Debao Huang

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Highlights: Self-implemented SfM Software (C++), FAA Remote Pilot
Interests: Photogrammetry, Computer Vision, Machine Learning, Deep Learning

Education

Ph.D., Electrical and Computer Engineering, The Ohio State University, USA (Advisor: Rongjun Qin) 05/2026 (expected)
M.S., Electrical and Computer Engineering, The Ohio State University, USA (Advisor: Rongjun Qin) 05/2023
B.S., Telecommunication Engineering, Sun Yat-sen University, China 06/2019

Technical Skills

Programming Languages: C++, Python, MATLAB
Skills: 3D Reconstruction (SfM, NeRF, 3DGS, 4DGS), Bundle Adjustment, Uncertainty Quantification, Vision Foundation Models
Frameworks and Libraries: OpenCV, Ceres, Eigen, LASlib, Rasterio, PyTorch, Diffusers, COLMAP, OpenDroneMap, Metashape

Research Projects

Live 3D Gaussian Splatting for Intelligence, Surveillance, and Reconnaissance – AFRL 10/2024–Present
- Developed the first 4DGS pipeline to reconstruct dynamic urban scenes from monocular UAV video, achieving an improvement of 4 dB in PSNR for rendering moving objects.
- Integrated 4DGS with photogrammetry, video segmentation and tracking, monocular depth estimation, and physics-guided trajectory optimization into a unified reconstruction framework. (outcomes: **P1**).

Uncertainty-Aware 3D Photogrammetric Reconstruction for Synthetic Environment – ONR 10/2022–Present
- Proposed a novel self-supervised uncertainty estimation method for MVS, enhancing accuracy by up to 54%, achieving SOTA performance on public aerial benchmarks.
- Implemented an uncertainty quantification framework for aerial and UAV photogrammetry. (outcomes: **S2**, **P5**).

Enabling Seamless 3D Semantic Reconstruction from Heterogeneous Data at Scale – ONR 01/2021–02/2025
- Developed SfM algorithms and introduced novel geometric constraints in bundle adjustment for multi-camera systems, enhancing accuracy by up to 86%. (outcomes: **S1**, **H1**, **P2**).
- Conducted the first study in the literature to assess PlanetScope satellite imagery for 3D reconstruction and change detection, enabling applications in environmental monitoring and disaster management. (outcomes: **P4**).

Software & System Development

[S1] Software: MetricSfM | C++, OpenMP, CUDA, Ceres, Eigen 2024
- Developed an end-to-end Structure-from-Motion pipeline supporting heterogeneous data sources (aerial, UAV, GoPro, mobile, and underwater cameras) with both GUI and CLI interfaces.

[S2] Software: Uncertainty Quantification Framework | C++, Python, Eigen, LASlib 2024
- Implemented uncertainty estimation for multi-view stereo (**P5**) and enabled storage of point-cloud error covariance matrices compliant with the Generic Point-Cloud Model standard from the National Geospatial-Intelligence Agency.

[H1] Hardware: Low-cost Multi-camera Mobile Mapping Systems 2022
- Developed a low-cost ground-mapping system using arbitrarily positioned GoPro cameras, incorporating geometric constraints (**P2**) for multi-camera self-calibration in MetricSfM (**S1**) to achieve robust 3D reconstruction.

Selected Publications

[**P1**] **Huang, D.**, Liu, H., Xu, N., & Qin, R. (2025). "Dynamic Urban Scene Modeling with 3D Gaussian Splatting from UAV Full Motion Videos". *ISPRS Geospatial Week*.

[**P2**] **Huang, D.**, Qin, R., & Elhashash, M. (2024). "Bundle Adjustment with Motion Constraints for Uncalibrated Multi-camera Systems at The Ground Level". *ISPRS Journal of Photogrammetry and Remote Sensing*. **(IF:12.2)**.

[**P3**] Xu, N., Qin, R., **Huang, D.**, & Remondino, F. (2024). "Multi-tiling Neural Radiance Field (NeRF)—Geometric Assessment on Large-scale Aerial Datasets". *The Photogrammetric Record*. **(Cover article of 12/2024 issue)**.

[**P4**] **Huang, D.**, Tang, Y., & Qin, R. (2022). "An Evaluation of PlanetScope Images for 3D Reconstruction and Change Detection–Experimental Validations with Case Studies". *GIScience & Remote Sensing*.

[**P5**] **Huang, D.**, Qin, R. (under review). "Uncertainty Quantification Framework for Aerial and UAV Photogrammetry through Error Propagation". *ISPRS Journal of Photogrammetry and Remote Sensing*. **(IF:12.2)**.

Certifications & Media Coverage

- FAA-certified Remote Pilot; survey missions totaling 73.4 hectares and 47.8 km of flight path since 2021.
- Research (**P4**) featured in Ohio State News: *"Using satellite data to help direct response to natural disasters"*.