

RESEARCH FOCUS

My research is focused on advancing **hardware-accelerated, machine-learning-augmented** visualization techniques to support **complex, large-scale scientific applications**. Specifically, I design hardware-accelerated parallel algorithms that facilitate realistic visualization of scientific data and create innovative methods for efficiently managing large-scale, distributed data. I also develop expressive and intelligent systems that optimize and automate scientific visualization and analysis processes, ultimately paving the way for more streamlined workflows and fostering scientific breakthroughs.

EDUCATION

- Sep. 2018 – Jun. 2024 (Expected) **PhD Candidate in Computer Science**
University of California – Davis, United States
Advisor: Dr. Kwan-Liu Ma
Thesis: A Programmable Streaming Framework for Extreme Scale Scientific Visualizations
- Aug. 2016 – May. 2018 **Master's in Computing, Graphics & Visualization Track**
Scientific Computing and Imaging Institute (SCI), University of Utah, United States
Advisor: Dr. Chuck Hansen
Thesis: Visit-OSPRay: Toward an Exascale Volume Visualization System
- Sep. 2012 – Jun. 2016 **Bachelor of Science in Physics, Physics & Mathematics Track, First Class Honor**
Hong Kong University of Science and Technology (HKUST), China
Advisor: Dr. Michael Wong and Dr. Nian Lin
Thesis: Statistical Neural Decoding for Saccadic Visual Stability
- Feb. 2015 – Aug. 2015 **Exchange Undergraduate Student**
Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland

PROFESSIONAL EXPERIENCE

- Sep. 2018 – Present **University of California – Davis**
Graduate Research Assistant, with Dr. Kwan-Liu Ma
 - Research in the field of expressive visualization, high-fidelity rendering, and machine learning.
- Jul. 2022 – Dec. 2022 **Argonne National Laboratory**
Research Internship, with Dr. Joseph A. Insley, Dr. Silvio Rizzi, and Dr. Victor Mateevitsi
 - Develop declarative and reactive programming interface in Ascent for in situ visualization.
 - Research on distributed neural representation for large-scale interactive volume rendering.
- Jul. 2021 – Dec. 2021 **Intel Corporation, Graphics Research**
Research Internship, with Dr. Michael J. Doyle
 - Research on deep-learning-assisted direct storage streaming for real-time rendering.
 - Research on efficient direct storage streaming for large-scale volume data.
- Jul. 2019 – Sep. 2019 **Intel Corporation**
Software Engineering for Computer Graphics
 - SIMD optimizations of the traversal and the scheduling algorithm for hardware ray tracing.
- Jul. 2018 – Sep. 2018 **Argonne National Laboratory**
Graduate Research Internship, with Dr. Joseph A. Insley and Dr. Silvio Rizzi
 - Develop a CPU rendering system inside the scalable and interactive parallel volume rendering – VL3.
 - Develop remote visualization clients for parallel volume rendering on supercomputer – Theta.
- Dec. 2016 – May. 2018 **University of Utah**
Research Assistant, with Dr. Chuck Hansen, Dr. Aaron Knoll, and Dr. Ingo Wald
 - Code modernization for many-core Intel architectures using the OSPRay ray-tracing library.
 - Integrate the OSPRay ray-tracing library into the visualization software – Visit.
- Jun. 2015 – Aug. 2015 **European Organization for Nuclear Research (CERN)**
Undergraduate Research, with Dr. Mathieu Benoit
 - Develop an auto-optimization program inside ALLPIX, a simulation software for silicon pixel detector.
- Sep. 2015 – Jun. 2016 **Hong Kong University of Science and Technology (HKUST)**
Undergraduate Research, with Dr. Michael Wong
 - Statistical analysis of neuron activities during monkey saccades using machine learning techniques.

Jun. 2013 – **Hong Kong University of Science and Technology (HKUST)**

Dec. 2014 *Undergraduate Research, with Dr. Nian Lin*

- Analyze images obtained from low-temperature scanning tunneling microscopy (STM).
- Use STM to measure and manipulate molecular properties and states on single molecular level.
- Implement a Monte Carlo simulation program for supra-molecular self-assembly.

