

Tzu-Mao Li

tzli@ucsd.edu

+1 (617) 955-7556

<https://cseweb.ucsd.edu/~tzli/>

<https://github.com/BachiLi/>

Research Areas

- Visual Computing
 - Light Transport Simulation
 - Inverse Rendering
 - Computational Photography
 - Physical Simulation
- Programming Systems
 - Automatic Differentiation
 - Domain-Specific Compilers
- Statistical Learning
 - Differentiable Programming
 - Monte Carlo Integration and Markov Chain Monte Carlo Methods

Education

Massachusetts Institute of Technology

Cambridge, Massachusetts, United States

Ph.D.: *Computer Science*

Sep 2014 - June 2019

Advisor: Frédo Durand

Thesis: Differentiable Visual Computing

(**ACM SIGGRAPH 2020 Outstanding Doctoral Dissertation Award**)

National Taiwan University

Taipei, Taiwan

Master of Science: *Computer Science and Information Engineering*

Sep 2011 - June 2013

Advisor: Yung-Yu Chuang

Thesis: SURE-Based Optimization for Adaptive Sampling and Reconstruction

Bachelor of Science: *Computer Science and Information Engineering*

Sep 2007 - June 2011

Work Experience

Assistant Professor at UC San Diego, San Diego, United States

July 2021 - Now

Postdoctoral Researcher at MIT CSAIL, Cambridge, United States

March 2020 - July 2021

Postdoctoral Researcher at UC Berkeley, Berkeley, United States

July 2019 - March 2020

Host: Jonathan Ragan-Kelley.

Research Internship at Facebook Reality Labs, Seattle, United States

Jun 2018 - Aug 2018

I worked on applying differentiable rendering for material and light reconstruction from RGBD photos.

Research Internship at NVIDIA Research, Seattle, United States

Jun 2017 - Aug 2017

I worked on a differentiable renderer.

Rendering Internship at Weta Digital, Wellington, New Zealand

Jun 2016 - Aug 2016

I worked on the Manuka renderer.

Alternative Military Service at National Palace Museum, Taipei, Taiwan

Aug 2013 - Jul 2014

Internship at Digimax, Taipei, Taiwan

Jul 2011 - Sep 2011

I developed an environment light editing system and implemented a physically-based hair shader.

Teaching Experience

Teaching Assistant at Massachusetts Institution of Technology, Cambridge, United States *Fall 2017*

Course: Digital and Computational Photography (6.815). Around 65 undergraduate and graduate students.

I helped designing problem sets, grading, and holding office hours.

Students were asked to write C++ image processing programs.

Teaching Assistant at National Taiwan University, Taipei, Taiwan

Spring 2012

Course: Compiler Design. Around 100 undergraduate students.

I helped designing problem sets, exams, grading, and holding office hours.

Students were asked to implement a compiler in Java that compiles a subset of C.

Publications

Efficient Automatic Scheduling of Imaging & Vision Pipelines for the GPU

Luke Anderson, Andrew Adams, Karima Ma, **Tzu-Mao Li**, Tian Jin, Jonathan Ragan-Kelley

Proceedings of the ACM on Programming Languages (OOPSLA), to appear

Learning to Cluster for Rendering with Many Lights

Yu-Chen Wang, Yu-Ting Wu, **Tzu-Mao Li**, Yung-Yu Chuang

ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2021), to appear

Multi-Resolution Shared Representative Filtering for Real-Time Depth Completion

Yu-Ting Wu, **Tzu-Mao Li**, I-Chao Shen, Hong-Shiang Lin, Yung-Yu Chuang

High Performance Graphics 2021

Systematically Differentiating Parametric Discontinuities

Sai Praveen Bangaru*, Jesse Michel*, Kevin Mu, Gilbert Bernstein, **Tzu-Mao Li**, Jonathan Ragan-Kelley
(first two authors contributed equally)

ACM Transactions on Graphics (Proceedings of SIGGRAPH 2021)

Unbiased Warped-Area Sampling for Differentiable Rendering

Sai Praveen Bangaru, **Tzu-Mao Li**, Frdo Durand

ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2020)

Differentiable Vector Graphics Rasterization for Editing and Learning

Tzu-Mao Li, Michal Luk, Michal Gharbi, Jonathan Ragan-Kelley

ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2020)

Physics-Based Differentiable Rendering: A Comprehensive Introduction

Shuang Zhao, Wenzel Jakob, **Tzu-Mao Li**

SIGGRAPH 2020 Course

DiffTaichi: Differentiable Programming for Physical Simulation

Yuanming Hu, Luke Anderson, **Tzu-Mao Li**, Jonathan Ragan-Kelley, Frdo Durand

International Conference on Learning Representation 2020

Taichi: A Language for High-Performance Computation on Spatially Sparse Data Structures

Yuanming Hu, **Tzu-Mao Li**, Luke Anderson, Jonathan Ragan-Kelley, Frdo Durand

ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2019)

Learning to Optimize Halide with Tree Search and Random Programs

Andrew Adams, Karima Ma, Luke Anderson, Riyadh Baghdadi, **Tzu-Mao Li**, Michaël Gharbi,

Benoit Steiner, Steven Johnson, Kayvon Fatahalian, Frdo Durand, Jonathan Ragan-Kelley

ACM Transactions on Graphics (Proceedings of SIGGRAPH 2019)

Sample-based Monte Carlo Denoising using a Kernel-Splatting Network

Michaël Gharbi, **Tzu-Mao Li**, Jaakko Lehtinen, Frdo Durand

ACM Transactions on Graphics (Proceedings of SIGGRAPH 2019)

Inverse Path Tracing for Joint Material and Lighting Estimation

Dejan Azinović, **Tzu-Mao Li**, Anton Kaplanyan, Matthias Nießner
Conference on Computer Vision and Pattern Recognition 2019 (oral presentation)

