Beichen Li

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Education

Massachusetts Institute of Technology, Ph.D. in Computer Science – Cambridge, MA — Aug 2018 – Jan 2025
- GPA: 5.0/5.0 (Minor: Economics)

Massachusetts Institute of Technology, M.S. in Computer Science – Cambridge, MA — Aug 2018 – Jun 2021

Tsinghua University, B.Eng. in Computer Science and Technology – Beijing, China — Aug 2014 – Jun 2018
- GPA: 3.91/4.0, Rank: 3/180

Experience

Research Assistant, Computational Design and Fabrication Group, MIT CSAIL – Cambridge, MA — Aug 2018 – Jan 2025
- **Advisor:** Prof. Wojciech Matusik
- Fine-tuned a pre-trained large vision-language model to generate procedural physics-based rendering (PBR) materials from single images through supervised fine-tuning
- Developed a differentiable procedural material modeling library, *DiffMat*, to match the appearance of procedural materials against real-world flash photos by optimizing the node parameters
- Developed a learning-accelerated computational pipeline to automatically discover 3D-printable microstructures with an optimal trade-off between stiffness and toughness

Research Intern, 3D Graphics Group, Adobe Research – Cambridge, MA — May 2023 – Aug 2023
- **Mentor:** Dr. Yiwei Hu
- Generated a large-scale procedural material dataset with over 10M paired images and material graphs to pre-train a Transformer-based model for image-conditioned procedural material generation
- Fine-tuned the pre-trained model on real-world flash photos using reinforcement learning to improve the visual quality of the generated materials

Research Intern, 3D and Immersive Group, Adobe Research – San Jose, CA (Remote) — May 2020 – Aug 2020
- **Mentor:** Dr. Miloš Hašan and Dr. Kalyan Sunkavalli
- Trained an RNN-based variational autoencoder to generate novel procedural material graphs from a dataset of exemplar materials

Team Leader, Student Supercomputing Team, Tsinghua University – Beijing, China — Nov 2017 – Jun 2018
- **Mentor:** Prof. Jidong Zhai
- Led a team of 6 students to participate in the ASC, ISC, and SC international student cluster competitions
- Benchmarked and optimized the performance of scientific applications (e.g., LINPACK, MASNUM, and MrBayes) on many-core CPU/GPU architectures

Research Intern, CMU Robotics Institute – Pittsburgh, PA — Jun 2017 – Sep 2017
- **Mentor:** Prof. Stelian Coros
- Implemented an interactive framework to co-optimize the motion and design parameters of 3D-printable robotic creatures based on sensitivity analysis and the adjoint method
- Developed an interactive demo to compare the efficiency of different gradient-based optimization algorithms

Undergraduate Research Assistant, Graphics and Geometric Computing Group, Tsinghua University – Beijing, China — Feb 2017 – Jun 2018
- **Advisor:** Prof. Shi-Min Hu
- Co-developed a real-time indoor scene reconstruction system on a mobile robot platform with heterogeneous sensors to enhance the accuracy and robustness of tracking

- Co-implemented an alternative indoor scene reconstruction workflow by stitching reconstructed 3D panoramas from three robot-mounted, unsynchronized, in-place-rotating RGB-D cameras

Publications

(*) indicates equal contribution

[1] **Beichen Li**, Rundi Wu, Armando Solar-Lezama, Changxi Zheng, Liang Shi, Bernd Bickel, and Wojciech Matusik. "VLMaterial: Procedural Material Generation with Large Vision-Language Models". *International Conference on Learning Representations (ICLR),* ***Spotlight***, 2025.

[2] **Beichen Li**, Yiwei Hu, Paul Guerrero, Miloš Hašan, Liang Shi, Valentin Deschaintre, and Wojciech Matusik. "Procedural Material Generation with Reinforcement Learning". *ACM Transactions on Graphics (TOG), Proceedings of ACM SIGGRAPH Asia 2024*, 2024.

[3] **Beichen Li**, Bolei Deng, Wan Shou, Tae-Hyun Oh, Yuanming Hu, Yiyue Luo, Liang Shi, and Wojciech Matusik. "Computational Discovery of Microstructured Composites with Optimal Stiffness-Toughness Trade-Offs". *Science Advances*, 2024.

[4] Yunsheng Tian, Pavle Vanja Konaković, **Beichen Li**, Ane Zuniga, Michael Foshey, Timothy Erps, Wojciech Matusik, and Mina Konaković Luković. "AutODEx: Automated Optimal Design of Experiments Platform with Data- and Time-Efficient Multi-Objective Optimization". *NeurIPS 2023 Workshop on Adaptive Experimental Design and Active Learning in the Real World*, 2023.

[5] **Beichen Li**, Liang Shi, and Wojciech Matusik. "End-to-End Procedural Material Capture with Proxy-Free Mixed-Integer Optimization". *ACM Transactions on Graphics (TOG), Proceedings of ACM SIGGRAPH 2023*, 2023.

[6] Liang Shi, **Beichen Li**, and Wojciech Matusik. "End-to-End Learning of 3D Phase-Only Holograms for Holographic Display". *Light: Science and Applications*, 2022.

