

Curriculum Vitae

Kyle (Yilin) Gao, PhD Candidate ^{1,2} in Systems Design Engineering

¹Geospatial Intelligence and Mapping lab (GIM Lab)

Department of Geography and Environmental Management

²Vision and Image Processing Lab

Department of Systems Design Engineering

Student Representative of Canada, International Cartographic Association Commission on Geospatial
Data Analytics

Student Committee Vice Chair, Canadian Institute of Geomatics

Waterloo Chapter Student Representative, Canadian Remote Sensing Society

University of Waterloo

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Contents

1	PERSONAL INFORMATION	3
1.1	Research Summary	3
1.2	Education	3
2	PUBLICATIONS	3
2.1	Peer-Reviewed Journal Papers	4
2.2	Peer-Reviewed Conference Papers	5
2.3	Preprints Under Peer-Review (P) and Others (O)	6
3	TEACHING EXPERIENCE	6
4	RESEARCH EXPERIENCE	7
4.1	SKILLS AND PROFICIENCIES	8
5	AWARDS AND FUNDING	8
5.1	Personal Awards and Funding	8
5.2	Government and Industry Funded Project Participation	8
6	PROFESSIONAL AND ACADEMIC SERVICES	9
6.1	Conference Oral Presentations	9
6.2	Seminar Organization	9
6.3	Professional Memberships	10
7	REFERENCES	10

1 PERSONAL INFORMATION

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Citizenship and Passport: Canadian

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Google Scholar — orcid:0000-0002-8320-6308

1.1 Research Summery

My thesis research is focused on leveraging interdisciplinary techniques from computer vision, computer graphics, and geographic information systems (GIS) to transform aerial and satellite images into detailed 3D representations of urban landscapes.

I also perform more general remote sensing based 2D and 3D computer vision research on the analysis of 2D images including object detection, classification and segmentation, as well as 3D point cloud object detection, classification, and segmentation. Sometimes, both modalities are combined to solve remote-sensing problems.

Keywords: remote sensing, neural rendering, Gaussian splatting, computer vision, urban 3D reconstruction, point clouds, remote sensing image processing, multi-view remote sensing

1.2 Education

University of Waterloo, Waterloo, ON, Canada

April 2021 — April 2025 (Expected)

PhD Candidate

Thesis Title: Towards urban digital twins: 3D reconstruction and rendering with remote sensing imagery

University of Victoria, Victoria, BC, Canada

September 2017 — July 2020

Master of Science: particle accelerator physics program

Thesis title: Beam-Beam resonance widths in the High Luminosity-Large Hadron Collider (HL-LHC), and reduction by phasing of interaction points

University of Waterloo, Waterloo, ON, Canada

September 2011 — July 2016

Honours Bachelor's degree in Mathematics with Distinction: mathematical physics program

2 PUBLICATIONS

As of Sep-29-2024, total citations:490, h-index:9, i-9 index:8.

Articles are listed in reverse-chronological order. My authorship position is highlighted in **bold**.

