Qi Wu

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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 – Dec. 2014 **Hong Kong University of Science and Technology (HKUST)**
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.