Peter Yichen Chen

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RESEARCH VISION — The overarching objective of my cross-disciplinary research is to democratize physics simulation by improving its precision, speed, ease of use, and generalizability. This is achieved through a thoughtful fusion of cutting-edge AI methodologies and classical numerical methods. My research empowers 3D content creation for artists, enhances design/fabrication/control for engineers, and aids discovery for scientists, **all through next-generation physics simulations that incorporate AI while retaining the essential foundation of partial differential equations (PDEs).**

ACADEMIC POSITIONS

Massachusetts Institute of Technology (MIT)   2022 - Present
Postdoc in Computer Science and Artificial Intelligence Lab (CSAIL)
Advisor: Wojciech Matusik

EDUCATION

Columbia University   2016 - 2022
Ph.D., Computer Science
Dissertation: *Multiscaling and Machine Learning Approaches to Physics Simulation*
Advisor: Eitan Grinspun

University of California, Los Angeles (UCLA)   2012 - 2016
B.S., Applied Mathematics, *Summa Cum Laude*
Advisor: Joseph Teran
🎖 Sherwood Prize in Mathematics for Outstanding Undergraduate Achievement

INDUSTRY COLLABORATIONS

Amazon Robotics   2024 - Present
Differentiable physics for object manipulations
Meta Reality Labs (AR/VR)   2020 - Present
Machine learning enhanced physics simulations for XR
Tencent Games   Summer 2021
GPU-accelerated, multi-physics game engine
Weta Digital   Summer 2018
*Multi-scale tissue simulation for **James Cameron's Avatar** (uncredited)*

TUTORIALS

[1] Miles Macklin, Nicolas Capens, Zeshun Zong, Pingchuan Ma, Peter Yichen Chen, and Gergely Klar. Warp: Differentiable spatial computing for python. *SIGGRAPH Courses*, 2024

PUBLICATIONS

[*]Co-first authors, [+] Corresponding authors

[1] Pranav Jain, Ziyin Qu, Peter Yichen Chen, and Oded Stein. Neural monte carlo fluid simulation. In *SIGGRAPH 2024*

[2] Liane Makatura, Michael Foshey, Bohan Wang, Felix HähnLein, Pingchuan Ma, Bolei Deng, Megan Tjandrasuwita, Andrew Spielberg, Crystal Elaine Owens, Peter Yichen Chen, Allan Zhao, Amy Zhu, Wil J Norton, Edward Gu, Joshua Jacob, Yifei Li, Adriana Schulz, and Wojciech Matusik. How can large language models help humans in design and manufacturing? *Harvard Data Science Review (HDSR)*, 2024

[3] Zeshun Zong, Xuan Li, Minchen Li, Wojciech Matusik, Eitan Grinspun, Maurizio Chiaramonte, Kevin Carlberg, Chenfanfu Jiang, and Peter Yichen Chen. Neural stress fields for reduced-order elastoplasticity and fracture. *SIGGRAPH ASIA 2023*

[4] Chang Yue, Peter Yichen Chen[+], Maurizio Chiaramonte, Kevin Carlberg, and Eitan Grinspun[+]. LiCROM: Linear-subspace continuous reduced order modeling with neural fields. *SIGGRAPH ASIA 2023*

[5] Pingchuan Ma[+], Peter Yichen Chen[+], Bolei Deng, Joshua B. Tenenbaum, Tao Du, Chuang Gan, and Wojciech Matusik. Learning neural constitutive laws from motion observations for generalizable PDE dynamics. In *International Conference on Machine Learning (ICML)*, 2023

[6] Yichen Li, Peter Yichen Chen, Tao Du, and Wojciech Matusik. Learning preconditioner for conjugate gradient PDE solvers. In *International Conference on Machine Learning (ICML)*, 2023b

[7] Honglin Chen[*], Rundi Wu[*], Eitan Grinspun, Changxi Zheng, and Peter Yichen Chen. Implicit neural spatial representations for time-dependent PDEs. In *International Conference on Machine Learning (ICML)*, 2023

