

# ZICHEN WANG

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## EDUCATION

### University of Michigan, Ann Arbor

Ph.D. in Computer Science and Engineering

Advised by Prof. Jeong Joon Park

Ann Arbor, MI

*present*

### Cornell University, College of Arts and Sciences

B.A. in Computer Science and Math

GPA: 4.07

Ithaca, NY

May 2024

## PUBLICATIONS AND PREPRINTS

*\* denotes alphabetic order and † denotes mentorship*

### DiffusionPDE: Generative PDE-Solving Under Partial Observation

May 2024 – Aug 2024

Jiahe Huang, Guandao Yang, **Zichen Wang**, JJ Park<sup>†</sup>

- This paper is currently under review
- We proposed a general framework for solving PDEs with diffusion models. In particular, we focused on solving PDEs under partial observation, which is common in real-world measurements yet challenging for classical PDE solvers. By modeling the joint distribution of coefficient/solution spaces, we achieved state-of-the-art performance on a wide range of PDEs
- I assisted running the experiments, drafting the paper, and writing responses during the rebuttal period

### A Simple Approach to Differentiable Rendering of SDFs

Feb 2023 – May 2024

**Zichen Wang**, Xi Deng, Ziyi Zhang, Wenzel Jakob<sup>†</sup>, Steve Marschner<sup>†</sup>

- Conditional accepted to SIGGRAPH Asia 2024
- We proposed a simple yet effective algorithm for physically based differentiable rendering of SDFs. We expanded the lower-dimensional boundary integral into a thin band that is easier to sample, achieving state-of-the-art performance in downstream applications such as 3D reconstruction and inverse rendering
- My contribution includes: (1) I proposed the original ideas; (2) I validated the idea with rigorous mathematics. (3) I coded our differentiable renderer from scratch in *Mitsuba3*; (4) I conducted a series of experiments to compare with previous methods

### Accurate Differential Operators of Neural Fields

May 2023 – Sep 2023

Aditya Chetan, Guandao Yang, **Zichen Wang**, Steve Marschner<sup>†</sup>, Bharath Hariharan<sup>†</sup>

- This paper is currently under review
- We identified the high-frequency noise in the automatic differentiation (AD) gradients in the INGP-style hybrid neural fields. We proposed to use plane-fitting either (1) as a post-hoc operator or (2) to fine-tune the network
- I coded experiments on rendering, simulation, and PDE solver. I also made several figures and wrote about rendering

### Revisiting a 2-Approximation for the $k$ -MST Problem in Graphs

Jan 2022 - Aug 2022

Emmett Breen<sup>\*</sup>, Renee Mirk<sup>\*†</sup>, **Zichen Wang**<sup>\*</sup>, and David P. Williamson<sup>\*†</sup>

- In Proceedings of SIAM Symposium on Simplicity in Algorithms (SOSA) 2023
- We revisited Garg's primal-dual algorithm for the  $k$ -MST problem and supplemented it with rigorous proofs
- I was the main contributor, introduced the novel concept of *kernels*, and gave a 20-minute presentation at the conference

### Four-Periodic Infinite Staircase for Four-Dimensional Polydisks

Jun 2022 - Jul 2022

C. Farley<sup>\*</sup>, T. Holm<sup>\*†</sup>, N. Magill<sup>\*</sup>, J. Schroder<sup>\*</sup>, **Z. Wang**<sup>\*</sup>, M. Weiler<sup>\*†</sup>, and E. Zabelina<sup>\*</sup>

- Presented at Joint Math Meeting 2023 and published on *Involve*, a Journal of Mathematics; originated from our work during Cornell Summer Program for Undergraduate Research (SPUR)
- We studied symplectic four-manifold ellipsoid embedding and discovered a new family of embeddings
- I was the main contributor and developed Python codes that quickly compute geometric transformations in high dimensions

### Closer to Cayuga's Waters: An Evaluation System of The Invasive *Hydrilla* Species

Jan 2022 - Feb 2022

**Zichen Wang**, Mo Lyu, Franklin Deng

- Published in Cornell Undergraduate Research Journal (CURJ) and is a revision of our work for the 2021 Cornell Math Contest in Modeling (CMCM)

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- We modeled the spread of the invasive *Hydrilla* species and ran Monte Carlo simulations on real data in Cayuga Lake

### On 2-digit and 3-digit Kaprekar's Routine

Nov 2020 - Jan 2021

Zichen Wang, Wei Lu<sup>†</sup>

- Submitted to arXiv [math.NT]
- We solved the structures of the 2-digit and 3-digit Kaprekar transformation and the maximum 2-digit Kaprekar distance

## EXPERIENCES

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### CS4999 Independent Research

Sep 2022 – May 2024

- I conducted research with Prof. Steve Marschner on differentiable rendering and inverse rendering. We started with *ray tracing in one weekend* series, read through Veach's thesis, and studied more recent works on inverse rendering. Meanwhile, I coded my own renderer from scratch in C++ and explored others' codes on neural fields and structure-from-motion. These experiences crystallized into my notes on rendering, differentiable rendering, and inverse rendering.

### Cornell University Artificial Intelligence (CUAI)

Sep 2022 – May 2023

- CUAI is an undergraduate research group on machine learning. The group has numerous publications at top ML conferences, including NeurIPS, ICML, etc. We held weekly meetings and reading groups to discuss recent works and ideas.
- I led the graphics reading group to study 3D reconstruction works

### Artistic Gaussians with CLIP

Sep 2023 – Dec 2023

- I am leading this course project to finetune Gaussians based on text inputs to achieve different artistic styles. We use Gaussian Splatting's rendering output as CLIP's image encoder input. Thus, given a prompt, we can update the Gaussians' sphere harmonics to maximize the CLIP score.

### Summer Geometry Initiative (SGI)

Jul 2023

- I attended the tutorial week of the 2023 Summer Geometry Initiative (SGI) organized by Prof. Justin Solomon. We had a solid introduction to geometry processing, with plenty of hands-on exercises, and listened to the newest progress in the field.

### SimSDF: Physically-Based Simulation with Signed Distance Field

May 2023

- SDF is well-known for easily determining if a point is a colliding point. However, it is not clear which points to query. Existing methods either traverse the grid, sample many random points, or revert to SDF-mesh collision detection. I led this course project to explore the possibility of more accurate and efficient SDF-SDF collision detection in rigid body simulations.

### MATH 4901 Supervised Reading

Jan 2022 - May 2022

- I held hour-long meetings with Prof. Liam Mazurowski every week to read Do Carmo's *Differential Geometry of Curves and Surface* and *Riemannian Geometry*

## TEACHING

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- Teaching Assistant, CS4620 Introduction to Computer Graphics Fall 2023
- Teaching Assistant, CS4820 Introduction to Analysis of Algorithms Summer 2022

## AWARDS

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- Top 300, William Lowell Putnam Mathematical Competition. 2022
- National 2nd Prize and Regional 1st Prize, Chinese National Olympiad in Informatics in Provinces. 2017 and 2018.
- Regional 1st Prize, Chinese Mathematics Olympiad. 2018

## SKILLS

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- Programming Languages: C++; Python; PyTorch
- Graphics Languages: Mitsuba3; Taichi Lang