

# RUOHAN YANG

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## EDUCATION

Massachusetts Institute of Technology, Stanford University, Georgia Institute of Technology, Wesleyan University

Online Certificated Courses

Sep 2022 – Jun 2024

- Combined GPA: 95/100
- **MIT**. MicroMasters Program: Probability Theory; Partial Differential Equations and Fourier Series; Multivariable Calculus: Differentiation; Multivariable Calculus: Integration; Electromagnetism: Electrostatics; Electromagnetism: Maxwell's Equations; Introduction to Mechanics: Rotational Dynamics
- **Georgia Institute of Technology**. Linear Algebra II: Matrix; Linear Algebra III: Determinants and Eigenvalues
- **Stanford University**. Quantum Mechanics I
- **Wesleyan University**. Introduction to Complex Analysis
- **École normale supé rieure**. Statistical Mechanics: Algorithms and Computations

The University of Edinburgh

Edinburgh, UK

Master of Arts in Contemporary Art Practice

Sep 2020 –Nov 2021

- GPA: Upper Second Class
- Selected Courses: Future Business of Art, Art Practices, Art Methods

Nanjing University of the Arts

Nanjing, China

Bachelor of Arts in Painting

Sep 2015 – Jun 2020

- GPA: 3.45
- Selected Courses: Information Technology, Anatomy, Principle of Economics, Mystery of Astronomy, Oil Painting Creation, Game Fundamentals, 3D Printing Art, Animation Art Design, History of Arts
- Selected Awards: Outstanding Graduate, Outstanding Graduation Project Exhibition

## PUBLICATIONS AND PRE-PRINTS

1. **Ruohan Yang**, “A Generalized Constructive Proof for Brouwer Fixed-Point Theorem on  $D^2$  and  $D^3$ ”, Published on 25 October 2024, OSF (Open Science Framework)(pre-print) <https://doi.org/10.31219/osf.io/cmf2j>
2. **Ruohan Yang**, “A Constructive Proof and Algorithm for the 2D Brouwer Fixed-Point Theorem with Surjective Mapping”, Published on 25 October 2024, OSF, (pre-print) <https://doi.org/10.31219/osf.io/5v2hr>.
3. **Ruohan Yang** and Zijun Zhong, “Algorithm Efficiency and Hybrid Applications of Quantum Computing”, Published on 17 November 2023, *CONF-MPCS 2023*, ISSN: 2753-8818.
4. Peixu Cai1, Wangze Shen, **Ruohan Yang**, and Qixian Zhou, “Reinforcing Feature Distributions of Hidden Units of Boltzmann Machine using Correlations”, Published in March 2023, *MEAI 2022 SPIE International Conference on Artificial Intelligence*, ISSN: 0277-786X.
5. **Ruohan Yang**, “Reconstruction of Radiance Field with Neural Network for Real-Time Rendering”, Published on 14 June 2023, *CONF-SPML 2023*, ISSN: 2755-2721

## RESEARCH EXPERIENCE

Fudan University

Shanghai, China

Mentors: Professor Yidun Wan, Dr. Zichang Huang

Jul 2024 – Present

Professor Yidun Wan’s Project Team

- **Objective:** To explore whether Loop Quantum Gravity converges to General Relativity under extreme continuous conditions
- **Responsibilities:**
  - Served as a research assistant in the Theoretical Physics and Quantum Computing project group, assisting in the research of numerical computations derived from Loop Quantum Gravity and continuous quantum mechanics simulations, covering models such as the Harmonic Oscillator and Double Well
  - Assisted in publishing a book on quantum computing, created book illustrations using LaTeX, TikZ, and Mathcha
  - Optimized code projects using the Julia programming language to enhance performance
  - Aided in formula derivation
- **Achievements:** Optimized the Hessian matrix, improving code performance by more than fourfold using *autodiff* with *Pytorch*; created a Cuda project which included solving differential equations for finding saddle points using Lefschetz thimble method on GPUs for future use (initial phases are currently underway)

Massachusetts Institute of Technology (Department of Physics)

Online

Mentor: Professor Mark Vogelsberger

May 2023 – Aug 2023

Exploration of Microscopic Particle Actions at a Distance in Quantum Mechanics Based on Wave-Particle Duality and Wave Equations

- **Objective:** Starting from classic photoelectric effect experiments in physics, this project explores the inception, development, and applications of quantum physics, including modules on classic experiments like double-slit interference, photoelectric effect, black-body radiation, and quantum entanglement.
- **Responsibilities:** Collaborated with team members to complete a comprehensive study of the hydrogen atom
- **Achievements:** Demonstrated complete solutions to two types of angular equations
  - The first method involved using angular momentum operators and boundary conditions to derive a recursive equation for angular momentum.
  - The second method utilized series expansions to determine the coefficients for solutions to the associated Legendre equation.

