1 PERSONAL INFORMATION

Kyle (Yilin) Gao, PhD, Postdoctoral Fellow – University of Waterloo
Phone: 1-226-789-5588
Email: y56gao@uwaterloo.ca
Google Scholar — orcid:0000-0002-8320-6308

1.1 Research Summary

My research focuses on two areas: **1) The intersection of remote sensing and 3D reconstruction, focusing on urban 3D modelling** and **2) GeoAI and integration with Large Language Models (LLM), focusing on LLM-assisted image, point cloud, and data analysis for environmental monitoring with a focus on natural disasters.**

Keywords: Remote Sensing, Photogrammetry, Computer Vision, GeoAI, Large Language Models, LiDAR, 3D Point Clouds, 3D Reconstruction, Geographic Information Systems (GIS)

1.2 Education

University of Waterloo, Waterloo, ON, Canada
Postdoctoral Fellow: Systems Design Engineering — May 2025 — Ongoing
Doctor of Philosophy (PhD): Systems Design Engineering. — April 2021 — May 2025

- Thesis Title: Towards Urban Digital Twins With Gaussian Splatting, Large-Language-Models, and Cloud Mapping Services
- Research: 40+ remote sensing, GIS, and computer vision projects. 37 peer-reviewed papers, 1000+ citations.
- Funding: 100,000 + $ (CAD) in personal scholarships and grants, including external proposal-based funding.

University of Victoria, Victoria, BC, Canada — September 2017 — July 2020
Master of Science (MSc): Physics

University of Waterloo, Waterloo, ON, Canada — September 2011 — July 2016
Honours Bachelor's degree in Mathematics with Distinction

2 PUBLICATIONS

2.1 Summary (August-20-2025)

- **Total citations: 1310 (Oct, 2025). Peer-reviewed publications: 37.**
- 29 peer-reviewed journal articles (23 in Q1 Journals), 8 peer-reviewed conference articles.
- 8 first-authored papers and (preprint) manuscripts.

Articles are listed in reverse chronological order. My authorship position is highlighted in **bold**. First-authored works are marked in blue.

2.2 Peer-Reviewed Journal Papers

Peer-reviewed journal publications include 23 Q1 journal papers.

- 14 articles in *International Journal of Applied Earth Observation and Geoinformation*. (Q1, IF = 8.6)
- 5 articles in *IEEE Transactions on Geoscience and Remote Sensing* (Q1, IF = 8.6)
- 1 article in *IPSRS Journal of Photogrammetry and Remote Sensing* (Q1, IF = 12.2)
- 1 article in *IEEE Transactions on Circuits and Systems for Video Technology* (Q1, IF = 11.1)
- 1 article in *IEEE Transactions on Intelligent Transportation Systems* (Q1, IF = 8.4)
- 1 article in *IEEE Transactions on Instrumentation and Measurement* (Q1, IF = 5.9)
- 5 articles in quartile $\leq$ Q2 journals.

J29 **Gao, Kyle**, D. Lu, H. He, L. Li, L. Xu, and J. Li, "Digital Buildings Analysis: 3D Modeling, GIS Integration, and Visual Descriptions Using Gaussian Splatting, ChatGPT/Deepseek, and Google Maps Platform," *IEEE Geoscience and Remote Sensing Letters*, vol. Upcoming Volume, 2025

J28 Z. Chen, T. Li, D. Li, J. Gou, C. Wang, **Gao, Kyle**, J. Li, and Z. Gong, "Leveraging multi-view images to learn domain-invariant discriminative embeddings for cross-view geo-localization," *IEEE Transactions on Circuits and Systems for Video Technology*, vol. Upcoming Volume, 2025

J27 D. Lu, **Gao, Kyle**, J. Li, D. Zhang, and L. Xu, "Exploring Token Serialization for Mamba-based LiDAR Point Cloud Segmentation," *IEEE Transactions on Geoscience and Remote Sensing*, vol. Upcoming Volume, 2025

