Minchen Li

Assistant Professor, Computer Science Department, Carnegie Mellon University

Email: minchernl@gmail.com, Homepage: cs.cmu.edu/~minchenl/

Contents

Research Focus

Integrating physics-based simulation with AI for CG, visual computing, robotics, and computational mechanics.

Bio

Minchen is an assistant professor in the Computer Science Department at Carnegie Mellon University, having joined in September 2023 after leaving his role as an assistant adjunct professor at UCLA Department of Mathematics, AIVC Lab. He was a postdoctoral researcher in the SIG Center for Computer Graphics at the University of Pennsylvania after completing his Ph.D. in the same group, advised by Chenfanfu Jiang. Minchen is a winner of the 2021 ACM SIGGRAPH Outstanding Doctoral Dissertation Award, the 2021 Symposium on Computer Animation (SCA) Doctoral Dissertation Award, and the 2020 Adobe Research Fellowship. His Ph.D. dissertation features the Incremental Potential Contact (IPC) method, which "presents a breakthrough in the notoriously challenging and long-standing problem of robust frictional contact simulation in nonlinear solid dynamics with guarantees of non-intersection" and has led to a series of follow-up works in both academia and industry. Minchen had four successive internships at Adobe Research. He received his M.Sc. in Computer Science from the University of British Columbia in 2018, advised by Alla Sheffer.

Education

University of Pennsylvania Philadelphia, PA, USA
Ph.D. in Computer and Information Science *Sep. 2018 – Dec. 2020*
- Thesis: Robust and Accurate Simulation of Elastodynamics and Contact (Advisor: Chenfanfu Jiang)

University of British Columbia Vancouver, BC, Canada
M.Sc. in Computer Science *Sep. 2015 – Apr. 2018*
- Thesis: FoldSketch: Enriching Garments with Physically Reproducible Folds (Advisor: Alla Sheffer)

Zhejiang University Hangzhou, China
B.Eng. (Hons) in Computer Science and Technology *Sep. 2011 – Jun. 2015*
- Thesis: Skeletal Animation in Virtual Try-On System (Advisor: Jijun Li)

Academic Positions

Assistant Professor Sep. 2023 – Present
Computer Science Department, Carnegie Mellon University *Pittsburgh, PA, USA*

Assistant Adjunct Professor Jul. 2021 – Aug. 2023
Department of Mathematics, UCLA *Los Angeles, CA, USA*

Postdoctoral Researcher Feb. 2021 – Jun. 2021
SIG Lab, University of Pennsylvania *Philadelphia, PA, USA*
- Advisor: Chenfanfu Jiang

Mitacs Globalink Research Intern Jul. 2014 – Sep. 2014
WiNMoS Lab, University of British Columbia *Vancouver, BC, Canada*
- Advisor: Victor C.M. Leung, Wei Cai

Industry Experience

Research Intern — Summer 2020, Summer 2019, Summer 2018, Fall 2017
Creative Intelligence Lab, Adobe Research — *Seattle, WA, USA*

Awards and Honors

Symposium on Computer Animation (SCA) Doctoral Dissertation Award	2021
ACM SIGGRAPH Outstanding Doctoral Dissertation Award	2021
Adobe Research Fellowship	2020
Mitacs Globalink Graduate Fellowship	2015 – 2016
Excellent Bachlor Thesis Award	2015
First Class Scholarship for Outstanding Merits	2013 – 2014

Publications [Google Scholar]

Dissertation and Thesis:

- Minchen Li. Robust and Accurate Simulation of Elastodynamics and Contact. Ph.D. Dissertation, University of Pennsylvania, 2020. *[2021 ACM SIGGRAPH Outstanding Doctoral Dissertation Award] [2021 Symposium of Computer Animation Doctoral Dissertation Award]*
- Minchen Li. FoldSketch : Enriching Garments with Physically Reproducible Folds. M.Sc. Thesis, University of British Columbia, 2018.

Books and Tutorials:

- Minchen Li, Chenfanfu Jiang. Physics-based Simulation. Free Online Book, 2024.
- Minchen Li. A Tutorial on Backward Propagation Through Time (BPTT) in the Gated Recurrent Unit (GRU) RNN. Technical Report, 2016. DOI: 10.13140/RG.2.2.32858.98247.