2.1 Peer-Reviewed Journal Papers

- J20 Nannan Yang, Liangzhi Li, Ling Han, **Gao, Kyle**, Songjie Qu, and Jonathan Li. Retrieving heavy metal concentrations in urban soil using satellite hyperspectral imagery. *International Journal of Applied Earth Observation and Geoinformation*, 132:104079, 2024
- J19 Dening Lu, **Gao, Kyle**, Qian Xie, Linlin Xu, and Jonathan Li. 3dgtm: 3d dual-attention global transformer network for point cloud classification and segmentation. *IEEE Transactions on Geoscience and Remote Sensing*, 2024a
- J18 Dening Lu, Jun Zhou, **Gao, Kyle**, Jing Du, Linlin Xu, and Jonathan Li. Dynamic clustering transformer network for point cloud segmentation. *International Journal of Applied Earth Observation and Geoinformation*, 128:103791, 2024b
- J17 Yuwei Cai, Bingxu Hu, Hongjie He, **Gao, Kyle**, Hongzhang Xu, Ying Zhang, Saied Pirasteh, Xiuqing Wang, Wenping Chen, and Huxiong 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*, 27(1):108–119, 2024
- J16 Zheng Gong, Rui He, **Gao, Kyle**, and Guorong Cai. Scene-aware online calibration of lidar and cameras for driving systems. *IEEE Transactions on Instrumentation and Measurement*, page 1–1, 2023. ISSN 1557-9662. doi: 10.1109/tim.2023.3342241. URL <http://dx.doi.org/10.1109/TIM.2023.3342241>
- J15 Liangzhi Li, Ling Han, **Gao, Kyle**, Hongjie He, Lanying Wang, and Jonathan Li. Coarse-to-fine matching via cross fusion of satellite images. *International Journal of Applied Earth Observation and Geoinformation*, 125:103574, 2023a
- J14 Liangzhi Li, Ling Han, Ming Liu, **Gao, Kyle**, Hongjie He, Langying Wang, and Jonathan Li. Sar-optical image matching with semantic position probability distribution. *IEEE Transactions on Geoscience and Remote Sensing*, 2023b
- J13 Ziyi Chen, Yuhua Luo, Yiping Chen, Jing Wang, Dilong Li, **Gao, Kyle**, Cheng Wang, and Jonathan 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*, 61: 1–12, 2023a
- J12 **Gao, Kyle**, Hongjie He, Dening Lu, Linlin Xu, Lingfei Ma, and Jonathan Li. Optimizing and evaluating swin transformer for aircraft classification: Analysis and generalizability of the mtarsi dataset. *IEEE Access*, 10:134427–134439, 2022a
- J11 Xiangda Lei, Haiyan Guan, Lingfei Ma, Yongtao Yu, Zhen Dong, **Gao, Kyle**, Mahmoud Reza Delavar, and Jonathan 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*, 115:103129, 2022
- J10 Dening Lu, Qian Xie, **Gao, Kyle**, Linlin Xu, and Jonathan Li. 3dctm: 3d convolution-transformer network for point cloud classification. *IEEE Transactions on Intelligent Transportation Systems*, 23(12):24854–24865, 2022
- J9 Wei Liu, Jiawei Liu, Zhipeng Luo, Hongbin Zhang, **Gao, Kyle**, and Jonathan 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*, 112:102931, 2022
- J8 Yi Lin, Tinghui Zhang, Xuanqi Liu, Jie Yu, Jonathan 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*, 112: 102903, 2022
- J7 Hongjie He, Hongzhang Xu, Ying Zhang, **Gao, Kyle**, Huxiong Li, Lingfei Ma, and Jonathan Li. Mask r-cnn based automated identification and extraction of oil well sites. *International Journal of Applied Earth Observation and Geoinformation*, 112:102875, 2022a
- J6 Hongjie He, **Gao, Kyle**, Weikai Tan, Lanya Wang, Sarah Narges Fatholahi, Nan Chen, Michael A Chapman, and Jonathan Li. Impact of deep learning-based super-resolution on building footprint

- extraction. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 43:31–37, 2022b
- J5 Hongjie He, **Gao, Kyle**, Weikai Tan, Lanying Wang, Nan Chen, Lingfei Ma, and Jonathan 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*, 111:102826, 2022c
- J4 **Gao, Kyle**, Mengge Chen, Sarah Narges Fatholahi, Hongjie He, Hongzhang Xu, José Marcato Junior, Wesley Nunes Gonçalves, Michael A Chapman, and Jonathan Li. A region-based deep learning approach to instance segmentation of aerial orthoimagery for building rooftop extraction. *Geomatica*, 75(1):148–164, 2022b
- J3 Hongjie He, Zijian Jiang, **Gao, Kyle**, Sarah Narges Fatholahi, Weikai Tan, Bingxu Hu, Hongzhang Xu, Michael A Chapman, and Jonathan Li. Waterloo building dataset: A city-scale vector building dataset for mapping building footprints using aerial orthoimagery. *Geomatica*, 75(3):99–115, 2022d
- J2 Peiran Zhao, Haiyan Guan, Dilong Li, Yongtao Yu, Hanyun Wang, **Gao, Kyle**, José Marcato Junior, and Jonathan Li. Airborne multispectral lidar point cloud classification with a feature reasoning-based graph convolution network. *International Journal of Applied Earth Observation and Geoinformation*, 105:102634, 2021
- J1 Nan Chen, Lichun Sui, Biao Zhang, Hongjie He, **Gao, Kyle**, Yandong Li, José Marcato Junior, and Jonathan 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*, 104:102570, 2021

