Haoan Feng

Maryland, US hfengac@terpmail.umd.edu
homepage Github Profile ORCID

ABOUT ME

My PhD research is on *neural representations of geospatial and volumetric data*: continuous, differentiable models of terrain and 3D signals, topology-aware analysis of their structure, and generative frameworks built on top of them. My interests also span *neural rendering, vision-language models, and AI for Science topics*. Looking ahead, I want to carry this line of work toward *spatial intelligence*, and in particular toward world models built on explicit 3D representations (implicit neural fields, Gaussian splats, and triangulated meshes), where scene structure can be queried, differentiated, and edited. Believing that collaboration across disciplines is key to driving innovation, my experience working with diverse teams has strengthened my commitment to interdisciplinary research.

EDUCATION

Doctor of Philosophy in Computer Science 2021 - *expect* 2027
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: Topology-Aware Modeling of Terrain and Volumetric Data: From Discrete to Neural Implicit Representations.*

Master of Philosophy in Computer Science and Engineering 2018 - 2020
Hong Kong University of Science and Technology, Hong Kong, China

- *GPA*: 3.9/4.3
- *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

PhD Research Intern at Dolby ATG Laboratories May 2026 – August 2026
Sunnyvale, CA *Mentors & Manager: Peimeng Guan, Dae Yeol Lee & Guan-Ming Su*
Greenfield research internship. Proposed, scoped, and led a research project on native asset authoring for volumetric video in the TVGS format.

- **Native Gaussian Asset Insertion & Authoring for Volumetric Video**:

- Proposed inserting authored text and icon elements into dynamic volumetric video as native Time-Varying Gaussian Splatting (TVGS) assets, so that inserted content follows the same rendering path as the host scene rather than being pasted on as a 2D overlay.
- Made inserted assets native to the splatting pipeline so they participate in the same single-pass depth-sorted compositing as the host scene, giving correct mutual occlusion by construction, verified in behind-glass occlusion scenarios.
- Brought physically based shading to inserted assets with a Cook–Torrance material model and image-based environment lighting, validated against Blender references.
- Automated the conversion of font glyphs into a reusable TVGS asset library with per-asset acceptance checks, and studied video-codec compression of the resulting assets.
- Developed a Viser-based interactive scene editor featuring a keyframe timeline and a text-track schema for timed, multi-instance annotation reuse; batched neural decoding brought over 10× speed-up and made paragraph-scale text editing interactive.

◇ **Feed-Forward Amortized Asset Authoring**:

- Identified per-asset optimization as the scaling bottleneck of the authoring workflow, and formulated an amortized alternative where a shared encoder–decoder predicts renderable TVGS assets directly from canonical anchor point clouds, leaving only a compact anchor group as the per-asset payload.
- Designed the representation around deterministic on-surface anchor sampling and a compact single-plane latent, reaching normal map prediction accuracy under 2 degrees on held-out assets.
- Engineered the training stack from scratch, including a streaming dataset pipeline, batched rasterization, and multi-GPU training, then scaled it to a corpus of over 27,000 physically based assets with leak-free splits that generalize to fonts never seen in training.
- Devised a compressed asset-group delivery format with roughly 28× storage reduction at negligible quality loss, plus a test-time refinement stage that further improved every asset in the test library.

PhD Research Intern at Dolby ATG Laboratories May 2025 – August 2025
Sunnyvale, CA *Mentor & Manager: Sri Harsha Musunuri & Guan-Ming Su*

◇ **Geometry-Guided Camera Motion Understanding in VideoLLMs** (accepted at CVPR 2026 Workshop PVUW):

- Developed a geometry-guided framework to augment Video Large Language Models (VideoLLMs) with cinematographic camera motion understanding.
- Curated and labeled a 12,274-segment camera-motion benchmark (CameraMotion-Dataset / CameraMotionVQA) from UE5-rendered video with ground-truth camera metadata, formulating canonical camera motions as constraint-aware multi-label classification.
- Probed pretrained vision encoders with a Q-former to evaluate whether camera motion cues are preserved, demonstrating systemic neglect of spatial perception in current VideoLLMs.

◇ **Prompt-Based Integration of Camera Perception**:

- Developed a plug-and-play strategy that injects camera motion and depth-aware spatial descriptors as textual prefixes to VideoLLMs, enabling richer filmmaker-centric video understanding without retraining.
- Enabled downstream tasks such as camera-aware VQA, descriptive video services (DVS), and scene-level plagiarism detection through structured cinematographic conditioning.
- Validated that explicit camera prompts improve temporal reasoning and stylistic sensitivity in VideoLLM-generated outputs, outperforming off-the-shelf VideoLLMs and a CameraBench-derived fine-tuning baseline on our CameraMotionVQA benchmark.

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**:

- Conducting a comprehensive survey using the PyTorch framework 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.

- Achieved accurate terrain surface reconstruction with 25% storage and 4 times training speed with a progressive training strategy.
- Conducted topological analysis, and topographical feature extraction on the implicit surface function represented by the neural network.
- Evaluated and visualized experimental results using OpenCV and Matplotlib and collaborated with teammates on the W&B platform for project and experiment tracking.