J26 **Gao, Kyle**, D. Lu, H. He, L. Li, N. Chen, L. Xu, and J. Li, "Instructor-Worker Large Language Model System for Policy Recommendation: a Case Study on Air Quality Analysis of the January 2025 Los Angeles Wildfires," *International Journal of Applied Earth Observation and Geoinformation*, vol. Upcoming Volume, 2025

J25 D. Lu, J. Zhou, **Gao, Kyle**, L. Xu, and J. Li, "3DLST: 3D Learnable Supertoken Transformer for LiDAR Point Cloud Scene Segmentation," *International Journal of Applied Earth Observation and Geoinformation*, vol. Upcoming Volume, 2025

J24 J. Du, L. Xu, L. Ma, **Gao, Kyle**, J. Zelek, and J. Li, "3D semantic segmentation: Cluster-based sampling and proximity hashing for novel class discovery," *ISPRS Journal of Photogrammetry and Remote Sensing*, vol. 223, pp. 274–295, 2025

J23 **Gao, Kyle**, D. Lu, H. He, L. Xu, and J. Li, "Enhanced 3D Urban Scene Reconstruction and Point Cloud Densification using Gaussian Splatting and Google Earth Imagery," *IEEE Transactions on Geoscience and Remote Sensing*, 2025

J22 D. Lu, L. Xu, J. Zhou, **Gao, Kyle**, Z. Gong, D. Zhang, and J. Li, "3D-UMamba: 3D U-Net with State Space Model for LiDAR Point Cloud Segmentation," *International Journal of Applied Earth Observation and Geoinformation*, 2025

J21 Z. Chen, H. Wang, X. Wu, J. Wang, X. Lin, C. Wang, **Gao, Kyle**, M. Chapman, and D. Li, "Object detection in aerial images using DOTA dataset: A survey," *International Journal of Applied Earth Observation and Geoinformation*, vol. 134, p. 104208, 2024

J20 N. Yang, L. Li, L. Han, **Gao, Kyle**, S. Qu, and J. Li, "Retrieving heavy metal concentrations in urban soil using satellite hyperspectral imagery," *International Journal of Applied Earth Observation and Geoinformation*, vol. 132, p. 104079, 2024

J19 D. Lu, **Gao, Kyle**, Q. Xie, L. Xu, and J. Li, "3DGTN: 3D Dual-Attention GLocal Transformer Network for Point Cloud Classification and Segmentation," *IEEE Transactions on Geoscience and Remote Sensing*, 2024

J18 D. Lu, J. Zhou, **Gao, Kyle**, J. Du, L. Xu, and J. Li, "Dynamic clustering transformer network for point cloud segmentation," *International Journal of Applied Earth Observation and Geoinformation*, vol. 128, p. 103791, 2024

J17 Y. Cai, B. Hu, H. He, **Gao, Kyle**, H. Xu, Y. Zhang, S. Pirasteh, X. Wang, W. Chen, and H. Li, "Automatic error correction: Improving annotation quality for model optimization in oil-exploration related land disturbances mapping," *The Egyptian Journal of Remote Sensing and Space Sciences*, vol. 27, no. 1, pp. 108–119, 2024

J16 Z. Gong, R. He, **Gao, Kyle**, and G. Cai, "Scene-aware Online Calibration of LiDAR and Cameras

for Driving Systems," *IEEE Transactions on Instrumentation and Measurement*, p. 1–1, 2023

J15 L. Li, L. Han, **Gao, Kyle**, H. He, L. Wang, and J. Li, "Coarse-to-fine matching via cross fusion of satellite images," *International Journal of Applied Earth Observation and Geoinformation*, vol. 125, p. 103574, 2023

J14 L. Li, L. Han, M. Liu, **Gao, Kyle**, H. He, L. Wang, and J. Li, "SAR-Optical Image Matching with Semantic Position Probability Distribution," *IEEE Transactions on Geoscience and Remote Sensing*, 2023