2.2 Peer-Reviewed Conference Papers

- C7 Nan Chen, Biao Zhang, Hongjie He, Zhouzhou 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*, pages 10358–10362. IEEE, 2024
- C6 Deliang Chen, Jianbo Xiao, **Gao, Kyle**, Yanyan Lu, Sarah Fatholahi, and Jonathan Li. Natural language aided remote sensing image few-shot classification. In *IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium*, pages 6298–6301. IEEE, 2023b
- C5 Xuanchen Liu, Shuxin Qiao, **Gao, Kyle**, Hongjie He, Lingfei Ma, and Jonathan 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*, pages 2989–2992. IEEE, 2023
- C4 Deliang Chen, Taotao Cheng, Yanyan Lu, **Gao, Kyle**, Sarah Fatholahi, and Jonathan 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*, pages 2823–2826. IEEE, 2023c
- C3 **Gao, Kyle** and Shane R. Kocielniak. Beam-Beam Resonance Widths in the HL-LHC, and Reduction by Phasing of Interaction Points. In *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, pages 2280–2283, 2022. doi: 10.18429/JACoW-IPAC2022-WEPOMS019
- C2 Hongjie He, Ke Yang, Yuwei 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*, pages 1343–1346. IEEE, 2021a
- C1 Hongjie He, Zijian Jiang, Weikai Tan, Yuwei Cai, Sarah Narges Fatholahi, **Gao, Kyle**, Hongzhang Xu, Bingxu Hu, Liyuan Qing, and Jonathan Li. Waterloo building dataset: A large-scale very-high-spatial-resolution image dataset for building rooftop extraction. *Abstracts of the ICA*, 3:1–2, 2021b

2.3 Preprints Under Peer-Review (P) and Others (O)

- P6 **Gao, Kyle**, Dening Lu, Hongjie He, Linlin Xu, and Jonathan Li. Photorealistic 3d urban scene reconstruction and point cloud extraction using google earth imagery and gaussian splatting. *arXiv preprint arXiv:2405.11021*
- P5 Xun Huang, Ziyu Xu, Hai Wu, Jinlong Wang, Qiming Xia, Yan Xia, Jonathan Li, **Gao, Kyle**, Chenglu Wen, and Cheng Wang. L4dr: Lidar-4dradar fusion for weather-robust 3d object detection. *arXiv preprint arXiv:2408.03677*
- P4 Dening Lu, Jun Zhou, **Gao, Kyle**, Linlin Xu, Jonathan Li, et al. Efficient point transformer with dynamic token aggregating for point cloud processing. *arXiv preprint arXiv:2405.15827*, a
- P3 Dening Lu, Jun Zhou, **Gao, Kyle**, Linlin Xu, and Jonathan Li. 3d learnable supertoken transformer for lidar point cloud scene segmentation. *arXiv preprint arXiv:2405.15826*, b
- P2 Dening Lu, Qian Xie, Mingqiang Wei, **Gao, Kyle**, Linlin Xu, and Jonathan Li. Transformers in 3d point clouds: A survey. *arXiv preprint arXiv:2205.07417*, c
- P1 **Gao, Kyle**, Yina Gao, Hongjie He, Dening Lu, Linlin Xu, and Jonathan Li. Nerf: Neural radiance field in 3d vision, introduction and review. *arXiv preprint arXiv:2210.00379*
- O2 **Gao, Kyle**. Beam-beam resonance widths in the hl-lhc, and reduction by phasing of interaction points. *Msc Thesis*, 2017
- O1 Dobrin Kaltchev and **Gao, Kyle**. Egun-elbt reference trajectory correction in presence of ambient fields. *TRIUMF Technical Report*, 2014

3 TEACHING EXPERIENCE

University of Waterloo, Department of Geography and Environmental Management Waterloo, Canada

Instructor-Geography 316 (Multivariate Statistics)

September 2024 — Present

- Modified and adapted lectures, coursework, and assignments, and developed a new set of exams.
- Offered expertise in active research areas of remote sensing and the application of multivariate statistical methods.
- Guided students in developing a thorough understanding of statistical methods in geography, remote sensing, and GIS through discussions and office hours.

University of Waterloo, Department of Systems Design Engineering Waterloo, Canada

Instructor-SYDE572 (Pattern Recognition)

January 2024 — April 2024

- Developed and designed original lectures, coursework, assignments, and exams from the ground up.
- Provided insight into active research areas in computer vision and its applications to remote sensing.
- Provided guidance ensuring students gained a comprehensive understanding of the underlying principles of pattern recognition during discussions.

University of Waterloo, Department of Geography and Environmental Management Waterloo, Canada

Teaching Assistant and Guest Lecturer-multiple courses

September 2021 — December 2023

- Courses TA-ed: GEOG474/484 (Intro to Machine Learning) two terms, GEOG316 (Multivariate statistics) three terms, GEOG376 (Advanced Remote sensing) one term.
- Developed comprehensive course notes (GEOG474/484) for a newly introduced course taught by my supervisor.
- Conducted engaging and informative guest lectures for GEOG474/GEOG484 and GEOG316.
- Rewrote a substantial portion of the course notes and assignments for GEOG316.

