Yunkai Zhao

Curriculum Vitae

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Education

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

09/2018 – 06/2022   **Bachelor of Science in Information and Computational Science**, *University of Science and Technology of China*, Hefei, China
School of the Gifted Young

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].

2. Near-isotropic, Extreme-stiffness, Continuous 3D Mechanical Metamaterial Sequences Using Implicit Neural Representation. **Yunkai Zhao**+, Lili Wang+, Xiaoya Zhai*, Jiacheng Han, Winston Wai Shing Ma, Junhao Ding, Yonggang Gu, Xiao-Ming Fu. Advanced Science, 2024.

Research Experience

09/2023 – 07/2024   **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.

07/2023 – 06/2024 (Expected)	**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

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.

02/2022 – 06/2022	**Undergraduate Thesis, GPU-Based Surface Subdivision Algorithm Development**, *School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China

Supervisors: Prof. Xiao-Ming Fu

Teaching Experience

09/2022 – 01/2023	**Teaching Assistant, Computational Methods**, *School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China

- 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.

Projects

02/2022 – 06/2022	**Basic Exercises in Computer Graphics (Self-study)**, *Self-study*, Hefei, China

- **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 – 09/2022	**Digital Geometry Processing**, *GCL Lab, School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China

- **C/C++ Coding.**
- **Mesh Processing:** Discrete differential geometry, mesh denoising, parameterization, interpolation, simplification, remeshing.
- **Surface Processing:** Surface reconstruction, registration.

10/2022 – 01/2023	**Topology Optimization**, *GCL Lab, School of Mathematical Sciences, University of Science and Technology of China*, Hefei, China

- **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.**

Skills

Technical Skills	C/C++: Intermediate; MATLAB: Intermediate; Python: Intermediate.
Software	Abaqus: Mechanical simulation for quasi-static processes; Python scripting for customization and automation in Abaqus; HyperMesh: remesh.

Languages   Chinese: Native; English: Fluent.