Preprints:

- Yadi Cao, Yidong Zhao, Minchen Li, Yin Yang, Jinhyun Choo, Demetri Terzopoulos, Chenfanfu Jiang. Material Point Methods on Unstructured Tessellations: A Stable Kernel Approach With Continuous Gradient Reconstruction. Arxiv 2312.10338.
- Minchen Li, Zachary Ferguson, Teseo Schneider, Timothy Langlois, Denis Zorin, Daniele Panozzo, Chenfanfu Jiang, Danny M. Kaufman. Convergent Incremental Potential Contact. Arxiv 2307.15908.
- Yuxing Qiu, Feng Gao, Minchen Li, Govind Thattai, Yin Yang, Chenfanfu Jiang. TPA-Net: Generate A Dataset for Text to Physics-based Animation. Arxiv 2211.13887.
- Yunuo Chen, Minchen Li, Wenlong Lu, Chuyuan Fu, Chenfanfu Jiang. Midas: A Multi-Joint Robotics Simulator with Intersection-Free Frictional Contact. Arxiv 2210.00130.
- Zeshun Zong*, Xuan Li* (equal contribution), Jianping Ye, Sian Wen, Yin Yang, Danny M. Kaufman, Minchen Li, Chenfanfu Jiang. Topology Optimization with Frictional Self-Contact. Arxiv 2208.04844.
- Yu Fang*, Jiancheng Liu*, Mingrui Zhang* (equal contributions), Jiasheng Zhang, Yidong Ma, Minchen Li, Yuanming Hu, Chenfanfu Jiang, Tiantian Liu. Complex Locomotion Skill Learning via Differentiable Physics. Arxiv 2206.02341.
- Zizhou Huang, Teseo Schneider, Minchen Li, Chenfanfu Jiang, Denis Zorin, Daniele Panozzo. A Large-Scale Benchmark for the Incompressible Navier-Stokes Equations. Arxiv 2112.05309.

Conference Proceedings and Journal Articles:

- Xuan Li, Minchen Li, Xuchen Han, Huamin Wang, Yin Yang, Chenfanfu Jiang. A Dynamic Duo of Finite Elements and Material Points. ACM SIGGRAPH 2024.
- Ying Jiang*, Chang Yu*, Tianyi Xie*, Xuan Li* (equal contribution), Yutao Feng, Huamin Wang, Minchen Li, Henry Lau, Feng Gao, Yin Yang, Chenfanfu Jiang. VR-GS: A Physical Dynamics-Aware Interactive Gaussian Splatting System in Virtual Reality. ACM SIGGRAPH 2024.