[8] Peter Yichen Chen, Jinxu Xiang, Dong Heon Cho, Yue Chang, G A Pershing, Henrique Teles Maia, Maurizio M Chiaramonte, Kevin Thomas Carlberg, and Eitan Grinspun. CROM: Continuous reduced-order modeling of PDEs using implicit neural representations. In *International Conference on Learning Representations (ICLR)*, 2023 **[notable-top-25%] [Best Paper Award @ Neural Fields Workshop]**

[9] Peter Yichen Chen, Maurizio Chiaramonte, Eitan Grinspun, and Kevin Carlberg. Model reduction for the material point method via an implicit neural representation of the deformation map. *Journal of Computational Physics (JCP), 2023*

[10] Xuan Li, Yi-Ling Qiao, Peter Yichen Chen, Krishna Murthy Jatavallabhula, Ming Lin, Chenfanfu Jiang, and Chuang Gan. PAC-NeRF: Physics augmented continuum neural radiance fields for geometry-agnostic system identification. In *International Conference on Learning Representations (ICLR)*, 2023a **[notable-top-25%]**

[11] Peter Yichen Chen, Maytee Chantharayukhonthorn, Yonghao Yue, Eitan Grinspun, and Ken Kamrin. Hybrid discrete-continuum modeling of shear localization in granular media. *Journal of the Mechanics and Physics of Solids (JMPS)*, 2021

[12] Yonghao Yue[*], Breannan Smith[*], Peter Yichen Chen[*], Maytee Chantharayukhonthorn[*], Ken Kamrin, and Eitan Grinspun. Hybrid grains: adaptive coupling of discrete and continuum simulations of granular media. *ACM Transactions on Graphics (TOG), Presented at SIGGRAPH ASIA 2018*

[13] Peter Yichen Chen, Jonathan David Blutinger, Yorán Meijers, Changxi Zheng, Eitan Grinspun, and Hod Lipson. Visual modeling of laser-induced dough browning. *Journal of food engineering*, 2019

[14] Jonathan David Blutinger, Yorán Meijers, Peter Yichen Chen, Changxi Zheng, Eitan Grinspun, and Hod Lipson. Characterization of CO2 laser browning of dough. *Innovative Food Science & Emerging Technologies*, 2019

[15] Jonathan David Blutinger, Yorán Meijers, Peter Yichen Chen, Changxi Zheng, Eitan Grinspun, and Hod Lipson. Characterization of dough baked via blue laser. *Journal of food engineering*, 2018

PREPRINTS

[16] Yue Chang, Otman Benchekroun, Maurizio M Chiaramonte, Peter Yichen Chen, and Eitan Grinspun. Neural representation of shape-dependent Laplacian eigenfunctions. *arXiv preprint arXiv:2408.10099*, 2024

[17] Hrishikesh Viswanath, Yue Chang, Julius Berner, Peter Yichen Chen, and Aniket Bera. Reduced-order neural operators: Learning lagrangian dynamics on highly sparse graphs. *arXiv preprint arXiv:2407.03925*, 2024

[18] Peter Yichen Chen, Chao Liu, Pingchuan Ma, John Eastman, Daniela Rus, Dylan Randle, Yuri Ivanov, and Wojciech Matusik. Learning object properties using robot proprioception via differentiable robot-object interaction. *Under Review*, 2025

[19] Peter Yichen Chen[*], Pingchuan Ma[*], Niklas Hagemann[*], John Romanishin, Wei Wang, Daniela Rus, and Wojciech Matusik. AI-enhanced automatic design of efficient underwater gliders. *Under Review*, 2025

AWARDS AND FELLOWSHIPS	♜ **Best Paper Award**, Neural Fields Workshop at ICLR, 2023
	MMLDT-CSET Conference Fellowship, National Science Foundation, 2021
	♜ **Best Poster Award**, New England Workshop on the Mechanics of Materials and Structures, 2017

