

Haoan Feng

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ABOUT ME

I am a dedicated researcher with a deep passion for exploring the interdisciplinary fields of computer vision and geospatial data analysis. My research interests broadly span *neural representations of geospatial data, neural rendering, topological analysis, generative models, and AI for Science topics*. Believing that collaboration across disciplines is key to driving innovation, my experience working with diverse teams has strengthened my commitment to interdisciplinary research. I am constantly expanding my knowledge in these areas, driven by curiosity and a desire to contribute to advancements in the field.

EDUCATION

Doctor of Philosophy in Computer Science 2021 - expect 2026

University of Maryland, College Park, United States

- ◇ GPA: 4.0/4.0
- ◇ *Related coursework*: Geographical Information Systems and Spatial Databases, Advanced Techniques in Visual Learning and Recognition.
- ◇ *Thesis: (provisional) Neural Representations of Geospatial Data: Analysis, Generation, and Beyond.*

Master of Philosophy in Computer Science and Engineering 2018 - 2020

Hong Kong University of Science and Technology, Hong Kong, China

- ◇ *Thesis: Linear structure vectorization in large-scale landscape point cloud.*

Bachelor of Engineering in Computer Science Engineering and Electronic and Computer Engineering 2014 - 2018

Hong Kong University of Science and Technology, Hong Kong, China

- ◇ GPA: 3.9/4.3
- ◇ *Related coursework*: Discrete Math Tools, Advanced Computer Graphics, Data Visualization, Probability and Random Processes in Engineering, Signals and Systems.

RESEARCH PROJECTS

Analytical Neural Representations of Geospatial Data 2021 - Present

University of Maryland, College Park

Advisor: Prof. Leila De Floriani

- ◇ **Survey on Neural Representations of Geospatial Data** (*In progress*):
 - Conducting a comprehensive survey on neural representations for geospatial data storage, rendering, and analysis.
 - Evaluating implicit and explicit representations to enhance flexibility, scalability, parallel computation, and support for physical simulation in geospatial contexts.
- ◇ **Implicit Neural Representation for Terrain Surface Modeling**: Published a practical continuous surface model for terrain data using implicit neural representations.

September 23, 2024

- Achieved accurate terrain surface reconstruction with 25% storage cost with a progressive training strategy.
- Conducted topological analysis, and topographical feature extraction on the implicit surface function represented by the neural network.
- ◇ **Topological Feature Tracking on Triangulated Irregular Networks (TINs) Using a Scale-Space Approach:** Designed and implemented an adaptive scale-space algorithm to track topologically critical features on 2D manifolds discretized as TINs.
 - Adapted previous regular grid-based scale-space algorithm to work with TINs with less overall memory cost.
 - Accelerated the triangular mesh smoothing process using custom GPU kernels.
 - Implemented a local geometry adaptive sampling method to construct efficient TINs from point cloud for topological analysis.

Researcher and Developer at Vision and Graphics Laboratory

2017 - 2020

Hong Kong University of Science and Technology

Advisor: Prof. Long Quan

- ◇ **Large-Scale Point Cloud Processing, Information Extraction, Semantic Segmentation:** Developed a comprehensive pipeline for processing large-scale noisy point clouds, enhancing PointNet's ability to segment thin and neglected structures. Created algorithms and a GUI tool for feature extraction, clustering, and recovering lost linear structures.
 - Enhanced PointNet with handcrafted features to better identify and segment thin structures in point clouds.
 - Designed a point cloud processing pipeline that statistically removes noisy data, analyzes local geometric features and adaptively segments the cloud for downstream tasks like pointwise classification, surface detection, and structure preservation.
 - Implemented a robust PCA algorithm (Fast-MCD) for fast data clustering and feature extraction as a pretext task.
 - Created algorithms and GUI tools for recovering lost linear structures (e.g., high-voltage powerlines), achieving modeling accuracy comparable to laser-scanning techniques.
- ◇ **3D Web Application for Large-scale Landscape Reconstruction:** Implemented a 3D web application, which loads 3D reconstructions of large-scale landscapes efficiently, and provides simulation of the Earth for user interaction and engineering measurement.
 - Built an efficient 3D data loading pipeline utilizing level-of-detail (LOD) to reduce data streaming by 90%, achieving 60fps on standard devices by optimizing data processing with web workers.
 - Integrated Apple ARKit for AR mode, designing user interactions for large-scale scenarios with precise transformation models.
 - Implemented high-accuracy landscape measurements for point-to-point distances and area calculations, offloading computational tasks to GPU via WebGL for a low-latency experience.
 - Enabled real-time interaction with complex 3D scenes containing billions of triangles using hidden-frame rendering and masking algorithms.