- Yidong Zhao, Minchen Li, Chenfanfu Jiang, Jinhyun Choo. Mapped Material Point Method for Large Deformation Problems with Sharp Gradients and Its Application to Soil-Structure Interactions. International Journal for Numerical and Analytical Methods for Geomechanics (IJNAMG), 2024.
- Jessica Weakly*, Xuan Li* (equal contributions), Tejas Agarwal, Minchen Li, Spencer Folk, Chenfanfu Jiang, Cynthia Sung. Bistable Aerial Transformer (BAT): A Quadrotor Fixed-Wing Hybrid that Morphs Dynamically via Passive Soft Mechanism. Journal of Mechanisms and Robotics (JMR), 2024.
- Ziyin Qu, Minchen Li, Yin Yang, Chenfanfu Jiang, Fernando de Goes. Power Plastics: A Hybrid Lagrangian/Eulerian Solver for Mesoscale Inelastic Flows. ACM Transactions on Graphics (SIGGRAPH Asia), 2023.
- Xuan Li, Yu Fang, Lei Lan, Huamin Wang, Yin Yang, Minchen Li, Chenfanfu Jiang. Subspace-Preconditioned GPU Projective Dynamics with Contact for Cloth Simulation. ACM SIGGRAPH Asia 2023.
- Zeshun Zong, Xuan Li, Minchen Li, Maurizio M. Chiaramonte, Wojciech Matusik, Eitan Grinspun, Kevin Carlberg, Chenfanfu Jiang, Peter Yichen Chen. Neural Stress Fields for Reduced-order Elastoplasticity and Fracture. ACM SIGGRAPH Asia 2023.
- Yu Fang*, Minchen Li* (equal contributions), Yadi Cao, Xuan Li, Joshuah Wolper, Yin Yang, Chenfanfu Jiang. Augmented Incremental Potential Contact for Sticky Interactions. IEEE Transactions on Visualization and Computer Graphics (TVCG), 2023.
- Yunuo Chen, Tianyi Xie, Cem Yuksel, Danny M. Kaufman, Yin Yang, Chenfanfu Jiang, Minchen Li. Multi-Layer Thick Shells. ACM SIGGRAPH 2023.
- Tianyi Xie, Minchen Li, Yin Yang, Chenfanfu Jiang. A Contact Proxy Splitting Method for Lagrangian Solid-Fluid Coupling. ACM Transactions on Graphics (SIGGRAPH), 2023.
- Lei Lan, Minchen Li, Chenfanfu Jiang, Huamin Wang, Yin Yang. Second-order Stencil Descent for Interior-point Hyperelasticity. ACM Transactions on Graphics (SIGGRAPH), 2023.
- Yuxing Qiu, Samuel Reeve, Minchen Li, Yin Yang, Stuart Slattery, Chenfanfu Jiang. A Sparse Distributed Gigascale Resolution Material Point Method. ACM Transactions on Graphics, 2022 (presentation at SIGGRAPH 2023).
- Yadi Cao, Menglei Chai, Minchen Li, Chenfanfu Jiang. Efficient Learning of Mesh-Based Physical Simulation with Bi-Stride Multi-Scale Graph Neural Network. International Conference on Machine Learning (ICML), 2023.
- Hangxin Liu, Zeyu Zhang, Ziyuan Jiao, Zhenliang Zhang, Minchen Li, Chenfanfu Jiang, Yixin Zhu, Song-Chun Zhu. Reconfigurable Data Glove for Reconstructing Physical and Virtual Grasps. Engineering, 2023.
- Xuan Li, Yadi Cao, Minchen Li, Yin Yang, Craig Schroeder, Chenfanfu Jiang. PlasticityNet: Learning to Simulate Metal, Sand, and Snow for Optimization Time Integration. Neural Information Processing Systems (NIPS), 2022.
- Yunuo Chen*, Minchen Li* (equal contributions), Lei Lan, Hao Su, Yin Yang, Chenfanfu Jiang. A Unified Newton Barrier Method for Multibody Dynamics. ACM Transactions on Graphics (SIGGRAPH), 2022.
- Xuan Li, Minchen Li, Chenfanfu Jiang. Energetically Consistent Inelasticity for Optimization Time Integration. ACM Transactions on Graphics (SIGGRAPH), 2022.
- Lei Lan, Danny M. Kaufman, Minchen Li, Chenfanfu Jiang, Yin Yang. Affine Body Dynamics: Fast, Stable & Intersection-free Simulation of Stiff Materials. ACM Transactions on Graphics (SIGGRAPH), 2022.
- Lei Lan, Guanqun Ma, Yin Yang, Changxi Zheng, Minchen Li, Chenfanfu Jiang. Penetration-free Projective Dynamics on the GPU. ACM Transactions on Graphics (SIGGRAPH), 2022.
- Ziyin Qu, Minchen Li, Fernando de Goes, Chenfanfu Jiang. The Power Particle-In-Cell Method. ACM Transactions on Graphics (SIGGRAPH), 2022.
- Yadi Cao, Yunuo Chen, Minchen Li, Yin Yang, Xinxin Zhang, Mridul Aanjaneya, Chenfanfu Jiang. An Efficient B-Spline Lagrangian/Eulerian Method for Compressible Flow, Shock Waves, and Fracturing Solids. ACM Transactions on Graphics, 2022 (presentation at SIGGRAPH 2022).
- Minchen Li. Reliable Contact Simulation with IPC. IEEE Computer Graphics and Applications, Dissertation Impact, 2022.
- Yidong Zhao*, Jinhyun Choo* (equal contribution), Yupeng Jiang, Minchen Li, Chenfanfu Jiang, Kenichi Soga. A Barrier Method for Frictional Contact on Embedded Interfaces. Computer Methods in Applied Mechanics and Engineering (CMAME), 2022.

