Hanyu Chen

(412) 452-2501 | chhy@cmu.edu | hanyuc.com

Education

Carnegie Mellon University 05/2023 – Present
M.S. in Computer Science – Research Thesis

Carnegie Mellon University 09/2019 – 05/2023
B.S. in Computer Science (QPA 3.94)

- Additional Major in Mathematical Sciences (Discrete Math & Logic)
- Minor in Computer Graphics

Publications

[1] **A Theory of Volumetric Representations for Opaque Solids** (project link)
Bailey Miller, **Hanyu Chen**, Alice Lai, and Ioannis Gkioulekas
IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2024 (oral presentation)

Research Experience

Point-cloud rendering based on the generalized winding number 06/2023 – Present
Advised by Prof. Ioannis Gkioulekas Carnegie Mellon University
Proposes accelerated rendering techniques for point clouds using Barnes-Hut approximations.

- Derived expressions for interpolating arbitrary features from the point cloud by solving Laplace's equation with Dirichlet boundary conditions.
- Implemented custom PyTorch extensions in C++ and CUDA that use the Barnes-Hut approximation to store intermediate features and gradients, accelerating rendering and optimization.

Volumetric representations for opaque solids 07/2022 – 12/2023
Advised by Prof. Ioannis Gkioulekas Carnegie Mellon University
Develops a theory for the representation of opaque solids as volumetric models from first principles.

- Proved conditions under which opaque solids can be modeled using exponential volumetric transport and derived expressions for the volumetric attenuation coefficient.
- Demonstrated Helmholtz reciprocity by rendering path-traced and light-traced image pairs.
- Generalized model to volume render point clouds using probabilities obtained from stochastic Poisson surface reconstruction.

Job Experience

Software Engineer Intern 06/2022 – 08/2022
Map Engine Team, Nvidia Santa Clara, CA (Remote)

- Built automated tool to filter and download road intensity images from cloud server.
- Analyzed issue logs from map review pipeline to create a dataset of approximately 180,000 valid road images and 10,000 invalid road images that contain misalignment and calibration issues.
- Trained deep learning model based on the ResNet34 architecture to detect invalid road images with a high recall rate, aiming to reduce workload for manual review.

Algorithm Engineer Intern 06/2021 – 08/2021
WLAN Team, Huawei Beijing, China

- Simulated a 5GHz wireless network with approximately 150 access points (APs) in an office setting, ensuring 40MHz bandwidth for each AP while minimizing interference between nearby APs.
- Implemented bipartite matching and depth-first search algorithms for dynamic channel allocation.
- Significantly improved performance, lowering total interference by over 70% and the probability of nearby APs being allocated to the same channel by over 50%.

Relevant Coursework

Computer Graphics & Vision
15-462 Computer Graphics, 15-458 Discrete Differential Geometry, 15-468 Physics-Based Rendering, 15-772 Real-Time Computer Graphics, 15-863 Computational Photography, 16-385 Computer Vision, 16-824 Visual Learning and Recognition

Machine Learning
10-315 Introduction to Machine Learning, 10-725 Convex Optimization, 11-485 Introduction to Deep Learning, 15-780 Graduate Artificial Intelligence

Theoretical Computer Science
15-251 Great Ideas in Theoretical Computer Science, 15-451 Algorithm Design and Analysis, 15-751 CS Theory Toolkit, 15-850 Advanced Algorithms

Computer Systems
15-213 Introduction to Computer Systems, 15-418 Parallel Computer Architecture and Programming

Mathematical Sciences
21-259 Calculus in 3D, 21-301 Combinatorics, 21-325 Probability, 21-373 Algebraic Structures, 21-374 Field Theory, 21-341 Linear Algebra, 21-801 Markov Chains and Mixing Times, 15-860 Monte Carlo Methods and Applications

Teaching Experience

Teaching Assistant 01/2023 – 05/2023
Physics-based Rendering, taught by Prof. Ioannis Gkioulekas Carnegie Mellon University

- Graded biweekly coding and written assignments for about 40 students and held weekly office hours.
- Maintained GitHub repos for releasing starter code and reference solutions, fixed multiple existing bugs, and added new features like environmental lighting.

Grader 08/2022 – 12/2022
Algebraic Structures, taught by Prof. Richard Statman Carnegie Mellon University

- Graded weekly written assignments and multiple take-home exams for about 30 students.

Course Projects

Adaptive LiDAR sampling based on generalized winding numbers 11/2023 – 12/2023
Computational Photography Carnegie Mellon University

- Developed an adaptive LiDAR sampling scheme for scanning 3D objects by progressively placing samples at locations of high uncertainty in the object geometry.
- Proposed a novel method for determining the uncertainty of a ray by computing the generalized winding numbers along the ray and estimating the variance of the free-flight distribution.

Differentiable rendering for optimizing local scene parameters 04/2022 – 05/2022
Physics-based Rendering Carnegie Mellon University

- Implemented a path-tracing based forward renderer and gradient renderer to compute gradients of the rendered image with respect to local scene parameters.
- Optimized albedos for Lambertian materials, exponents for Phong materials, and locations of lighting to match the rendered image to a given target image using gradient descent.

CUDA-Based Bag-of-Words scene recognition 04/2022 – 05/2022
Parallel Computer Architecture and Programming Carnegie Mellon University

- Implemented parallel algorithms in C++ and CUDA to classify images based on visual words.
- Parallelized image convolution, k-means clustering, and feature creation using CUDA kernels, resulting in a 50x speedup over a sequential algorithm, and an 8x speedup over an OpenMP implementation.

Animating Hand-drawn Sketches Using Image Autoencoders 10/2021 – 12/2021
Visual Learning and Recognition Carnegie Mellon University

- Implemented a CNN-based autoencoder with an auxiliary discriminator network to animate hand-drawn sketches by interpolating between latent vectors and reconstructing keyframes.
- Assisted teammate in creating splines to achieve non-linear interpolation paths and using extrapolation to achieve animation effects like "anticipation" and "follow-through".

Poster Presentation

How do you render a probability? 12/2022
Undergraduate Research Symposium, Carnegie Mellon University Pittsburgh, PA

Skills

Programming Languages: C, C++, Python, Standard ML
Frameworks: PyTorch, OpenCV, NumPy, Eigen, CUDA, OpenMP, Git