PUBLICATIONS

Conference Articles

- [1] **Feng, H.**, Song, Y., & De Floriani, L. (2024). **Critical Features Tracking on Triangulated Irregular Networks by a Scale-Space Method**. In *The 32nd ACM International Conference on Advances in Geographic Information Systems (SIGSPATIAL '24)*, October 29–November 1, 2024, Atlanta, GA, USA. ACM, New York, NY, USA, 13 pages. <https://doi.org/10.1145/3678717.3691218>. **(Oral Presentation, )**
- [2] **Feng, H.**, Xu, X., & De Floriani, L. (2024). **ImplicitTerrain: a Continuous Surface Model for Terrain Data Analysis**. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition* (pp. 899–909). **(Oral Presentation @ 1st Implicit Neural Representation for Vision Workshop, )**
- [3] Zhen, M., Li, S., Zhou, L., Shang, J., **Feng, H.**, Fang, T., & Quan, L. (2020). **Learning Discriminative Feature with CRF for Unsupervised Video Object Segmentation**. In *Computer Vision–ECCV 2020: 16th European Conference, Glasgow, UK, August 23–28, 2020, Proceedings, Part XXVII 16* (pp. 445–462). Springer International Publishing.

Preprint(s)

- [1] **Feng, H.**, Novello, T., Aldana, D., & De Floriani, L. **SASNet: Spatial-Adaptive Sinusoidal Neural Network for Clear Neural Images**. *(in preparation)*.
- [2] Aldana, D., **Feng, H.**, Novello, T., & De Floriani, L. **Structured Pruning in Implicit Neural Representations**. *(in preparation)*.
- [3] **Feng, H.** (2020). **Linear Structure Vectorization in Large-Scale Landscape Point Cloud**. *(MPhil dissertation)*.

PRESENTATIONS

- 1. ImplicitTerrain: a Continuous Surface Model for Terrain Data Analysis, *CVPR 2024 Workshop on Implicit Neural Representation for Vision*, Seattle, United States (June 18, 2024).

SKILLS

Programming

- Python:

- ◇ Primary development language for published research, implementing machine learning algorithms using the PyTorch framework.
- ◇ Developed GPU-accelerated algorithms with Python bindings and CUDA kernel programming.
- ◇ Evaluated and visualized experimental results using Python packages (e.g., OpenCV, Matplotlib), and collaborated with teammates on the W&B platform for project tracking and experimentation.

- C++:

- ◇ Implemented scale-space algorithms and data structures for analyzing triangulated irregular networks, following object-oriented programming principles.
- ◇ Optimized algorithm inference speed using parallel computation with the OpenMP library, improving efficiency by parallelizing tasks on leaf nodes in tree structures.

- **Others:**

- ◇ Development primarily in Unix (CentOS) environments, managing computational tasks with SLURM.
- ◇ Practical experience in database management (MySQL, MongoDB) and professional engineering software (QGIS, MATLAB, MeshLab).
- ◇ Experienced in full-stack web development, including backend (NodeJS, PHP) and frontend (ReactJS).

Languages

- ◇ Mandarin (native), English (fluent), Cantonese & Japanese (amateur)

ACADEMIC SERVICE

Conference reviewer:

- ◇ International Conference on Pattern Recognition (ICPR 2024)

EXPERIENCE

Guest Lectures

- ◇ **Machine Learning Algorithms for Point Clouds** in the course *CMSC401: Algorithms for Geospatial Computing*, Spring 2024

Teaching Assistant

University of Maryland, College Park, MD, US 2021 - 2024

- ◇ CMSC414: Computer and Network Security, Fall 2022 & Fall 2024
- ◇ CMSC401: Algorithms for Geospatial Computing, Spring 2023 & Spring 2024
- ◇ CMSC416: Introduction to Parallel Computing, Fall 2023
- ◇ CMSC454: Algorithms for Data Science, Spring 2022
- ◇ CMSC427: Computer Graphics, Fall 2021

Hong Kong University of Science and Technology 2018 - 2020

- ◇ Introduction to Computer Science in Python and Multimedia Computing
- ◇ Object-Oriented Programming and Data Structures

Moodle Software Developer and Technical Support 2020

Hong Kong University of Science and Technology, Hong Kong, China

- ◇ Implemented LaTeX file compilation, encoding, and distribution features in the Moodle course management system as part of a copyright protection scheme.
- ◇ Developed web app user interfaces and system plugins for diverse applications using PHP and MySQL.

September 23, 2024

CERTIFICATIONS & AWARDS

- ◇ Chair's Graduate Fellowship 2021 - 2023
- ◇ Simatelex Charitable Foundation Scholarship 2015 - 2018
- ◇ University's Scholarship Scheme for Continuing Undergraduate Students (HKUST top 2% CGA Award) 2015 - 2018
- ◇ Champion Team in HackUST (Healthcare Theme), Hong Kong 2017
- ◇ First Runner-up in VAST Challenge 2016 (Global Data Visualization Competition) 2016
- ◇ First Prize in Chinese Western Mathematical Olympiad 2012

EXTRACURRICULAR ACTIVITIES

- ◇ Volunteer teaching and cultural experience program at Bali, Indonesia 2017
- ◇ General Secretary of the Model United Nations Club, HKUSTSU 2015 - 2016

REFERENCES

References available upon request.