- Xuan Li*, Yu Fang* (equal contribution), Minchen Li, Chenfanfu Jiang. BFEMP: Interpenetration-Free MPM-FEM Coupling with Barrier Contact. Computer Methods in Applied Mechanics and Engineering (CMAME), 2021.
- Minchen Li, Danny M. Kaufman, Chenfanfu Jiang. Codimensional Incremental Potential Contact. ACM Transactions on Graphics (SIGGRAPH), 2021.
- Yu Fang*, Minchen Li* (equal contribution), Chenfanfu Jiang, Danny M. Kaufman. Guaranteed Globally Injective 3D Deformation Processing. ACM Transactions on Graphics (SIGGRAPH), 2021.
- Zachary Ferguson, Minchen Li, Teseo Schneider, Francisca Gil-Ureta, Timothy Langlois, Chenfanfu Jiang, Denis Zorin, Danny M. Kaufman, Daniele Panozzo. Intersection-free Rigid Body Dynamics. ACM Transactions on Graphics (SIGGRAPH), 2021.
- Lei Lan*, Yin Yang* (equal contribution), Danny M. Kaufman, Junfeng Yao, Minchen Li, Chenfanfu Jiang. Medial IPC: Accelerated Incremental Potential Contact With Medial Elastics. ACM Transactions on Graphics (SIGGRAPH), 2021.
- Xuan Li*, Jessica McWilliams* (equal contribution), Minchen Li, Cynthia Sung, Chenfanfu Jiang. Soft Hybrid Aerial Vehicle via Bistable Mechanism. IEEE International Conference on Robotics and Automation (ICRA), 2021. *[Best Paper Award in Mechanisms and Design]*
- Yue Li*, Xuan Li*, Minchen Li* (equal contribution), Yixin Zhu, Bo Zhu, Chenfanfu Jiang. Lagrangian-Eulerian Multi-Density Topology Optimization with the Material Point Method. International Journal for Numerical Methods in Engineering (IJNME), 2021.
- Minchen Li, Zachary Ferguson, Teseo Schneider, Timothy Langlois, Denis Zorin, Daniele Panozzo, Chenfanfu Jiang, Danny M. Kaufman. Incremental Potential Contact: Intersection- and Inversion-free, Large-Deformation Dynamics. ACM Transactions on Graphics (SIGGRAPH), 2020.
- Joshuah Wolper, Yunuo Chen, Minchen Li, Yu Fang, Ziyin Qu, Jiecong Lu, Meggie Cheng, Chenfanfu Jiang. AnisoMPM: Animating Anisotropic Damage Mechanics. ACM Transactions on Graphics (SIGGRAPH), 2020.
- Yu Fang*, Ziyin Qu* (equal contribution), Minchen Li, Xinxin Zhang, Yixin Zhu, Mridul Aanjaneya, Chenfanfu Jiang. IQ-MPM: An Interface Quadrature Material Point Method for Non-sticky Strongly Two-Way Coupled Nonlinear Solids and Fluids. ACM Transactions on Graphics (SIGGRAPH), 2020.
- Xinlei Wang*, Yuxing Qiu* (equal contribution), Stuart R. Slattery, Yu Fang, Minchen Li, Song-Chun Zhu, Yixin Zhu, Min Tang, Dinesh Manocha, Chenfanfu Jiang. A Massively Parallel and Scalable Multi-GPU Material Point Method. ACM Transactions on Graphics (SIGGRAPH), 2020.
- Xinlei Wang*, Minchen Li* (equal contribution), Yu Fang, Xinxin Zhang, Ming Gao, Min Tang, Danny M. Kaufman, Chenfanfu Jiang. Hierarchical Optimization Time Integration for CFL-rate MPM Stepping. ACM Transactions on Graphics, 2020 (presentation at SIGGRAPH 2020).
- Yupeng Jiang, Minchen Li, Chenfanfu Jiang, Fernando Alonso-Marroquin. A Hybrid Material-Point SpheropolygonElement Method for Solid and Granular Material Interaction. International Journal for Numerical Methods in Engineering (IJNME), 2020.
- Minchen Li, Ming Gao, Timothy Langlois, Chenfanfu Jiang, Danny M. Kaufman. Decomposed Optimization Time Integrator for Large-Step Elastodynamics. ACM Transactions on Graphics (SIGGRAPH), 2019.
- Yu Fang, Minchen Li, Ming Gao, Chenfanfu Jiang. Silly Rubber: An Implicit Material Point Method for Simulating Nonequilibrated Viscoelastic and Elastoplastic Solids. ACM Transactions on Graphics (SIGGRAPH), 2019.
- Joshuah Wolper, Yu Fang, Minchen Li, Jiecong Lu, Ming Gao, Chenfanfu Jiang. CD-MPM: Continuum Damage Material Point Methods for Dynamic Fracture Animation. ACM Transactions on Graphics (SIGGRAPH), 2019.
- Minchen Li, Danny M. Kaufman, Vladimir G. Kim, Justin Solomon, Alla Sheffer. OptCuts: Joint Optimization of Surface Cuts and Parameterization. ACM Transactions on Graphics (SIGGRAPH Asia), 2018.
- Minchen Li, Alla Sheffer, Eitan Grinspun, and Nicholas Vining. FoldSketch: Enriching Garments with Physically Reproducible Folds. ACM Transactions on Graphics (SIGGRAPH), 2018.
- Xinxin Zhang, Minchen Li, and Robert Bridson. Resolving Fluid Boundary Layers with Particle Strength Exchange and Weak Adaptivity. ACM Transactions on Graphics (SIGGRAPH), 2016.
- Minchen Li, Wei Cai, Ke Wang, Hong Ji, and Victor C.M. Leung. Prototyping Decomposed Cloud Software: A Case Study on 3D Skeletal Game Engine. IEEE International Conference on Cloud Computing Technology and Science (CloudCom), 2015.