J13 Z. Chen, Y. Luo, Y. Chen, J. Wang, D. Li, **Gao, Kyle**, C. Wang, and J. Li, "BrGAN: Blur Resist Generative Adversarial Network With Multiple Joint Dilated Residual Convolutions for Chlorophyll Color Image Restoration," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 61, pp. 1–12, 2023

J12 **Gao, Kyle**, H. He, D. Lu, L. Xu, L. Ma, and J. Li, "Optimizing and Evaluating Swin Transformer for Aircraft Classification: Analysis and Generalizability of the MTARSI Dataset," *IEEE Access*, vol. 10, pp. 134427–134439, 2022

J11 X. Lei, H. Guan, L. Ma, Y. Yu, Z. Dong, **Gao, Kyle**, M. R. Delavar, and J. Li, "WSPointNet: A multi-branch weakly supervised learning network for semantic segmentation of large-scale mobile laser scanning point clouds," *International Journal of Applied Earth Observation and Geoinformation*, vol. 115, p. 103129, 2022

J10 D. Lu, Q. Xie, **Gao, Kyle**, L. Xu, and J. Li, "3DCTN: 3D convolution-transformer network for point cloud classification," *IEEE Transactions on Intelligent Transportation Systems*, vol. 23, no. 12, pp. 24854–24865, 2022

J9 W. Liu, J. Liu, Z. Luo, H. Zhang, **Gao, Kyle**, and J. Li, "Weakly supervised high spatial resolution land cover mapping based on self-training with weighted pseudo-labels," *International Journal of Applied Earth Observation and Geoinformation*, vol. 112, p. 102931

J8 Y. Lin, T. Zhang, X. Liu, J. Yu, J. Li, and **Gao, Kyle**, "Dynamic monitoring and modeling of the growth-poverty-inequality trilemma in the Nile River Basin with consistent night-time data (2000–2020)," *International Journal of Applied Earth Observation and Geoinformation*, vol. 112, p. 102903, 2022

J7 H. He, H. Xu, Y. Zhang, **Gao, Kyle**, H. Li, L. Ma, and J. Li, "Mask R-CNN based automated identification and extraction of oil well sites," *International Journal of Applied Earth Observation and Geoinformation*, vol. 112, p. 102875, 2022

J6 H. He, **Gao, Kyle**, W. Tan, L. Wang, S. N. Fatholahi, N. Chen, M. A. Chapman, and J. Li, "Impact of Deep Learning-Based Super-Resolution on Building Footprint Extraction," *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. 43, pp. 31–37, 2022

J5 H. He, **Gao, Kyle**, W. Tan, L. Wang, N. Chen, L. Ma, and J. Li, "Super-resolving and composing building dataset using a momentum spatial-channel attention residual feature aggregation network," *International Journal of Applied Earth Observation and Geoinformation*, vol. 111, p. 102826, 2022

J4 **Gao, Kyle**, M. Chen, S. Narges Fatholahi, H. He, H. Xu, J. Marcato Junior, W. Nunes Gonçalves, M. A. Chapman, and J. Li, "A region-based deep learning approach to instance segmentation of aerial orthoimagery for building rooftop extraction," *Geomatica*, vol. 75, no. 1, pp. 148–164, 2022

J3 H. He, Z. Jiang, **Gao, Kyle**, S. Narges Fatholahi, W. Tan, B. Hu, H. Xu, M. A. Chapman, and J. Li, "Waterloo building dataset: A city-scale vector building dataset for mapping building footprints using aerial orthoimagery," *Geomatica*, vol. 75, no. 3, pp. 99–115, 2022

J2 P. Zhao, H. Guan, D. Li, Y. Yu, H. Wang, **Gao, Kyle**, J. M. Junior, and J. Li, "Airborne multispectral LiDAR point cloud classification with a feature Reasoning-based graph convolution network," *International Journal of Applied Earth Observation and Geoinformation*, vol. 105, p. 102634, 2021

