

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
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- 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
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- 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, P6**).

Walk-through Rendering from Images of Varying Altitude – IARPA	08/2023–08/2025
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- Secured the leading position among 6 teams from over 20 universities and companies.
- Overcame the challenge of 3D reconstruction from heterogeneous data by integrating conventional SfM and deep learning-based feature matching methods. (outcomes: **P2**).

Enabling Seamless 3D Semantic Reconstruction from Heterogeneous Data at Scale – ONR	01/2021–02/2025
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- Developed SfM algorithms and introduced novel geometric constraints in bundle adjustment for multi-camera systems, enhancing accuracy by up to 86%. (outcomes: **S1, H2, P3**).
- Conducted the first study in the literature to assess PlanetScope satellite imagery for 3D reconstruction and change detection. (outcomes: **P5**).

Software and System Development

[H1] Hardware: Waterproof Stereo Camera System with Synchronized Shutter	2025
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- Developed the first fully synchronized stereo camera system for underwater coral reef imaging.
- Captured stereo image pairs to enable precise 3D reconstruction and measurement of coral morphologies, supporting creation of underwater 3D assets and benchmarks.

[S1] Software: MetricSfM C++, OpenMP, CUDA, Ceres, Eigen	2024
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- 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.
- Integrated multiple pose solvers (**P2**), geometric constraints (**P3**), and robust georeferencing.

[S2] Software: Uncertainty Quantification Framework C++, Python, Eigen, LASlib	2024
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- Implemented uncertainty estimation for multi-view stereo (**P6**).
- Enabled storage of point-cloud error covariance matrices compliant with the Generic Point-Cloud Model standard from the National Geospatial-Intelligence Agency.

[H2] Hardware: Low-cost Multi-camera Mobile Mapping Systems	2022
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- Developed a low-cost, multi-camera ground mapping system using arbitrarily positioned GoPro cameras.
- Incorporated geometric constraints (**P3**) for multi-camera self-calibration in MetricSfM (**S1**), achieving robust 3D reconstruction while reducing equipment costs, enabling accessible 3D data collection for non-experts.

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. (2025). "Revisiting Minimal Solver of Camera Triplets for Incremental Structure-from-Motion". *WACV Workshop*.
- [P3] **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**).
- [P4] 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**).
- [P5] **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*.
- [P6] **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, Awards, and Media Coverage

- FAA-certified Remote Pilot; survey missions totaling 73.4 hectares and 47.8 km of flight path since 2021.
- Outstanding Reviewer, *British Machine Vision Conference (BMVC)*, 2024.
- Research (**P5**) featured in Ohio State News: "*Using satellite data to help direct response to natural disasters*".