

# Yunkai Zhao

## Curriculum Vitae

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### Education

- 09/2018 – **Bachelor of Science in Information and Computational Science**, *University of Science and Technology of China*, Hefei, China  
School of the Gifted Young
- 09/2022 – **Master of Science in Information and Computational Science, Specialization in Computer Graphics**, *University of Science and Technology of China*, Hefei, China  
06/2025 (Expected) School of Mathematical Sciences

### Publication

1. Guided Diffusion for Fast Inverse Design of Density-based Mechanical Metamaterials. Yanyan Yang, Lili Wang, Xiaoya Zhai, Kai Chen, Wenming Wu, **Yukai Zhao**, Ligang Liu, Xiao-Ming Fu. *Preprint*. [Link].

### Research Experience

- 02/2022 – **Undergraduate Thesis, GPU-Based Surface Subdivision Algorithm Development**, *School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China  
06/2022 Supervisors: Prof. Xiao-Ming Fu
- 07/2023 – **Research Assistant, Rapid Inverse Design of 3D Mechanical Metamaterials using Diffusion Model**, *GCL Lab, School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China  
06/2024 (Expected) Supervisors: Prof. Xiao-Ming Fu, Prof. Xiaoya Zhai
- **Focus:** The project focused on developing advanced metamaterial structures through state-of-the-art generative models.
  - **Objective:**
    - Establish a pioneering 3D mechanical metamaterial database to explore and optimize the design of metamaterials with desired mechanical properties.
    - Use diffusion models to accelerate the discovery and validation of new structures, and conduct interpretability analyses related to the models.
  - **My Role:**
    - Conducted early-stage literature review to inform the project's direction.
    - Established, organized, and annotated a large dataset of metamaterial structures.
    - Implemented data augmentation techniques to enhance the dataset and improve model training.
    - Assisted in the validation of initial ideas and methodologies during the early phases of the project.
  - **Outcomes:** The project resulted in research papers that are currently under review, contributing new knowledge to the field of metamaterials.

- 09/2023 – **Research Assistant, Designing 3D Mechanical Metamaterial Sequences Approaching Theoretical Stiffness Limits**, *GCL Lab, School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China  
Supervisors: Prof. Xiao-Ming Fu, Prof. Xiaoya Zhai
- **Focus:** Design mechanical metamaterial sequences using numerical methods to achieve theoretical stiffness limits.
  - **Objective:**
    - Develop mechanical metamaterial sequences using innovative numerical methods.
    - Simulate multiple properties of the designed structures using commercial software.
    - Manufacture the metamaterial sequences using additive manufacturing techniques and design mechanical experiments for validation.
  - **My Role:**
    - Proposed the use of innovative techniques to successfully generate sequences with smooth, continuously varying surfaces.
    - Directed the numerical simulations and experimental validation processes, ensuring accuracy and reliability of the results.
    - Led the drafting of the initial manuscript for publication.
  - **Outcomes:** The project resulted in a research paper that is currently under review, with the manuscript recommended by the editor for transfer to *\*Advanced Science\**, contributing new knowledge to the field of metamaterials.

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## Teaching Experience

- 09/2022 – **Teaching Assistant, Computational Methods**, *School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China  
01/2023
- Assisted in grading assignments and exams, providing feedback to students.
  - Participated in the design of course assignments.
  - Answered student questions and prepared materials for tutorial sessions.

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## Projects

- 02/2022 – **Basic Exercises in Computer Graphics (Self-study)**, *Self-study*, Hefei, China  
06/2022
- **Digital Image Processing:** Image warping, image fusion.
  - **Digital Geometry Processing:** 3D geometry representation, common data structures.
  - **Rendering and Simulation:** Basics of rendering, simulation, and animation.
- 04/2022 – **Digital Geometry Processing**, *GCL Lab, School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China  
09/2022
- **C/C++ Coding.**
  - **Mesh Processing:** Discrete differential geometry, mesh denoising, parameterization, interpolation, simplification, remeshing.
  - **Surface Processing:** Surface reconstruction, registration.
- 10/2022 – **Topology Optimization**, *GCL Lab, School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China  
01/2023
- **MATLAB Programming.**
  - **Linear Elastic Finite Element Analysis.**
  - **Topology Optimization:** 88-line base code, multi-objective, multi-loading, stress constraints, local volume constraints.
  - **High-Performance 3D Topology Optimization.**
  - **Microstructure and Metamaterials.**

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## Skills

- Technical Skills C/C++: Intermediate; MATLAB: Intermediate; Python: familiar. For non-algorithmic tasks, I efficiently use LLM assistance. Also skilled in using LLM assisting writing and graphic design.
- Software Abaqus: Mechanical simulation for quasi-static processes; Python scripting for customization and automation in Abaqus; HyperMesh: Remeshing and volumetric meshing.
- Languages Chinese: Native; English: Fluent.