

## 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. 2020 **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

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### 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** *Submitted to IEEE Transactions on Visualization and Computer Graphics*

### **Photon Field Networks for Dynamic Real-Time Volumetric Global Illumination**

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

**Preprint** *Submitted to IEEE Transactions on Visualization and Computer Graphics*

### **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** *Submitted to Eurographics Symposium on Parallel Graphics and Visualization*

### 2022 **Instant Neural Representation for Interactive Volume Rendering**

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

**Preprint** *Submitted to 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

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### 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

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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

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2023 Winter	<b>Guest Lecture</b>	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	<b>Teaching Assistant</b>	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	<b>Teaching Assistant</b>	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	<b>Teaching Assistant</b>	Software Development & Object-Oriented Programming in C++ (ECS 36B), UC Davis
	Undergraduate level course instructed by Dr. Francois Gygi.	
2019 Spring	<b>Teaching Assistant</b>	Introduction to Programming (ECS 32A), UC Davis
	Undergraduate level course instructed by Dr. Nathan Hanford.	
2019 Winter	<b>Teaching Assistant</b>	Introduction to Programming (ECS 32A), UC Davis
	Undergraduate level course instructed by Dr. Nelson Max.	

## SERVICE AND OUTREACH

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### Program Committee Member

2021 & 2022 ACM/IEEE SC Workshop on In Situ Infrastructures for Enabling Extreme-scale Analysis and Visualization (ISAV)

### Paper Reviewer

2023 IEEE PacificVis Full Papers

2022 IEEE LDAV Posters

2018 IEEE VIS SciVis Short Papers

## SELECTED SOFTWARE CONTRIBUTIONS

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**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.