- Wei Cai, Conghui Zhou, Minchen Li, Xiuhua Li, and Victor C.M. Leung. MCG Test-bed: An Experimental Test-bed for Mobile Cloud Gaming. ACM MobiSys Workshop on Mobile Gaming (MobiGames), 2015.

Invited Talks

Introduction to Optimization Time Integration for Solids and Fluids

USTC CG Summer School (Host: Ligang Liu and Xiaomin Fu) — *Jul. 9, 2024*

SGP 2024 Graduate School (Host: Edward Chien and Silvia Sellán) — *Jun. 22, 2024*

Accelerating Deformable Body Simulation with AI Towards Time-Sensitive Applications

UCLA Math285J Guest Lecture (Host: Chenfanfu Jiang) — *Apr. 5, 2024*

Stanford CS348I Guest Lecture (Host: C. Karen Liu) — *Feb. 27, 2024*

Meta Reality Labs (Pittsburgh) Reading Group (Host: Gengshan Yang and Christian Richardt) — *Feb. 9, 2024*

Reliable Simulation of Frictional Contact for Deformable Solids and Beyond

Computer Science and Engineering Seminar, UC San Diego (Host: Ravi Ramamoorthi) — *Apr. 19, 2023*

Computer Science Department Seminar, Carnegie Mellon University (Host: Keenan Crane) — *Mar. 13, 2023*

Computer Science Department Seminar, Cornell University (Host: Steve Marschner) — *Mar. 6, 2023*

School of Interactive Computing Seminar, Georgia Institute of Technology (Host: Greg Turk) — *Feb. 2, 2023*

Multibody Simulation with Affine Body Dynamics

Graphics And Mixed Environment Seminar (GAMES) (Host: Yifan Peng and Qiang Zou) — *Aug. 15, 2022*

Graphics & Vision Seminar, Snap Research (Host: Menglei Chai) — *Jun. 16, 2022*

Social Robot Seminar, School of Film, Xiamen University (Host: Junfeng Yao and Lei Lan) — *Jun. 9, 2022*

Pixel Cafe Seminar, University of California, San Diego (Host: Hao Su and Albert Chern) — *Apr. 29, 2022*

