformations and collisions for full robustness
- Implemented and optimized Newton-based solvers for nonlinear material and contact energies, integrating PCA/AE/ICNN subspaces into the deformation reconstruction/simulation pipeline
- Demonstrated improved stability and out-of-distribution generalization through extensive benchmarking against challenging full-space motion trajectories

Dalla Lana School of Public Health **Jun. 2024 – Present**

Undergraduate Student Researcher | *Jude Dzevela Kong* *Toronto, ON*

- Developed advanced SEIRS models using differential equations with seasonal forcing via Fourier series, and Bayesian inference (**MCMC**, **rstan**) for precise parameter estimation calibrated on Canadian influenza data
- Applied numerical methods and nonlinear optimization techniques to refine model calibration and validation
- Conducted a systematic review of 120 studies on mathematical and machine learning approaches in epidemiology, synthesizing methodologies, trends, and best practices

Publications

Huang, S., Grinspun, E., & Chang, Y. (2025). *A Convex-Inspired Neural Construction for Structured and Generalizable Nonlinear Model Reduction.* Manuscript in preparation; in preperation to SIGGRAPH 2026. arXiv:2511.18241

Huang, S., Bragazzi, N. L., *et al.*, & Kong, J. D. (2025). *A Systematic Review of Mathematical and Machine Learning Models of Avian Influenza. One Health*, 21, 101203. https://doi.org/10.1016/j.onehlt.2025.101203

Projects

Superconductor Transition Temperature Prediction | *PyTorch, Transformer* **Nov. 2024 – Dec. 2024**

- Curated superconducting datasets via Materials Project API, including CIF structures and transition temperatures
- Encoded atomic data into 25D Gaussian-mapped feature vectors and designed sentence-structured representations
- Trained Transformer-based models with preliminary MAEs of 0.85–0.99 across two configurations

Numerical Methods for Option Pricing | *MATLAB, Iterative Methods, Finite Difference* **Mar. 2025 – Apr. 2025**

- Implemented finite difference solvers for the **Black–Scholes PDE** and analyzed numerical stability and convergence
- Solved American put options via projected SOR to enforce early-exercise inequality constraints
- Generated technical visualizations of solution surfaces and convergence trends for reporting

LoRA Rank Scaling Analysis | *PyTorch, Hugging Face, Qwen, LoRA* **Oct. 2025 – Nov. 2025**

- Reviewed key LoRA literature and analyzed intruder-dimension findings through empirical study
- Built a controlled Qwen-0.5B fine-tuning pipeline to test LoRA ranks 2–256 and analyze weight matrices
- Found $r = 2$ offers strongest generalization in empirical analysis, while higher ranks overfit via intruder dimensions

Awards and Talks

Awards: University of Toronto Excellence Award ($8,000), Dean's List Scholar (3 years)
Talks: Annual Ontario-Quebec pre-SIGGRAPH Workshop 2025 Speaker, ARIA 2025 Poster Presenter

Teaching

MAT186: Calculus I, University of Toronto — Teaching Assistant, Fall 2025
MAT187: Calculus II, University of Toronto — Teaching Assistant, Winter 2026

Courses

Real Analysis; Linear Algebra; Probability and Statistics; Numerical Methods; Differential Equations; Computational Finance (Graduate); Computational Differential Equations (Graduate); Mathematical Theory of Finance (Graduate); Deep Learning Theory (Graduate); Physics-Based Animation

Technical Skills

Technical Topics: Neural Fields, Deep Learning for Animation, Physics-Informed Neural Networks, Graph Neural Networks, Numerical Analysis, LLM Training/Inferencing
Programming Languages: Python, Java, C, C++, MATLAB, R, SQL, Mathematica
Developer Tools: VS Code, Git, Linux Shell, PyCharm, IntelliJ, Blender, Unity, LaTeX
Frameworks and Libraries: pandas, NumPy, SciPy, PyTorch, pymatgen, scikit-learn, PyMC, Warp