[7] Minghao Guo, Veronika Thost, **Beichen Li**, Payel Das, Jie Chen, and Wojciech Matusik. "Data-Efficient Graph Grammar Learning for Molecular Generation". *International Conference on Learning Representations (ICLR),* ***Oral Presentation***, 2022.

[8] **Beichen Li**, Wan Shou, and Wojciech Matusik. "Computational Discovery of Microstructure Designs". *US Patent Number: US20220374569A1*, 2022.

[9] Aldair E. Gongora*, Siddharth Mysore*, **Beichen Li***, Wan Shou, Wojciech Matusik, Elise F. Morgan, Keith A. Brown, and Emily Whiting. "Designing Composites with Target Effective Young's Modulus using Reinforcement Learning". *ACM Symposium on Computational Fabrication (SCF)*, 2021.

[10] Yiyue Luo, Yunzhu Li, Pratyusha Sharma, Wan Shou, Kui Wu, Michael Foshey, **Beichen Li**, Tomás Palacios, Antonio Torralba, and Wojciech Matusik. "Learning Human-Environment Interactions using Conformal Tactile Textiles". *Nature Electronics,* ***Cover Article***, 2021.

[11] Liang Shi, **Beichen Li**, Changil Kim, Petr Kellnhofer, and Wojciech Matusik. "Towards Real-Time Photorealistic 3D Holography with Deep Neural Networks". *Nature*, 2021.

[12] Liang Shi, **Beichen Li**, Miloš Hašan, Kalyan Sunkavalli, Tamy Boubekeur, Radomír Měch, and Wojciech Matusik. "MATch: Differentiable Material Graphs for Procedural Material Capture". *ACM Transactions on Graphics (TOG), Proceedings of ACM SIGGRAPH Asia 2020*, 2020.

[13] Sheng Yang, **Beichen Li**, Yan-Pei Cao, Hongbo Fu, Yu-Kun Lai, Leif Kobbelt, and Shi-Min Hu. "Noise-Resilient Reconstruction of Panoramas and 3D Scenes using Robot-Mounted Unsynchronized Commodity RGB-D Cameras". *ACM Transactions on Graphics (TOG)*, 2020.

[14] Xianchen Xu, Chen Wang, Wan Shou, Zongliang Du, Yangyang Chen, **Beichen Li**, Wojciech Matusik, Nassar Hussein, and Guoliang Huang. "Physical Realization of Elastic Cloaking with a Polar Material". *Physical Review Letters*, 2020.

[15] Jie Xu, Tao Du, Michael Foshey, **Beichen Li**, Bo Zhu, Adriana Schulz, and Wojciech Matusik. "Learning to Fly: Computational Controller Design for Hybrid UAVs with Reinforcement Learning". *ACM Transactions on Graphics (TOG), Proceedings of ACM SIGGRAPH 2019*, 2019.

[16] Sheng Yang, **Beichen Li**, Minghua Liu, Yu-Kun Lai, Leif Kobbelt, and Shi-Min Hu. "HeteroFusion: Dense Scene Reconstruction Integrating Multi-Sensors". *IEEE Transactions on Visualization and Computer Graphics (TVCG)*, 2019.

[17] Ruta Desai, **Beichen Li**, Ye Yuan, and Stelian Coros. "Interactive Co-Design of Form and Function for Legged Robots using the Adjoint Method". *International Conference on Climbing and Walking Robots (CLAWAR),* ***Best Paper (2nd)****,* 2018.

Projects

DiffMat: PyTorch-Based Differentiable Material Graph Library for Procedural Material Capture GitHub: mit-gfx/diffmat

- Implemented differentiable versions of commonly-used procedural material nodes in Adobe Substance 3D Designer (including complex nodes like *Pixel Processor* and *FX-Map*) using PyTorch
- Implemented a mixed-integer optimization algorithm to co-optimize the continuous and discrete node parameters in procedural material graphs for matching real-world flash photos
- Accelerated the forward execution of texture generator nodes by >100x using the Taichi programming language
- Tools Used: Python, Adobe Substance 3D Designer

Awards and Fellowships

Ernst A. Guillemin Artificial Intelligence and Decision Making Thesis Award, MIT Department of Electrical Engineering and Computer Science (EECS) Jun 2022

Outstanding Graduate of Tsinghua University, Tsinghua University Jun 2018

Outstanding Graduate of Beijing, Beijing Municipal Commission of Education Jun 2018

ISC Student Cluster Competition Champion, HPC-AI Advisory Council Jun 2017, Jun 2018

ASC Student Supercomputer Challenge Champion, ASC Committee May 2017, May 2018

National Scholarship, Ministry of Education of China 2016, 2017

Service

Reviewer, ACM SIGGRAPH, ACM SIGGRAPH Asia, ICRA

Teaching Assistant, MIT 6.839 Advanced Computer Graphics Fall 2021

- Developed and graded assignments, held office hours, and provided feedback on student projects

Web Developer, MIT Sidney-Pacific Graduate Community 2020 – 2021

- Participated in feature development and bug fixing for the community website

Technical Skills

Languages: Python (PyTorch, Hugging Face), C++ (OpenMP, CUDA), MATLAB, HTML/CSS, LaTeX

Software: Adobe Creative Cloud (Illustrator, Premiere Pro, Substance 3D Designer), Blender, Visual Studio Code, Git, Overleaf