# HAOYU HAN

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## EDUCATION

**University of Science and Technology of China (USTC)**     *09 / 2020 - 07 / 2024(expected)*
B.S., Major in Information and Computational Science(Computational Math)
Overall GPA: 4.02/4.30

Relevant core courses: Mathematical Analysis(A+), Data Structures and Database(A+), Differential Equations(A+), Linear Algebra, Numerical analysis(A+), Numerical algebra(A+), Finite Element Method, Computer Graphics(A+), Deep Learning

**Harvard University**     *07 / 2023 - 12 / 2023*
Visiting intern in Computational Robotics Lab, advised by Professor Heng Yang.

## PUBLICATIONS

[1] **Haoyu Han**, Heng Yang. **On the Nonsmooth Geometry and Neural Approximation of the Optimal Value Function of Infinite-Horizon Pendulum Swing-up**. Submitted to L4DC(https://hyhan0118.github.io/l4dc.pdf).

[2] Hugo Buurmeijer, **Haoyu Han**, Christian Chan, Robert Wood, Heng Yang. **High-Gain Observer Design for State Estimation of Rigid-Body Systems with Learned Dynamics**. In submission.

## RESAERCH EXPERIENCE

**Computation and Analysis on Optimal Control of Pendulum[1]**     Harvard University
*Individual Contributor*    *Advisor: Prof. Heng Yang*     *August 2023 - Present*

· The first Successfully calculated the cost-to-go function of the pendulum with an error under 1e-4, both with and without control constraints, employing a novel contour line methodology and Pontryagin's maximum principle (PMP).
· Discovered a non-smooth spiral line in the cost-to-go function, meticulously calculated its geometry, and rigorously proved its existence using symmetry and ODE theory.
· Proved the optimality and sub-optimality of piecewise $C^1$ value function as a verification theorem.
· Compared with other optimal cost-to-go functions, achieved superior results and further guided the neural network to attain enhanced performance.

**Residual Dynamics and Observer Design for Robot Bee[2]**     Harvard University
*Co-Contributor*    *Advisor: Prof. Heng Yang*     *July 2023 - August 2023*

· Transformed the dynamics of various systems, including cartpole, acrobot, and 3D rigid-body, into high-gain standard form and successfully implemented the high-gain observer in MATLAB.
· Established a tighter bound for the high-gain observer using AM-GM inequality and demonstrated its superior performance.
· Proved an error bound and convergence for residual dynamics through a neural network.
· Conducted experiments on real robots and demonstrated that the observer error was lower than the established bound.

**Cloth Shadow Art**     USTC
*Indivisual Contributor*    *Advisor: Prof. Ligang Liu*     *March 2023 - July 2023*

· Aimed at using differential simulation to design a square fabric with an arbitrary hole in it. Optimized the hole such that, under certain given inputs (e.g., control or wind), the dynamic shape of the hole matches a cartoon character.
· Implemented the Finite Element Method (FEM) for cloth simulation in C++ using libigl, including StVK, ARAP, and bending energy models. The first computed the full Hessian, including the differentiation of 3D-2D projection.
· Implemented various simulation methods, including Implicit Euler, Explicit Euler, Projective Dynamics (PD), and PBD in C++. Conducted a comparative analysis among them and concluded that FEM is the most authentic.
· Optimized a simple example of a waving wing and rendered a video.

## PROJECTS

### Reproduce Several projects in computer graphics                                  USTC

· Reproduce several papers using C++ such as Poisson image edit, ARAP/ASAP, fast simulation,path-tracing, shader, etc.

### Reproduce Several projects in computer vision                                    USTC

· Reproduce several papers using C++ and MATLAB, such as Nerf, camera calibration, video stabilization, image stitching, etc.
· Surveyed image generation through GAN.

### Kaggle competition: Natural Language Processing with Disaster Tweets             USTC

· Successfully fine-tuned the BERT model for disaster verification tasks using Pytorch with kaggle rank 134/1289.
· Applied parameter freezing in conjunction with Ensemble Learning for enhanced model performance.

## SKILLS

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| **English** | TOEFL 101(R27/L26/S23/W25) |
| **GRE math subject** | 910(94%) |
| **Computer Languages** | C , C++ , C# , Java |
| **Tools** | LaTeX, Matlab , Mathematica , pytorch, Unity , QT , OpenCV , MarkDown |

## AWARDS

**China National Scholarship(highest Scholarship from Ministry of Education of China)**
*09/2022*

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|---|---|
| The China Optics Valley Scholarship | *09/2023* |
| Outstanding Student Scholarship Grade 2(Top 10%) | *09/2021* |
| Endeavor Scholarship | *09/2021* |
| Outstanding Freshman Scholarship | *09/2020* |

## EXTRACURRICULAR

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|---|---|
| member of USTC Programming club , USTC paper folding club | *09/2020 - Present* |
| member of Student Union of School of the Gifted Young | *09/2020 - 09/2021* |
| DIY an AR glass and a light cube | *09/2020* |