ZICHEN WANG

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EDUCATION

Cornell University, College of Arts and Sciences Ithaca, NY

B.A. in Computer Science and Math Expected, May 2024

GPA: 4.07

PUBLICATIONS AND PREPRINTS

** denotes equal contribution and † denotes mentorship*

Boundary Path Sampling Feb 2023 - Jan 2024

***Zichen Wang**, Xi Deng, Steve Marschner†*

- Plan to submit to SIGGRAPH 2024
- I conducted a close study on the path space structure and proposed a faster differentiable rendering algorithm with SDF. Based on the path integral formulation, we introduce the novel concept of the visible path space where the visibility term is always 1. It follows that the boundary path space coincides with the boundary of the visible path space. This allows us to relax and approximate boundary paths with nearby paths, as well as sampling boundary paths during forward rendering.
- I proposed the theory, validated it in 2d with C++ codes, and coded the differentiable renderer in Mitsuba3.

Accurate Differential Operators of Neural Fields May 2023

*Aditya Chetan, Guandao Yang, **Zichen Wang**, Steve Marschner†, Bharath Hariharan†*

- Submitted to NeurIPS 2023
- Hybrid SDF networks have recently been a popular neural field as they are small and easy to train. Despite these advantages, the high-frequency noise in the auto-diff gradients hinders them from real applications. In this work, we proposed a differential operator to obtain smooth normals and higher-order direvatives. This can be done by fitting a tangent plane to the nearby sampled points.
- I coded experiments on rendering, simulation, and PDE solver. I also wrote the paragraphs on rendering.

Revisiting a 2-Approximation for the *k*-MST Problem in Graphs Jan 2022 - Aug 2022

Emmett Breen, Renee Mirka*†, **Zichen Wang***, and David P. Williamson†**

- Proceedings of SIAM Symposium on Simplicity in Algorithms (SOSA) 2023
- I gave a 20-minute presentation at the conference
- We revisited Garg's primal-dual algorithm for the *k*-MST problem and supplemented with rigorous proofs
- I introduced the novel concept of *kernels* to better study the structure of the spanning tree

Four-Periodic Infinite Staircase for Four-Dimensional Polydisk Jun 2022 - Jul 2022

C. Farley, T. Holm*†, N. Magill*, J. Schroder*, **Z. Wang***, M. Weiler*†, and E. Zabelina**

- Accepted by Joint Math Meeting 2023 and is our work in Cornell Summer Undergraduate Research Program (SPUR)
- We studied symplectic four-manifold ellipsoid embedding and computed a new family of infinite staircases
- I developed Python codes that quickly compute almost toric fibration and embedded contact homology

Closer to Cayuga's Waters: An Evaluation System of The Invasive *Hydrilla* Species Jan 2022 - Feb 2022

***Zichen Wang**, Franklin Deng, Mo Lyu, and Alexander Vladmirsky†*

- Accepted by the Cornell Undergraduate Research Journal (CURJ) and is a revision of our work for the 2021 Cornell Math Contest in Modeling (CMCM)
- We derived an evaluation system that uses statistical inference to obtain real-time data of the invasive *Hydrilla* species in Cayuga Lake and predicts the future spread of the plant through stochastic Monte Carlo simulation

On 2-digit and 3-digit Kaprekar's Routine Nov 2020 - Jan 2021

***Zichen Wang**, Wei Lu†*

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

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EXPERIENCES

CS4999 Independent Research Sep 2022 - *present*

- I conducted research with Prof. Steve Marschner on differentiable rendering and inverse rendering. We started from *ray tracing in one weekend* series, read through Veach's thesis, and literature reviewed on more recent papers in differentiable rendering. Meanwhile, I coded my own renderer from scratch in C++ and explored numerous models on novel view synthesis and inverse rendering. These experiences crystalized into my notes on rendering, differentiable rendering, and inverse rendering.

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. In this project, we explored the possibility of SDF-SDF collision detection in rigid body simulations. We proposed to take the maximum of SDFs to different objects and run gradient descent to obtain the contact region. Compared with mesh representations, our approach gives more accurate normals and adhere closer to the ground truth.

Cornell University Artificial Intelligence (CUAI) Sep 2022 - *present*

- 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.

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

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

AWARDS

- Top 300, William Lowell Putnam Mathematical Competition. 2022
- Top 1%, American Mathematics Competition 12. 2019
- 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

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