J1 N. Chen, L. Sui, B. Zhang, H. He, **Gao, Kyle**, Y. Li, J. M. Junior, and J. Li, "Fusion of Hyperspectral-Multispectral images joining Spatial-Spectral Dual-Dictionary and structured sparse Low-rank representation," *International Journal of Applied Earth Observation and Geoinformation*, vol. 104,

p. 102570, 2021

2.3 Peer-Reviewed Conference Papers

C8 X. Huang, Z. Xu, H. Wu, J. Wang, Q. Xia, Y. Xia, J. Li, **Gao, Kyle**, C. Wen, and C. Wang, "L4DR: LiDAR-4DRadar Fusion for Weather-Robust 3D Object Detection," in *AAAI Conference on Artificial Intelligence (AAAI-25)*, 2025

C7 N. Chen, B. Zhang, H. He, Z. Liu, and **Gao, Kyle**, "Synchronizing Spatiotemporal Reflectance Fusion via Dual Bayesian Nonparametric Inference and Explicit Downsampling," in *IGARSS 2024-2024 IEEE International Geoscience and Remote Sensing Symposium*, pp. 10358–10362, IEEE, 2024

C6 D. Chen, J. Xiao, **Gao, Kyle**, Y. Lu, S. Fatholahi, and J. Li, "Natural Language Aided Remote Sensing Image Few-Shot Classification," in *IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium*, pp. 6298–6301, IEEE, 2023

C5 X. Liu, S. Qiao, **Gao, Kyle**, H. He, L. Ma, and J. Li, "Nighttime Light Missing Data Retrieval Using Modis Version 6 Satellite Data and Mask Dilated Partial Convolutional Neural Network," in *IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium*, pp. 2989–2992, IEEE, 2023

C4 D. Chen, T. Cheng, Y. Lu, **Gao, Kyle**, S. Fatholahi, and J. Li, "Research on Fast Detection Method of Wind Turbine in Remote Sensing Image Land Area Based on YOLO," in *IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium*, pp. 2823–2826, IEEE, 2023

C3 **Gao, Kyle** and S. R. Koscielniak, "Beam-Beam Resonance Widths in the HL-LHC, and Reduction by Phasing of Interaction Points," in *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, pp. 2280–2283, 2022

C2 H. He, K. Yang, Y. Cai, and **others**, "The impact of data volume on performance of deep learning based building rooftop extraction using very high spatial resolution aerial images," in *2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS*, pp. 1343–1346, IEEE, 2021

C1 H. He, Z. Jiang, W. Tan, Y. Cai, S. N. Fatholahi, **Gao, Kyle**, H. Xu, B. Hu, L. Qing, and J. Li, "Waterloo Building Dataset: A large-scale very-high-spatial-resolution image dataset for building rooftop extraction," *Abstracts of the ICA*, vol. 3, pp. 1–2, 2021

2.4 Preprints (P), Preprints Under Peer-Review (PR) and Others (O)

PR6 W. Sun, Q. Wu, H. Xu, **Gao, Kyle**, Z. Xu, Y. Chen, D. Zhang, L. Ma, J. S. Zelek, and J. Li, "Sagonline: Segment any gaussians online," *Submitted to AAAI Conference on Artificial Intelligence (AAAI-26)*, 2025

PR5 **Gao, Kyle**, L. Li, H. He, D. Lu, L. Xu, and J. Li, "Gaussian Building Mesh (GBM): Extract a Building's 3D Mesh with Google Earth and Gaussian Splatting," *Submitted to Remote Sensing Applications: Society and Environment*, 2025

