

# 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 **material 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  
Committee: Ken Kamrin, Changxi Zheng, Steve Waiching Sun, Hod Lipson

**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 RESEARCH** **Meta Reality Labs (AR/VR)** 2020 - Present  
Mentors and sponsors: Kevin Carlberg, Maurizio Chiaramonte

**PUBLICATIONS** \*Co-first authors, + Corresponding authors

- [1] 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*
- [2] Chang Yue, **Peter Yichen Chen**<sup>+</sup>, Maurizio Chiaramonte, Kevin Carlberg, and Eitan Grinspun<sup>+</sup>. LiCROM: Linear-subspace continuous reduced order modeling with neural fields. *SIGGRAPH ASIA 2023*
- [3] Pingchuan Ma<sup>+</sup>, **Peter Yichen Chen**<sup>+</sup>, 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
- [4] 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
- [5] Honglin Chen<sup>\*</sup>, Rundi Wu<sup>\*</sup>, Eitan Grinspun, Changxi Zheng, and **Peter Yichen Chen**. Implicit neural spatial representations for time-dependent PDEs. In *International Conference on Machine Learning (ICML)*, 2023
- [6] **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]**
- [7] **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

- [8] 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%**]
- [9] **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
- [10] 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**
- [11] **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
- [12] 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
- [13] 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**

- [14] 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? *arXiv*, 2023

**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**

- AI-enhanced Physics Simulation**
  - 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
SELECTED PRESENTATIONS	Model Reduction for the Material Point Method on Nonlinear Manifolds Using Deep Learning	
	MMLDT-CSET Conference	September 2021
	AAAI Symposium on Combining AI and ML with Physics Sciences	March 2021
	Simulating Shear Localization Using a Hybrid Discrete-Continuum Approach	
	Engineering Mechanics Institute (EMI) Conference	June 2019
	New England Workshop on Mechanics (NEW.Mech)	October 2019
	Simulating Funnel Discharge of Granular Materials Using a Hybrid MPM-DEM Approach	
	New England Workshop on Mechanics (NEW.Mech) <b>[Best Poster Award]</b>	October 2017
MORE INDUSTRY RESEARCH	Tencent Games	Summer 2021
	<i>GPU-accelerated, multi-physics game engine</i>	
	Weta Digital	Summer 2018
	<i>Multi-scale tissue simulation for <b>James Cameron's Avatar</b> (uncredited)</i>	
TEACHING EXPERIENCES	MIT 6.837 Computer Graphics - Particle Simulations	Fall 2023
	Substitute lecturer	
	Topics: <i>Numerical ODEs, Time Integration, Lennard-Jones Forces, and Collision</i>	
	Columbia University COMS 4167 Physics-based Computer Animation	Fall 2017
	Teaching assistant	
	Topics: <i>Time Integration, Collision Detection, Rigid Bodies, Elasticity, Incompressible Viscous Fluid, Finite Element Method, Finite Difference Method, Computational Fluid Dynamics, Control</i>	
	Columbia University COMS W4160 Computer Graphics	Spring 2018
	Teaching assistant	
	Topics: <i>OpenGL, Graphics Pipeline, Shaders, Texture Mapping, Ray Tracing, Rendering Equation, Monte Carlo Integration, Triangle Meshes, Mesh Manipulation, Character Animation, Forward/Backward Kinematics, Spline Curves</i>	
	New Jersey Institute of Technology IT 360 Computer Graphics	Spring 2020, Fall 2021
	Guest lecturer	
SELECTED COURSEWORKS	<b>Mechanics:</b> <i>Continuum Mechanics, Fluid Mechanics, Theory of Elasticity, Computational Plasticity, Finite Element Method (FEM), Multiscale Modeling</i>	
	<b>Mathematics:</b> <i>Numerical Analysis for ODEs and PDEs, Computational Linear Algebra, Convex Optimization, Scientific Computing</i>	
	<b>Computer Science:</b> <i>Programming (C/C++, CUDA), Operating System, Analysis of Algorithms</i>	
ADVISING	Federal University of Paraíba	
	João P. V. Teixeira, undergrad student	2023 - Present
	Instituto de Matemática Pura e Aplicada	
	Daniel Perazzo, master student	2023 - Present
	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

## SERVICES

Organizers for  
The AI4PDE meetup at ICLR 2023  
Mentors for  
The Summer Geometry Initiative 2023  
The RCDC@SIGGRAPH Undergraduate Mentorship Program 2021

## REVIEWING FOR CONFERENCES AND JOURNALS

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

## REFERENCES

**Eitan Grinspun**  
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