University of Victoria, Department of Physics and Astronomy

Victoria, Canada

Teaching Assistant and Lab Assistant-multiple courses

September 2017 — September 2018

- Created and conducted tutorial sessions for both midterms and finals in multiple courses.
- Assisted students during the lab sessions, offering support, answering questions, and troubleshooting experimental issues, facilitating their learning and enhancing their practical skills in physics engineering.
- Helped students adhere to safety protocols, ensuring a safe and secure laboratory environment.

4 RESEARCH EXPERIENCE

University of Waterloo, Geospatial Intelligence and Mapping Lab Waterloo, Canada
Graduate Research Assistant-Remote Sensing/Computer Vision November 2020 — Present

- Spearheaded successful grant applications with MITACS and actively contributed to NSERC-DG applications, securing substantial funding for advancing our research group's initiatives.
- Engaged in collaborations that yielded numerous publications, supervised research projects of junior graduate students.
- Currently leading research endeavors focused on the exploration of neural radiance fields and Gaussian splatting for the large-scale 3D reconstruction and rendering of urban environment from remote sensing images.

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

- Studied beam-beam resonances of the Large Hadron Collider using Lie algebra methods.
- Derived and implemented new algorithms to predict resonances based on particle bunch dynamics.
- Derived a new resonance reduction condition based on relative bunch phasing.

National Research Council of Canada, Quantum Physics Group Waterloo, Canada
Research Assistant September 2014 — December 2014

- Demonstrated quantum hall effects in low temperature experiments on Canada's domestically produced electron dot quantum computing chips.
- Maintained sensitive low temperature equipment and quantum computing chips.

TRIUMF, Accelerator Physics Group Waterloo, Canada
Research Assistant January 2014 — April 2014

- Developed algorithm modeling electron beams in TRIUMF's Electron Linear Accelerator.
- Implemented algorithm which minimizes beam orbit deviation.

Health Canada, Human Monitoring Laboratory Waterloo, Canada
Research Assistant September 2013 — December 2013

- Performed Monte Carlo simulations modelling irradiation of human bodies
- Researched and applied statistical methods to reduce variance in Monte Carlo N-Particle (MCNP) simulations increasing performance by an order of magnitude.
- Implemented parallelization of MCNP software on computing cluster.

University of Waterloo, Department of Physics and Astronomy Waterloo, Canada
Research Assistant September 2013 — December 2013

- Developed a Python tool querying SQL database, performing data engineering, visualization, interpolation, and coordinate transformation on galaxy survey data.
- Created a web interface for the Python query tool.

4.1 SKILLS AND PROFICIENCIES

- Subject expert in 2D and 3D computer vision and applications to remote sensing and GIS, serving as peer-reviewer for multiple journals.
- Expert in machine/deep learning including fundamentals, theory, algorithms and applications, proficient in standard machine learning/deep learning libraries (certified in TensorFlow and PyTorch).
- Skilled communicator experienced in lecturing, grant applications, seminar organization and standard academic and professional communication.
- Experienced in research project supervision, resulting in numerous publications.
- **Languages:** English (native), French (speaking and writing), Mandarin (speaking)

5 AWARDS AND FUNDING

5.1 Personal Awards and Funding

- Ontario Graduate Scholarship (OGS) \$15000 per year
Province of Ontario April 2023-Ongoing
- President's Graduate Scholarship \$5000 per year
University of Waterloo April 2023-Ongoing
- Mitacs Accelerate Grant \$30000 per year
Mitacs 2022-2023
- Engineering Dean's Domestic Student Award \$8500 per year
University of Waterloo 2022-2023
- University of Waterloo Merit Scholarship \$1000 on admission
University of Waterloo 2011
- QEII-Aiming for the Top Scholarship \$3500 per year
Province of Ontario 2011-2015
- Dean's Honour List– from terms 1A to 4A 2011-2015
University of Waterloo