Differentiable Monte Carlo Ray Tracing through Edge Sampling

Tzu-Mao Li, Miika Aittala, Frédo Durand, Jaakko Lehtinen
ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2018)

Differentiable Programming for Image Processing and Deep Learning in Halide

Tzu-Mao Li, Michaël Gharbi, Andrew Adams, Frédo Durand, Jonathan Ragan-Kelley
ACM Transactions on Graphics (Proceedings of SIGGRAPH 2018)

Aether: An Embedded Domain Specific Sampling Language for Monte Carlo Rendering

Luke Anderson, **Tzu-Mao Li**, Jaakko Lehtinen, Frédo Durand
ACM Transactions on Graphics (Proceedings of SIGGRAPH 2017)

Anisotropic Gaussian Mutations for Metropolis Light Transport through Hessian-Hamiltonian Dynamics

Tzu-Mao Li, Jaakko Lehtinen, Ravi Ramamoorthi, Wenzel Jakob, Frédo Durand
ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2015)

Dual-Matrix Sampling for Scalable Translucent Material Rendering

Yu-Ting Wu, **Tzu-Mao Li**, Yu-Hsun Lin, Yung-Yu Chuang
IEEE Transactions on Visualization and Computer Graphics, 2015

SURE-Based Optimization for Adaptive Sampling and Reconstruction

Tzu-Mao Li, Yu-Ting Wu, Yung-Yu Chuang
ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2012)

Invited Talks

Differentiable Rendering without Approximation

Qualcomm, San Diego, March 2021

Beyond Convolutional Neural Networks: Differentiable Visual Computing

University of British Columbia, April 2020

University of Texas at Austin, April 2020

Cornell University, April 2020

University of California, San Diego, April 2020

Columbia University, March 2020

Brown University, February 2020

Differentiable, Optimizable, and Retargetable Array Programming with Halide and Taichi

Magic Leap, Sunnyvale, Nov. 2019

Differentiable Visual Computing or

Differentiable Programming for Computer Graphics and Deep Learning

University of California, Berkeley, Oct. 2019 and Sep. 2019

Adobe Research, San Jose, Sep. 2019

National Taiwan University, Taipei, Nov. 2018

Hessian-Hamiltonian Monte Carlo Rendering

MCQMC 2016, Stanford

(12th International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing)

Open-source software

redner: <https://github.com/BachiLi/redner>

A differentiable Monte Carlo path tracer with PyTorch and TensorFlow interfaces, that can differentiate with respect to arbitrary scene parameters, while taking geometric discontinuities into account.

I wrote most of the code.

diffvg: <https://github.com/BachiLi/diffvg>

A differentiable vector graphics rasterizer with PyTorch and TensorFlow interfaces. I wrote most of the code with the help of Michael Gharbi and Mike Lukac.

Halide: <https://github.com/halide/Halide/>

A domain-specific language for image and array processing. I helped maintenance, added automatic differentiation and atomic operation to the language, and developed automatic schedulers for optimizing Halide programs.

dpt: <https://github.com/BachiLi/dpt/>

A differentiable bidirectional path tracer that can compute Hessian of light path contribution with respect to path parameters. It implements our Hessian-Hamiltonian Monte Carlo Rendering algorithm. I wrote all of the code.

had: <https://github.com/BachiLi/had/>

A header-only automatic differentiation library, based on operator overloading, that implements the edge-pushing algorithm for Hessian computation. I wrote most of the code.

Aether: <https://github.com/aekul/aether>

An embedded domain-specific language for Monte Carlo rendering. I helped Luke Anderson with the development.

Patents

Inverse Path Tracing for Material and Lighting Estimation

Anton Kaplanyan, Dejan Azinovic, Matthias Niessner, **Tzu-Mao Li**
US Patent 17,178,122

Differentiable rendering pipeline for inverse graphics

Tzu-Mao Li, Marco Salvi, Jaakko Lehtinen, Aaron Lefohn
US Patent 10,565,747

Professional Services

Program Committee:

Eurographics Symposium on Rendering 2020, 2021
SIGGRAPH 2021

Reviewer:

SIGGRAPH, SIGGRAPH Asia
Transaction on Graphics
Eurographics
Eurographics Symposium on Rendering
Pacific Graphics
Principles and Practice of Parallel Programming
Transactions on Pattern Analysis and Machine Intelligence
Computer Graphics Forum
The Visual Computer
High-Performance Graphics
Transactions on Visualization and Computer Graphics
Journal of Computer Graphics Techniques
Journal of Parallel and Distributed Computing
Computer Graphics Forum

Press Coverage

“ACM SIGGRAPH 2020 Doctoral Dissertation Award Goes to MIT CSAILs Tzu-Mao Li for PhD Thesis on Differentiable Visual Computing”, 2020
Synced.

“2020 Outstanding Doctoral Dissertation Award: Tzu-Mao Li”

ACM SIGGRAPH

“Novel denoising method generates sharper photorealistic images faster”, 2019
EurekaAlert! TechXplore, ScienceDaily.

Languages

Chinese (native speaker), English, Japanese

References

Frédo Durand

Professor, Massachusetts Institute of Technology
fredo@mit.edu

Jonathan Ragan-Kelley

Assistant Professor, Massachusetts Institute of Technology
jrk@csail.mit.edu

Jaakko Lehtinen

Associate Professor, Aalto University, Principal Research Scientist, NVIDIA Research
jaakko.lehtinen@aalto.fi

Ravi Ramamoorthi

Professor, University of California, San Diego
ravir@cs.ucsd.edu

Yung-Yu Chuang

Professor, National Taiwan University
cy@csie.ntu.edu.tw