PUBLICATIONS

2023 **Memory-Efficient GPU Volume Path Tracing of AMR Data Using the Dual Mesh**

Stefan Zellmann, **Qi Wu**, Kwan-Liu Ma, and Ingo Wald

EuroVis *Eurographics Conference on Visualization*

HyperINR: A Fast and Predictive Hypernetwork for Implicit Neural Representations via Knowledge Distillation

Qi Wu, David Bauer, Yuyang Chen, and Kwan-Liu Ma

Preprint

Photon Field Networks for Dynamic Real-Time Volumetric Global Illumination

David Bauer, **Qi Wu**, and Kwan-Liu Ma

VIS *IEEE Visualization Conference*

Distributed Neural Representation for Reactive in situ Visualization

Qi Wu, Joseph A. Insley, Victor A. Mateevitsi, Silvio Rizzi, Michael E. Papka, and Kwan-Liu Ma

Preprint

2022 **Interactive Volume Visualization via Multi-Resolution Hash Encoding based Neural Representation**

Qi Wu, David Bauer, Michael J. Doyle, and Kwan-Liu Ma

TVCG *IEEE Transactions on Visualization and Computer Graphics*

FoVolNet: Fast Volume Rendering using Foveated Deep Neural Networks

David Bauer, **Qi Wu**, and Kwan-Liu Ma

VIS *IEEE Visualization Conference, **Best Paper Honorable Mentions***

A Flexible Data Streaming Design for Interactive Visualization of Large-Scale Volume Data

Qi Wu, Michael J. Doyle, and Kwan-Liu Ma

EGPGV *Eurographics Symposium on Parallel Graphics and Visualization*

Beyond ExaBricks: GPU Volume Path Tracing of AMR Data

Stefan Zellmann, **Qi Wu**, Alper Sahistan, Kwan-Liu Ma, and Ingo Wald

Preprint

Distributed Volumetric Neural Representation for in situ Visualization and Analysis

Qi Wu, Joseph A. Insley, Victor A. Mateevitsi, Silvio Rizzi, and Kwan-Liu Ma

Poster *IEEE Large Scale Data Analysis and Visualization Symposium Poster*

2020 **DIVA: A Declarative and Reactive Language for in situ Visualization**

Qi Wu, Tyson Neuroth, Oleg Igouchkine, Konduri Aditya, Jacqueline H. Chen, and Kwan-Liu Ma

LDAV *IEEE Large Scale Data Analysis and Visualization Symposium*

2019 **Ray Tracing Generalized Tube Primitives: Method and Applications**

Mengjiao Han, Ingo Wald, Will Usher, **Qi Wu**, Feng Wang, Valerio Pascucci, Charles D. Hansen, Chris R. Johnson

EuroVis *Eurographics Conference on Visualization*

2018 **VisIt-OSPRay: Toward an Exascale Volume Visualization System**

Mengjiao Han, Ingo Wald, Will Usher, **Qi Wu**, Feng Wang, Valerio Pascucci, Charles D. Hansen, Chris R. Johnson

EGPGV *Eurographics Symposium on Parallel Graphics and Visualization*

CPU Isosurface Ray Tracing of Adaptive Mesh Refinement Data

Feng Wang, Ingo Wald, **Qi Wu**, Will Usher, and Chris R. Johnson

VIS *IEEE Visualization Conference*

Topological data analysis made easy with the Topology ToolKit

Guillaume Favelier, Charles Gueunet, Attila Gyulassy, Julien Kitware, Joshua Levine, Jonas Lukasczyk, Daisuke Sakurai, Maxime Soler, Julien Tierny, Will Usher, and **Qi Wu**

Tutorial *IEEE Visualization Conference Tutorial*

2015 **Thermodynamic versus Kinetic Control in Self-Assembly of Zero, One, Quasi-two and Two Dimensional Metal-Organic Coordination Structures**

Lin, Tao, **Qi Wu**, Jun Liu, Ziliang Shi, Pei Nian Liu, Nian Lin

JCP *Journal of Chemical Physics*

INVITED TALKS & PRESENTATIONS

- 2023 **Los Alamos National Laboratory**
Invited Talk: "Distributed neural representation for reactive in situ visualization".
- 2022 **Ohio State University**
Invited Talk: "Implicit neural representation for interactive volume rendering of large-scale data".
- Stanford University Legion Retreat**
Invited Lightning Talk: "Realizing Adaptive in situ Visualization Workflows in Regent".
- US Department of Energy Computer Graphics Forum**
Invited Technical Talk: "A Distributed Volumetric Neural Representation for Interactive Visualization of Large-Scale Data"
- IEEE Large Scale Data Analysis and Visualization**
Early Career Lightning Talk: "Instant Neural Representation for Interactive Volume Rendering"
- Intel Innovation Conference**
Invited Exhibitor: "Accelerating Instant Neural Representation & FoVolNet with OneAPI"
- 2018 **Utah Carbon Capture Multidisciplinary Simulation Center Annual Meeting**
Presentation: "Visit-OSPRay: Toward an Exascale Volume Visualization System"
- 2017 **Utah Carbon Capture Multidisciplinary Simulation Center Annual Meeting**
Presentation: "Visit-OSPRay: Scalable Volume Rendering on Intel KNL CPUs"
- 2016 **ACM/IEEE Supercomputing Conference**
University of Utah Booth: "Volume Rendering with Visit-OSPRay"
- 2014 **Physical Society of Hong Kong (PSHK) Conference**
Presentation: "Monte Carlo Simulation for 2D Supramolecular Self-Assembly"
- Undergraduate Research Opportunities Program, HKUST**
Presentation: "The effect of metal atoms in the MOFs self-assembly"