P4 X. Liu, S. Qiao, **Gao, Kyle**, H. He, M. A. Chapman, L. Xu, and J. Li, "Advancements in Road Lane Mapping: Comparative Fine-Tuning Analysis of Deep Learning-based Semantic Segmentation Methods Using Aerial Imagery," *arXiv preprint arXiv:2410.05717*

PR3 D. Lu, J. Zhou, **Gao, Kyle**, L. Xu, J. Li, *et al.*, "Efficient Point Transformer with Dynamic Token Aggregating for Point Cloud Processing," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*

PR2 D. Lu, Q. Xie, M. Wei, **Gao, Kyle**, L. Xu, and J. Li, "Transformers in 3D point clouds: A survey," *Submitted to Expert Systems with Applications*

PR1 **Gao, Kyle**, Y. Gao, H. He, D. Lu, L. Xu, and J. Li, "NERF: Neural radiance field in 3d vision, introduction and review," *Submitted to Computational Visual Media*

O2 **Gao, Kyle**, "Towards Urban Digital Twins With Gaussian Splatting, Large-Language-Models, and Cloud Mapping Services," *PhD Thesis*, 2025

O1 **Gao, Kyle**, "Beam-Beam Resonance Widths in the HL-LHC, and Reduction by Phasing of Interaction Points," *Msc Thesis*, 2020

3 AWARDS, GRANTS, AND FUNDING

3.1 Project Funding and Scholarships (Postdoc)

- National Resource Canada (NRCAN) project on urban flash flood risk assessment **(PI)** $40,000
  Goverment of Canada 2025-2026
- Foreign Youth Talent Program $38,000
  Chang'an University 2026
- Mitacs project on LLM-assisted climate risk assessment (application in progress) $70,000 per year
  Mitacs 2026-2028
- NSERC Post-doctoral Scholarship/Banting Scholarship (application in progress) $70,000 per year
  Natural Science and Engineering Research Council (NSERC) 2026-2028
- Humboldt Fellowship (application in progress) $45,000 per year
  Humboldt Foundation 2026-2028
- Schmidt AI Fellowship (application in progress) $85,000+11,000 per year
  University of Toronto 2026-2028

3.2 Personal Awards, Scholarships and Funding (PhD)

100,000 CAD ($) + total in awards and scholarships.

- Ontario Graduate Scholarship (OGS) $15,000 per year
  Province of Ontario 2023-2025
- President's Graduate Scholarship $5,000 per year
  University of Waterloo 2023-2025
- Mitacs Accelerate Grant (proposal author and project lead) $30,000 per year
  Mitacs 2022-2023
- Engineering Dean's Domestic Student Award $8,500 per year
  University of Waterloo 2022-2023

4 TEACHING EXPERIENCE

Supervision

I supervised numerous (10+) individual paper-based projects over my PhD. As a post-doc, I currently (unofficially) supervise the thesis research of two master's students.

Teaching

University of Waterloo, Department of Geography and Environmental Management
Sessional Lecturer: Geography 316 (Multivariate Statistics in R) September 2024 — December 2024

University of Waterloo, Department of Systems Design Engineering
Sessional Lecturer: SYDE 572 (Introduction to Pattern Recognition) January 2024 — April 2024

University of Waterloo, Department of Geography and Environmental Management Waterloo, Canada
Teaching Assistant and Guest Lecturer-6 courses September 2021 — December 2023

University of Victoria, Department of Physics and Astronomy Victoria, Canada
Teaching Assistant and Lab Assistant-2 courses September 2017 — September 2018

5 RESEARCH EXPERIENCE

University of Waterloo, GIM Lab, VIP Lab Waterloo, Canada
Postdoctoral Fellow May 2025 – Present

- Leading my labs' research on 1) Urban 3D model reconstruction with Gaussian Splatting, 2) Large Language Model-based climate and disaster risk assessment from cloud-based geographic information systems, 3) Large Language Model-based remote sensing scene understanding.
- **Multiple papers are in preparation for each of the aforementioned research areas I lead.**
- Secured National Resources Canada (NRCAN) contract on flash flood risk mapping from urban growth as co-PI, proposal author, and project lead.