◇ **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 for more accurate critical feature tracking results and less overall computational resources.
- Accelerated the triangular mesh smoothing process roughly $100\times$ on GPU using C++ adjacency-graph extraction and custom GPU kernels via PyTorch, and made critical point tracking fully parallel by eliminating the global event sort, reducing tracking cost from $O(ES \log E)$ to $O((ES+K)/P)$.
- 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

Journal Article(s)

[1] **Feng, H.**, Song, Y., & De Floriani, L. (2026). **A Parallel Scale-Space Method for Critical Features Tracking on Triangulated Irregular Networks.** *ACM Transactions on Spatial Algorithms and Systems (TSAS)*. https://doi.org/10.1145/3812549. (🔗, 🌐)

Conference Articles

[1] **Feng, H.**, Aldana, D., Novello, T., & De Floriani, L. (2026). **SASNet: Spatially-Adaptive Sinusoidal Networks for INRs.** In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR 2026)*. (🔗,)

[2] **Feng, H.**, Xu, X., & De Floriani, L. (2026). **ImplicitTerrainV2: Wavelet-Guided Spatially Adaptive Neural Terrain Representation.** In *The 34th ACM International Conference on Advances in Geographic Information Systems (SIGSPATIAL '26)*, November 3-6, 2026, Riverside, CA, USA. ACM, New York, NY, USA. https://doi.org/10.1145/3841645.3843428. (🔗, 🌐,)

[3] **Feng, H.**, Xu, X., & De Floriani, L. (2026). **Rethinking Amortized Neural Representations for High-Resolution Terrain Elevation Data.** In *The 34th ACM International Conference on Advances in Geographic Information Systems (SIGSPATIAL '26)*, November 3-6, 2026, Riverside, CA, USA. ACM, New York, NY, USA. https://doi.org/10.1145/3841645.3844199. **(Poster paper, 🔗, 🌐,)**

[4] **Feng, H.**, Musunuri, S. H., & Su, G.-M. (2026). **Geometry-Guided Camera Motion Understanding in VideoLLMs.** In *CVPR 2026 Workshop on Pixel-level Video Understanding in the Wild (PVUW)*. (🔗)

[5] Tao, Y., **Feng, H.**, Xu, X., & De Floriani, L. (2026). **A Topology-Guided GeoAI Agentic Framework for Urban Flood Screening.** In *The 1st ACM SIGSPATIAL Student Challenge on Open Agents with Spatial Intelligence for Social Good (OASIS '26)*, Riverside, CA, USA, to appear. **Top-10 finalist; selected for on-site presentation and demo.** (arXiv:2610.30660, 🌐)

[6] **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. **(Best paper runner-up, Oral Presentation, 🔗, 📄)**

[7] **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*, 🔗)**

[8] 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) & Other(s)

[1] **Feng, H.**, Wang, T., Guan, P., Lee, D. Y., & Su, G.-M. (2026). **FFGaussType: Feed-Forward Conversion of Glyph and SVG Geometry into Compact Gaussian Assets.** *arXiv preprint arXiv:2611.26431*. (🔗, 🌐)

[2] Aldana, D., **Feng, H.**, Novello, T., & De Floriani, L. **Structured Pruning in Implicit Neural Representations**. *(under conference review)*.

[3] **Feng, H.** (2020). **Linear Structure Vectorization in Large-Scale Landscape Point Cloud.** *(MPhil dissertation, 🔗)*.

PRESENTATIONS

1. SASNet: Spatially-Adaptive Sinusoidal Networks for INRs, *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR 2026)*, Denver, United States (June 2026, 📹).
2. Critical Features Tracking on Triangulated Irregular Networks by a Scale-Space Method., *ACM SIGSPATIAL 2024*, Atlanta, United States (October 30th, 2024).
3. 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

- Daily programming languages: Python and C++.
- Parallel computation toolkits: CUDA and OpenMP.
- Experiment and data visualization toolkits: OpenCV, Matplotlib, W&B, D3.js, and Tableau.

Miscellaneous

- Professional engineering software: QGIS, MATLAB, MeshLab, and Paraview.
- Development primarily in Unix (CentOS) environments, managing computational tasks with SLURM.
- Database (MySQL, MongoDB) and web development (NodeJS, PHP, ReactJS).

Languages

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

ACADEMIC SERVICE

Conference reviewer:

- International Conference on Pattern Recognition (ICPR 2024)
- Conference on Neural Information Processing Systems (NeurIPS 2025, 2026)
- IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR 2026)
- IEEE/CVF International Conference on Computer Vision (ICCV 2026)
- European Conference on Computer Vision (ECCV 2026)
- Pacific Graphics (2026)

EXPERIENCE

Guest Lectures

- **Machine Learning Algorithms for Point Clouds** in the course *CMSC401: Algorithms for Geospatial Computing*, Spring 2024, 2025

Teaching Assistant

University of Maryland, College Park, MD, US 2021 - 2025

- CMSC414: Computer and Network Security, Fall 2022 & Fall 2024, 2025
- CMSC401: Algorithms for Geospatial Computing, Spring 2023, 2024, 2025
- 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

November 20, 2026

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.

CERTIFICATIONS & AWARDS

- Jacob K. Goldhaber Travel Grant (CVPR 2026), University of Maryland Graduate School 2026
- CS Department Travel Award (CVPR 2026), University of Maryland 2026
- Chair's Graduate Fellowship 2021 - 2023
- Postgraduate Studentship 2018 - 2020
- 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.

November 20, 2026