Reliable Contact Simulation with IPC

Software for Soft Robotics Research Workshop, RoboSoft 2022 (Host: S.M.Hadi Sadati) — *Apr. 4, 2022*

Colloquia@CS, McGill University (Host: Xujie Si and Paul G. Kry) — *Mar. 25, 2022*

ACM SIGGRAPH Outstanding Doctoral Dissertation Award Talk (Host: Mathieu Desbrun) — *Aug. 9, 2021*

School of Computing (SoC) Seminar, Clemson University (Host: Yin Yang) — *Nov. 20, 2020*

Incremental Potential Contact: Intersection- and Inversion-free, Large-Deformation Dynamics

Graphics And Mixed Environment Seminar (GAMES) (Host: Tiantian Liu and Weiwei Xu) — *Nov. 26, 2020*

Computer Graphics Summer School, Peking University (Host: Bin Wang) — *Aug. 26, 2020*

Decomposed Optimization Time Integrator for Large-Step Elastodynamics

Graphics And Mixed Environment Seminar (GAMES) (Host: Xiaowei Zhou and Lin Lv) — *Sep. 5, 2019*

OptCuts: Joint Optimization of Surface Cuts and Parameterization

Graphics And Mixed Environment Seminar (GAMES) (Host: Ruizhen Hu and Lin Lv) — *Dec. 27, 2018*

Teaching

Instructor at Carnegie Mellon University, Pittsburgh

15-769: Physically-based Animation of Solids and Fluids — *Fall 2023*

Instructor at University of California, Los Angeles

Math 164: Optimization — *Fall 2022*

Math 151A: Applied Numerical Methods — *Fall 2021*

Math 32A: Calculus of Several Variables — *Summer 2021*

Teaching Assistant at University of Pennsylvania

EAS 205 – Scientific Computing (Instructor: Chenfanfu Jiang) — *Spring 2020*

CIS 563 – Physically Based Animation (Instructor: Chenfanfu Jiang) — *Fall 2019*

Teaching Assistant at University of British Columbia

CPSC 418 – Parallel Computation (Instructor: Mark R. Greenstreet) — *Spring 2016*

CPSC 314 – Computer Graphics (Instructor: Mikhail Bessmeltsev) — *Fall 2015*

Research Community Service

Session Chair

- ACM SIGGRAPH (2024)
- ACM SIGGRAPH/Eurographics SCA (2023)

Program Committee

- CCF CAD/CG (2024)
- ACM SIGGRAPH (2024)
- AAAI Student Program (2024)
- ACM SIGGRAPH Asia (2023)
- Computer Graphics International (2023)
- ACM SIGGRAPH/Eurographics SCA (2023, 2024)
- Pacific Graphics (2022, 2024)

Reviewer (excluding committee services listed above)

- Applied Mathematical Modelling (2024)
- NeurIPS (2023, 2024)
- Journal of Rock Mechanics and Geotechnical Engineering (2023)
- Computer Graphics Forum (2023)
- Journal of Impact Engineering (2022)
- ACM SIGGRAPH Asia (2021, 2022, 2024)
- The Visual Computer (2021)
- IEEE ICRA (2021, 2023)
- IEEE TVCG (2020, 2022, 2023, 2024)
- ACM Transactions on Graphics (2020, 2021, 2023)
- ACM SIGGRAPH (2020, 2021, 2022, 2023)
- Eurographics (2020)
- Virtual Reality (2019, 2020)

Media Publicity

- [**UCLA Newsroom**] UCLA team receives best paper award at international robotics conference.
- [**UPenn CIS Blog**] [**Adobe Research News**] Minchen Li receives SIGGRAPH Dissertation Award.
- [**Gizmodo**] [**80 Level**] [**ACM SIGGRAPH Blog**] [**Business Wire**] [**Animation Magazine**] Meat-Tearing CG Breakthrough Promises to Make Video Game Injuries Disgustingly Realistic.
- [**Adobe Research News**] Nurturing Next-Gen Computer Scientists: The Adobe Research Fellowship.
- [**The Takeout**] [**VICE**] [**80 Level**] Advances in science: We can now tear CGI bread in half.
- [**Adobe Research News**] Interns Find Freedom to Innovate at Adobe Research.