5.2 Government and Industry Funded Project Participation

- Empowering education and capacity building focusing on natural disasters based on GeoAI and computer vision, ISPRS Education and Capacity Building Initiatives 2024, CHF.
Supervised by S. Pirasteh (PI) \$10,000, 2024
- A Probabilistic Deep Learning Model to Project the Location and Timing of Future Big Wildfires, Mitacs Accelerate.
Supervised by L. Xu (PI), \$133,000 (30%), Apr 2024 - Mar 2027
- Automated monitoring of vegetation regrowth in developed mining areas using high-resolution satellite imagery, NRCan, Contract No. 3000759770.
Supervised by J. Li (PI) \$27,572.00, Oct 2022 - Mar 2023
- Inverse graphics network for 3D building reconstruction using a GAN-based approach, Mitacs Accelerate. Proposed project and primary researcher, main beneficiary of funding.
Supervised by J. Li (PI) \$30000 per year, Sep 2022 - Aug 2023
- 3D Mapping and Change Detection in Indoor Environments Using Multisource LiDAR Point Clouds, NSERC Discovery Grants, RGPIN-2022-03741.
Supervised by J. Li (PI) \$310,000 (\$62,000/year), Apr 2022 - Mar-2027
- A Deep-learning Approach to High-Precision Geospatial Data from Multi-source Sensors, Imperial Oil University Research Awards.
Supervised by M. Chapman (PI), \$25K (50%), Apr 2021 - Mar 2022

6 PROFESSIONAL AND ACADEMIC SERVICES

Peer-Reviewer

- *ACM Transactions on Multimedia Computing, Communications and Applications*
- *IEEE Transactions on Visualization and Computer Graphics*
- *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*
- *IEEE Geoscience and Remote Sensing Letters*
- *IEEE Transactions on Intelligent Transportation Systems*
- *IEEE Transactions on Geoscience and Remote Sensing*
- *International Journal of Applied Earth Observation and Geoinformation*
- *ISPRS Journal of Photogrammetry and Remote Sensing*
- *Remote Sensing*
- *Canadian Journal of Remote Sensing*
- *Geomatica*

Student Representative of Canada on the ICA

International Cartographic Association (ICA)

Commission on Geospatial Data Analytics

2023 — Ongoing

- Advocated for the interests and concerns of student members and promoted student engagement and participation in ICA matters.

Student Committee Vice Chair

Canadian Institute of Geomatics (CIG)

2023 — Ongoing

- Invited guest speakers and coordinated seminars contributing to the professional development and networking opportunities of student members.
- Advocated for the interests and concerns of student members and promoted student engagement and participation in CIG activities.

Waterloo Chapter Student Representative

Canadian Remote Sensing Society (CRSS)

2020 — Ongoing

- Invited guest speakers, organized and promoted seminars to promoting student engagement, providing networking opportunities.
- Served as communication link between the CRSS and local student members conveying relevant information such as updates and opportunities, as well as relaying student concerns.

6.1 Conference Oral Presentations

- Natural language aided remote sensing image few-shot classification.
IEEE International Geoscience and Remote Sensing Symposium. 2023
- Research on fast detection method of wind turbine in remote sensing image land area based on yolo. *IEEE International Geoscience and Remote Sensing Symposium* 2023

6.2 Seminar Organization

Invited guest speakers. Coordinated, organized, and advertised seminars.

- CIG and CRSS seminar on urban building detection and wildfire monitoring.
Invited speakers: Prof. Dongmei Chen and Dr. Zilong Zhang. Oct 2023
- CIG and CRSS seminar on fresh water ice and sea ice remote sensing.
Invited speakers: Prof. Grant Gunn and Linlin Xu. Mar 2023
- CIG and CRSS seminar on hyperspectral remote sensing and LiDAR digital elevation model.
Invited speakers: Prof. Yuhong He and Prof. John Lindsay. Nov 2022

6.3 Professional Memberships

Association for Computing Machinery <i>Professional Member</i>	2024 — Ongoing
International Cartographic Association <i>Student Representative</i>	2023 — Ongoing
Geoscience and Remote Sensing Society (IEEE) <i>Member</i>	2023 — Ongoing
Institute of Electrical and Electronics Engineers (IEEE) <i>Graduate Student Member</i>	2021 — Ongoing
Canadian Remote Sensing Society (CRSS) <i>Waterloo Chapter Student Representative</i>	2020 — Ongoing
Canadian Institute of Geomatics (CIG) <i>Student Committee Vice Chair and Member</i>	2020 — Ongoing

7 REFERENCES

Prof. Jonathan Li-Supervisor

Professor, *Department of Geography and Environmental Management*

Cross-Appointed Professor, *Department of Systems Design Engineering*

University of Waterloo, Canada

Director of the *Geospatial Intelligence and Mapping Lab, University of Waterloo*

Fellow of the *Royal Society of Canada Academy of Science, Institute of Electrical and Electronic Engineers, Canadian Academy of Engineering, and Engineering Institute of Canada.*

Contact information available upon request.

Prof. Linlin Xu-Supervisor

Assistant Professor, Department of Geomatics Engineering, University of Calgary, Canada

Adjunct Professor, Department of Systems Design Engineering, Canada

Contact information available upon request.

More references available upon request.