University of Waterloo, Geospatial Intelligence and Mapping Lab Waterloo, Canada
Graduate Research Assistant September 2020 – April 2025

- Led and contributed to multiple research initiatives every year, resulting in over 30 peer-reviewed publications.
- Secured individual funding through Mitacs (60,000 $) – with an additional 50,000 $ + in academic scholarships. Contributed to a successful NSERC Discovery Grant application (310,000 $) with my supervisor.

TRIUMF, Accelerator Physics Group Vancouver, Canada
Graduate Research Assistant-Particle Accelerator Physics January 2018 — January/July 2020

- Researched Lie algebra-based modeling of electromagnetic fields inside the Large Hadron Collider. Returned to the University of Victoria after January 2020 for MSc thesis writing.

Undergraduate Research Assistant (Co-op internships) Multiple Positions Canada
Undergraduate Research Assistant

- *National Research Council of Canada, Quantum Physics Group*: Demonstrated quantum Hall effects in low-temperature experiments on electron dot quantum computing chips.
- *TRIUMF, Accelerator Physics Group*: Created mathematical model of linear electron accelerator.
- *Health Canada*: Parallelized Monte Carlo simulations of radiation on the human body.
- *University of Waterloo, Department of Physics and Astronomy*: Created visualization software and web interface for galactic Doppler shift data (2M++).

6 PROFESSIONAL AND ACADEMIC SERVICES/ACTIVITIES

6.1 Invited Speaker

Chang'an University, Xi'an China July 2025
Title: **An overview of the applications of Large Language Models to Remote Sensing and Geographic Information Systems**

East China Normal University, Shanghai China July 2025
Title: **Lie Algebra in Computer Vision, from Homography to SLAM**

Hefei University of Technology, Hefei China July 2025
Title: **An overview of the applications of Large Language Models to Remote Sensing and Geographic Information Systems**

6.2 Conferences Organization/Committee

- **Chair** of 2026 *ISPRS Congress Thematic Session*, Session title: "Multimodal Large Language Models for Remote Sensing".
- **Co-chair** of *11th Annual Conference on Vision and Intelligent System (CVIS 25)*.
- **Program Committee** for Main Track and AI Alignment Track: *40th Annual AAAI Conference on Artificial Intelligence (AAAI 26)*.

6.3 Journal Editorial Board

- **Special Issue Editor** *Photogrammetric Engineering and Remote Sensing Special Issue*: "Large Language Model in Remote Sensing: Across Different Modalities"

6.4 Peer-Reviewer

As of August 2025, I have peer-reviewed over 45 manuscripts for the following journals.

- *ISPRS Journal of Photogrammetry and Remote Sensing*
- *International Journal of Applied Earth Observation and Geoinformation*
- *IEEE Transactions on Geoscience and Remote Sensing*
- *IEEE Transactions on Neural Networks and Learning Systems*
- *IEEE Transactions on Visualization and Computer Graphics*
- *IEEE Geoscience and Remote Sensing Letters*
- *IEEE Transactions on Intelligent Transportation Systems*
- *ACM Transactions on Multimedia Computing, Communications and Applications*
- *Neurocomputing*

6.5 Student Leadership Positions

Student Representative of Canada on the ICA 2023 — 2025
International Cartographic Association (ICA)
Commission on Geospatial Data Analytics
Student Committee Vice Chair 2023 — 2025
Canadian Institute of Geomatics (CIG)
Waterloo Chapter Student Representative 2020 — 2025
Canadian Remote Sensing Society (CRSS)

6.6 Professional Memberships

Professional Member 2024 — Ongoing
Association for Computing Machinery
Member 2023 — Ongoing
Geoscience and Remote Sensing Society (GRSS)
Member 2021 — Ongoing
Institute of Electrical and Electronics Engineers (IEEE)