#### Carnegie Mellon University (Department of Mathematics)

Mentor: Prof. Shlomo Ta'asan, Distinguished Professor

Online

Sep 2022 – Nov 2022

#### Optimization in Science and Engineering Project

- **Objective:** This research project, led by a mathematics professor, aimed to explore and understand essential mathematical concepts including convex sets, convex functions, and their properties, as well as convex optimization and duality. The study also covered non-differentiable optimization and non-convex optimization theories.
- **Responsibilities:** Implemented a comprehensive Python project with three main components
  - Solved primal and dual matrices using Newton's method
  - Applied Newton's method and barrier methods to inequality constraints
  - Implemented Newton's method for primal-dual approaches

#### Massachusetts Institute of Technology (Department of Physics)

Mentor: Professor Mark Vogelsberger

Online

May 2022 – Aug 2022

#### Introduction to Deep Learning: Theory and Application

- **Objective:** The project included learning about machine learning theories, neural networks, *TensorFlow* applications, Generative Adversarial Networks, and deep learning for natural language processing.
- **Responsibilities:**
  - Successfully implemented and refined Recurrent Neural Networks (RNNs) and Generative Adversarial Networks (GANs) to enhance model capabilities in handling sequential and generative data tasks
  - Conducted in-depth studies on the Diffusion model, providing theoretical underpinnings and innovative approaches for subsequent projects
  - Mastered and applied the Transformer architecture to address complex sequence processing challenges
  - Developed a desktop application using Convolutional Neural Networks (CNNs) for early detection of skin cancer, significantly improving diagnostic accuracy
  - Proposed mathematical optimizations to reduce node correlation in Boltzmann Machine algorithms, innovating convergence methods that enhanced model training efficiency and stability

## WORK EXPERIENCE

### Alibaba Group

Technical Art Engineer, Lingxi Interactive Entertainment

Shanghai, China

Aug 2021 – Nov 2023

- **Graphics Rendering:**
  - Developed display rendering effects based on Unity's High Definition Render Pipeline, including war fog and large map UI enhancements
  - Contributed to the Technical Art Center's shared platform for water rendering solutions, including rendering, shading refraction, screen space reflection, geometric shapes, and interactive water simulations based on the physics wave equation
  - Independently developed cartoon rendering solutions combining physically based rendering and Non-Photorealistic Rendering, and documented character rendering schemes and tool usage
  - Developed shaders and post-processing effects, such as 3D noise texture-based volumetric cloud rendering, tree vertex animation, and depth perspective
- **Optimization:**
  - Assisted clients in performance optimization using *Profiler* and *RenderDoc*, established art production standards including batch optimization, package analysis, and shader LODs (Level of details)
  - Developed and maintained tools for art workflows and game packaging needs, accelerating development progress (e.g., shader variant management, resource import settings, multiple lighting tools)
  - Collaborated with the technical department in sharing sessions, disseminating rendering knowledge widely used for client learning across other project teams
- **Game Logic:** Led the development of an console game involving AI-generated army combat, integrating multithreaded clustering algorithms and AI behavior trees to manage multiple AI character movements, formations, attacks, hits, pursuits, and deaths
- **Achievements:**
  - Mastered a diverse set of skills in computer graphics, rendering, and physical simulation

- Independently supported the development and launch of a First-Person Shooter game (*Program X22*, available on YouTube), served as the lead technical artist and client-side collaborator responsible for graphical rendering, game performance optimization, workflow tool development, and game style design and implementation.

## Jier Art

Contracted Artist

Shanghai, China

Aug 2021 – Nov 2023

- Exhibited original virtual reality artworks in two global online exhibitions, showcasing innovative perspectives and interdisciplinary creativity.
- Leveraged virtual reality platforms to present immersive art experiences, integrating technology and aesthetics.
- Received recognition for enhancing the artistic narrative through cutting-edge digital mediums.

## Beijing 51World Digital Twin Technology Co., Ltd

Technical Art Intern

Shanghai, China

May 2020 – Aug 2020

- Utilized *Unreal Engine* for material blueprint editing and optimization of effects.
- Gained proficiency in *Unreal Engine*, rendering, and graphics techniques.

## EXTRACURRICULAR EXPERIENCES

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### Technical Blog and Fluid Simulation Open-Source Project

Author

Shanghai, China

Feb 2022 – Present

- **Responsibilities:**
  - Independently developed a GPU-based(Graphics Processing Unit), coupled fluid simulation open-source project (available on GitHub), implementing algorithms such as SPH (Smoothed Particle Hydrodynamics)and PBD (Position-Based Dynamics), features include GPU-based radix sort, bitonic sort, sparse hash grid search, and unidirectional coupling of solids to fluids
  - Managed a technical blog with over 5,000 followers and over 3,700 bookmarks
  - Created comprehensive tutorials for the project, making the process accessible and practical for beginners and application developers using *Unity*
- **Achievements:**
  - Developed real-time fluid simulation for *Unity* applications, leveraging GPU for high-performance computations including SPH and PBD methods, boundary and fluid particles, computer shaders, bitonic sort, radix sort, and volume rendering
  - The project serves as an educational resource for beginners and professionals in game development, providing detailed documentation and a hands-on fluid engineering project
- **Future Goals:**
  - To expand the simulation capabilities by adding rigid body simulation.
  - To integrate Material Point Method method for fluid-solid coupling into a versatile, simple, and fast real-world physics engine framework based on *Unity*.
- **Link to project (in Chinese):** <https://www.zhihu.com/people/aleanna/posts>

## ADDITIONAL INFORMATION

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**Interests:** Swimming, Pilates, piano, fitness, K-pop dance, guitar, programming, reading, cooking, oil painting

**Computer Skills:** *C#, hlsl, Python, pytorch, cuda, cmake, Julia, c++*

**Language:** Chinese (Native), English (Fluent), Japanese (Beginner)

**Personal Web:** <https://alen-cell.github.io>