Zehua Wang

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Education

- **Massachusetts Institute of Technology** — Cambridge, MA
  B.S. in Physics and Computer Science (intended) — *Expected May 2028*
- **Tsinghua University, Institute for Interdisciplinary Information Sciences (IIIS)** — Beijing, China
  Freshman Year; GPA: 3.95/4.00 — *Aug. 2024 – July. 2025*
- **Tsinghua University, Institute for Interdisciplinary Information Sciences (IIIS)** — Beijing, China
  Preparatory Program; GPA: 4.00/4.00 — *Feb. 2024 – July. 2024*

Honors & Awards

- **54th International Physics Olympiad (IPhO)**: Gold Medal, **1st Place in Theoretical Round** — *July 2024*
- **9th Romanian Master of Physics (RMPh)**: Gold Medal, 3rd Place — *March 2023*
- **40th Chinese Physics Olympiad (CPhO)**: Gold Medal — *Oct 2023*
- **39th Chinese Physics Olympiad (CPhO)**: Gold Medal — *Oct 2022*
- **China Young Physicists' Tournament**: **Team First Place** (Team Leader) — *March 2023*
- **Tsinghua University**: Xuetangban Scholarship & Freshman Scholarship — *Dec 2024*

Experience

- **Undergraduate Researcher, Learning-based Control** — Beijing, China
  Tsinghua University; Supervised by Prof. Huazhe Xu — *Anticipated: Oct. 2024 – June 2025*
  - Investigated a novel RIR (Reinforcement Learning to Imitation Learning to Real-world) framework for robot manipulation on a Franka robotic arm (simulated), leveraging PPO and DrQ-v2 for initial RL training.
  - Designed a multi-stage approach for specialist training in simulation and multitask generalization via imitation learning, addressing complexities of sim-to-real transfer and policy generalization.
  - Conducted comprehensive literature reviews on advanced robot learning, informing experimental design and gaining experience in problem formulation and conceptual design.

Projects

- **PaperPlay: Hand-drawn Sketches to Playable Games (HackMIT 2025 - 2nd Place Modal Prize)**: Built a system turning hand-drawn sketches into games using an OpenCV pipeline, a physics engine, and real-time AI commentary. Developed shape recognition, integrated Modal for backend, and built a web platform for sharing and competitive play. [Demo] [Video]
- **Enhancing Diffusion Models with RL and Adversarial Rewards**: Leveraged RL and adversarial discriminators to enhance diffusion models. Formulated reverse diffusion as an MDP to optimize quality, achieving up to **21.7% FID reduction** vs. baseline. Plug-and-play for existing models. [Code & Report]
- **Consistent Local Edits in Videos via Attention Manipulation in Diffusion Models (CLEVAM-DM)**: Engineered a training-free framework for consistent local video editing. Multi-stage pipeline with **BrushNet inpainting**, **DDIM inversion**, **full attention sharing**, and **PerVFI** for temporal coherence. [Code & Report]
- **Algorithm Design for the Metric k-Center Problem**: Authored a survey and built a unified evaluation framework. Proposed three algorithms; best achieved empirical approximation ratio **1.049** (vs. SCR 1.064). [Code & Survey]
- **LLM-Powered Knowledge Database**: Developed an agent-driven file-to-knowledge system using Llama 3. Architected and implemented the core inference module. [Code] [Demo]
- **Minimal Reinforcement Learning Framework (RL-Zero)**: Developed a modular RL framework in Python for reproducible experimentation. Features: config-driven training, experiment tracking, and video logging. [Code]
- **Centralized Visual Package Router (CVPR)**: Led full-stack development of a type-safe logistics management and visualization system. Built backend in Scala and frontend in TypeScript/React, emphasizing FP. [Code]

Relevant Coursework

- **Deep Learning**: Mastered theoretical foundations (**convergence analysis**, **DDPMs**) and modern architectures (**Transformers**, **GNNs**). Applied through projects: implemented **autograd**, trained **VAEs/GANs**, and **fine-tuned a 1B+ parameter LLM**.
- **Computer Vision**: Implemented classical and modern algorithms (e.g., **SIFT** for panorama stitching, 3D-to-2D **projections** for autonomous driving visualization) from scratch, and trained a **semantic segmentation model**.
- **Algorithm Design**: Rigorous study of algorithm design and analysis (Kleinberg & Tardos), covering **approximation and randomized algorithms**.
- **Intro to Computer Systems**: Explored OS, computer architecture, and networking concepts. Projects: optimized performance on Raspberry Pi with SIMD (**40x speedup**), implemented concurrent data structures, and built a distributed service with gRPC.