AWARDS

- 2022 IEEE Visualization Conference Best Paper Honorable Mentions
- 2016 University of Utah Best Data Visualization Prize Winner
- 2016 First Honor Classification on Graduation, HKUST
- 2013 & 2016 Dean's List of HKUST for Academic Excellence, HKUST
- 2013 – 2016 Ho & Ho Foundation Undergraduate Full Scholarship for 4 Years
- 2014 Finalist of Mr. Armin & Mrs. Lillian Kitchell Undergraduate Research Award

TEACHING

- 2023 Fall **Co-Instructor** Computer Graphics (ECS 175), UC Davis
Undergraduate level course instructed by Dr. Kwan-Liu Ma. I contributed to the development and preparation of course materials and assignments. Additionally, I am responsible for delivering 20% of the lecture content.
- 2023 Winter **Guest Lecture** Computer Graphics (ECS 175), UC Davis
Undergraduate level course instructed by Dr. Kwan-Liu Ma. I was invited to give two guest lectures: "Toward Hardware-Accelerated Interactive Path Tracing" and "Machine Learning in Computer Graphics Research".
- 2021 Spring **Teaching Assistant** Advanced Visualization (ECS 277), UC Davis
Graduate level course instructed by Dr. Bernd Hamann. I assisted the design of both course assignments as well as the final project.
- 2020 Fall **Teaching Assistant** Computer Graphics (ECS 175), UC Davis
Undergraduate level course instructed by Dr. Bernd Hamann. I assisted the design of both course assignments as well as exams.
- 2020 Winter **Teaching Assistant** Software Development & Object-Oriented Programming in C++ (ECS 36B), UC Davis
Undergraduate level course instructed by Dr. Francois Gygi.
- 2019 Spring **Teaching Assistant** Introduction to Programming (ECS 32A), UC Davis
Undergraduate level course instructed by Dr. Nathan Hanford.
- 2019 Winter **Teaching Assistant** Introduction to Programming (ECS 32A), UC Davis
Undergraduate level course instructed by Dr. Nelson Max.

SERVICE AND OUTREACH

Program Committee Member

- 2023 IEEE Symposium on Large Data Analysis and Visualization (LDAV)
- 2021 - 2023 ACM/IEEE SC Workshop on In Situ Infrastructures for Enabling Extreme-scale Analysis and Visualization (ISAV)

Paper Reviewer

- 2024 IEEE PacificVis Full Papers (TVCG Track)
- 2023 IEEE PacificVis Full Papers, IEEE VIS Full Papers, VIS 2023 Short Papers, IEEE TVCG
- 2022 IEEE LDAV Posters
- 2018 IEEE VIS SciVis Short Papers

SELECTED SOFTWARE CONTRIBUTIONS

VisIt, a widely used open source, interactive, scalable, visualization, animation, and analysis tool.

I designed a high-fidelity OSPRay-based distributed volume renderer within VisIt, which continues to be actively utilized and appreciated by its users.

OSPRay, Intel's the open, scalable, and portable ray tracing engine

I collaborated extensively with Intel engineers, making many contributions to OSPRay through the development of numerous features and optimizations.

VL3, a scalable and interactive parallel volume rendering developed by Argonne National Laboratory

I developed a CPU-based distributed volume rendering backend, along with a remote visualization client, specifically designed to enhance the capabilities of VL3.

DIVA, a declarative and reactive programming language for adaptive in situ visualization and analysis.

Ascent, a many-core capable flyweight in situ visualization and analysis infrastructure for multi-physics HPC simulations

I created a declarative and reactive programming interface for Ascent, leveraging the capabilities of the DIVA framework.

TopoVol, a computational topology guided volume rendering tool.

I created the first application to utilize the Topology ToolKit. The application was presented in the 2018 IEEE Visualization conference.

qaRay, a distributed CPU path-tracing engine with a Blender plugin.

TransferFunctionModule, a light weighted ImGui widget for transfer function manipulation.