Zhihan Zhu

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Education

Southern University of Science and Technology (SUSTech), B.S. in Information Engineering — Sept. 2023 – Present

- GPA: 3.86/4.00; Weighted Average Score: 92.05; Ranking: 10/48; Expected Graduation: June 2027.
- Relevant coursework: Linear Algebra, Probability and Statistics, Engineering Mathematics, AI and Machine Learning, Statistical Learning for Data Science.

Research Interests

Generative AI, with a focus on Diffusion Models and Flow Matching, Multimodal Large Language Models, LLM Agents, Long-Video Understanding, and Visual Memory.

Selected Papers

HyGRAIL: Cost-Aware and Evidence-Grounded Scientific Hypothesis Discovery over Knowledge Graphs — Under Review, May 2026

Yihang Sun, ***Zhihan Zhu***, Zhiyuan Jiang, Jingyi Ge, Zixuan Li, Jiaxuan You. *EMNLP 2026, under review.*

- Developed a cost-aware GNN–LLM framework for scientific hypothesis discovery over knowledge graphs, integrating graph triage, evidence retrieval, and LLM-based hypothesis review.

Runge-Kutta Approximation and Decoupled Attention for Rectified Flow Inversion and Semantic Editing — Under Review, Sept. 2025

Weiming Chen, ***Zhihan Zhu***, Yijia Wang, Zhihai He. *arXiv:2509.12888 [cs.CV]. IEEE Transactions on Image Processing (TIP), under review.* doi.org/10.48550/arXiv.2509.12888

- Designed a high-order Rectified Flow inversion method inspired by Runge-Kutta ODE solvers and introduced Decoupled Diffusion Transformer Attention (DDTA) for precise semantic editing.

Generative Semantic Coding for Ultra-Low Bitrate Visual Communication and Analysis — Under Review, Oct. 2025

Weiming Chen, Yijia Wang, ***Zhihan Zhu***, Zhihai He. *IEEE Transactions on Image Processing (TIP), under review. arXiv:2510.27324 [cs.CV].* doi.org/10.48550/arXiv.2510.27324

- Developed a generative semantic coding framework that combines deep compression with rectified flow generation for ultra-low-bitrate visual communication and downstream analysis.

Latent Bias Alignment for High-Fidelity Diffusion Inversion in Real-World Image Reconstruction and Manipulation — Under Review, Mar. 2026

IEEE Transactions on Circuits and Systems for Video Technology (TCSVT), under review. arXiv:2603.23903 [cs.CV]. doi.org/10.48550/arXiv.2603.23903

- Contributed to diffusion inversion and real-image reconstruction methods for improving high-fidelity image manipulation in real-world scenarios.

Research Experience

Undergraduate Researcher, Artificial Intelligence Lab, SUSTech — Sept. 2024 – Present
Advisor: Prof. Zhihai He (IEEE Fellow)

- Developed methods for Rectified Flow inversion and Diffusion Transformer editing, improving real-image reconstruction and semantic controllability through high-order ODE approximation and attention-level control.
- Studied generative semantic coding for ultra-low-bitrate visual communication, combining text semantics, compact latent coding, and rectified-flow generation for both image reconstruction and visual analysis.
- Built one-step diffusion-based super-resolution systems using MeanFlow and SDXL-Turbo, including reference-conditioned restoration modules and custom DIV2K/Flickr2K training pipelines.

Research Intern, Northwestern University — Mar. 2026 – Present
MLL Lab; Project: Language-Conditioned Visual Memory for MLLMs

Conducted research on text-conditioned compact visual memory for multimodal large language models, aiming to

unify video understanding and reconstruction by encoding residual visual information not captured by language. Developed methods for decoupling captions from visual tokens and designing text-guided compression representations that support long-video reasoning, retrieval, and reconstruction.

Research Intern, University of Illinois Urbana-Champaign (UIUC) Mar. 2026 – Present
U Lab; Project: HyGRAIL – Scientific Hypothesis Discovery over Knowledge Graphs

Conducted research on scientific hypothesis discovery over materials knowledge graphs, addressing the limitations of graph-only prediction and ungrounded LLM review for sparse and ambiguous candidate links. Developed a hybrid GNN–LLM framework that combines heterogeneous graph-based triage, knowledge-graph evidence retrieval, and natural-language evidence grounding to support cost-aware hypothesis verification.

Patents

- Zhihai He, Weiming Chen, **Zhihan Zhu**, Yijia Wang, Jian Ouyang. *Image Editing Method Based on Attention Decoupling, Device, Terminal and Storage Medium.* App. No.: CN 202511281645.1, accepted by CNIPA.
- Zhihai He, Weiming Chen, Yijia Wang, **Zhihan Zhu**. *Template-Replacement Image Compression & Reconstruction Method, System and Storage Medium.* App. No.: CN 202511281423.X, accepted by CNIPA.

Awards & Honors

- Gold Award (Guangdong Provincial Level, Top 0.02%), "Yunjing Zhiyu" - Intelligent Aquaculture System, China International College Students' Innovation Competition, 2025.
- Outstanding Student, Southern University of Science and Technology, 2025 and 2024.
- Second-Class Scholarship for Academic Excellence, SUSTech, 2024–2025; Third-Class Scholarship for Academic Excellence, SUSTech, 2023–2024.
- 6th Place, Men's 400m, 9th SUSTech Athletics Games.

Technical Skills

Programming: Python, C/C++, Java, MATLAB.
Deep Learning: PyTorch, Hugging Face Diffusers, Stable Diffusion, FLUX, SDXL, DiT, ControlNet, VAE, GNNs, vLLM, verl, and LLM/MLLM pipelines.
Systems: Linux, Git, CUDA, HPC/LSF, multi-GPU training, LaTeX.
Languages: Chinese (native), English (IELTS 6.5).