UNDERGRADUATE HONORS	Sherwood Prize in Mathematics for Outstanding Undergraduate Achievement, UCLA, 2016
	College and Departmental Honors, UCLA, 2016
	Jeffrey George Wilson Research Award, UCLA, 2015
	Irving and Jean Stone Research Award, UCLA, 2015
	Meritorious Winner in Mathematical Contest in Modeling (MCM), COMAP, 2015
	Caltech SURF Fellowship, California Institute of Technology, 2014
	The Rose Gilbert in Memory of Maggie Gilbert Scholarship, UCLA, 2014
	Honorable Mention in Mathematical Contest in Modeling (MCM), COMAP, 2014

INVITED TALKS

Neural PDE: AI-enhanced Physics Simulation

Autodesk Research	November 2024
Toyota Research Institute	September 2024
University of Virginia	April 2024
University of British Columbia	April 2024
Brown University	March 2024
Duke University	February 2024
University of Waterloo	January 2024
University of North Carolina, Chapel Hill	January 2024
University of California, Davis	January 2024
Arizona State University	January 2024
University of Hong Kong	January 2024
Boston University	October 2023
Georgia Tech	October 2023

Accurate and Fast PDE Solvers via Neural Fields

Caltech	August 2023
Peking University	May 2023
Tsinghua University	April 2023
University of Stuttgart and NEC Labs	March 2023
Extrality	January 2023

Towards a Physical Metaverse

ETH Zurich	February 2022
MIT	February 2022
UCLA	February 2022
NVIDIA AI	January 2022

Multiscaling and Machine Learning Approaches to Physics Simulation

NVIDIA Omniverse	November 2021

Hybrid Grains: Adaptive Coupling of Discrete and Continuum Simulations of Granular Media

DreamWorks Animation	June 2019

TEACHING EXPERIENCES

MIT Kaufman Teaching Certificate Program	Spring 2024
MIT 6.837 Computer Graphics - Particle Simulations	Fall 2023

Substitute lecturer

Topics: *Numerical ODEs, Time Integration, Lennard-Jones Forces, and Collision*

Columbia University COMS 4167 Physics-based Computer Animation	Fall 2017

Teaching assistant

Topics: *Time Integration, Collision Detection, Rigid Bodies, Elasticity, Incompressible Viscous Fluid, Finite Element Method, Finite Difference Method, Computational Fluid Dynamics, Control*

Columbia University COMS W4160 Computer Graphics	Spring 2018

Teaching assistant

Topics: *OpenGL, Graphics Pipeline, Shaders, Texture Mapping, Ray Tracing, Rendering Equa-*

tion, Monte Carlo Integration, Triangle Meshes, Mesh Manipulation, Character Animation, Forward/Backward Kinematics, Spline Curves

New Jersey Institute of Technology IT 360 Computer Graphics   Spring 2020, Fall 2021
Guest lecturer

JUNIOR STUDENT MENTORSHIP		
	Instituto de Matemática Pura e Aplicada	
	Daniel Perazzo, master student	2023 - 2024
	Federal University of Paraíba	
	João P. V. Teixeira, undergrad student → PhD student at UofT	2023 - 2024
	MIT	
	John Eastman, undergrad student → master student at MIT	2022 - 2023
	Marcel Roed, master student → PhD student at Stanford	2022 - 2023
	Columbia University	
	Jinxu Xiang, master student → Graphics Researcher at Tencent Pixel Lab	2021 - 2023
	Dong Heon Cho, master student → PhD student at Duke	2021 - 2023
	G Pershing, undergrad student	Spring 2022
	Mingxuan Li, master student → Intern at Treyarch	Spring 2022
	Logan Wang, master student → Intern at Meta Reality Labs	Fall 2021

REVIEWING

International Conference on Learning Representations (ICLR)
Neural Information Processing Systems (NeurIPS)
Association for the Advancement of Artificial Intelligence (AAAI)
ACM Computing Surveys
ACM SIGGRAPH North America
ACM SIGGRAPH Asia
ACM Transactions on Graphics (TOG)
Eurographics
Pacific Graphics
Journal of Food Engineering

PROGRAM COMMITTEE

ACM SIGGRAPH Asia 2024
ACM SIGGRAPH / EUROGRAPHICS Symposium on Computer Animation (SCA) 2024