Chuchu Chen

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Research Interests

My research focuses on reliable robotic perception and state estimation for physical-world autonomy and extended reality (XR). I develop probabilistic sensing, nonlinear estimation and optimization, multi-sensor fusion and calibration, and uncertainty-aware real-time perception methods that enable robots and intelligent devices to understand their surroundings, reason under uncertainty, and navigate safely and efficiently in unknown environments.

Education & Training

2025 **Ph.D., Mechanical Engineering**, University of Delaware, Newark, DE
Advisor: Dr. Guoquan (Paul) Huang
2025 **M.S., Computer & Information Sciences**, University of Delaware, Newark, DE
2017 **B.S., Mechanical Engineering**, Harbin Engineering University, Harbin, China

Appointments & Positions

2025–now **Assistant Professor**, George Washington University (GWU), Washington, DC
Department of Mechanical & Aerospace Engineering
Research Lab: Estimation, Perception, and Intelligent Computing **(EPIC) Lab**
Website: chuchuchen.net/epic-lab GitHub: github.com/epic-lab-gwu
2020–2025 **Research Assistant**, University of Delaware, Newark, DE
2019–2020 **Teaching Assistant**, University of Delaware, Newark, DE

Teaching

Course page: chuchuchen.net/teaching-1

2026S **MAE 6245**: Robotics Systems
2025F **MAE 4182**: Electromechanical Control System Design
2024S UD MEEG 877: Perception and Estimation (PnE) for Robotics (TA)
2020/23S UD MEEG 677: Estimation I (TA)
2019F UD MEEG 311: Vibration and Control (TA)

Advising

Ph.D. Students

2026–now **Yifu (Joseph) Tian**, MAE Ph.D. student, GWU.
2026–now **Ruijie (Nerako) Li**, MAE Ph.D. student, GWU.

Master's Students

2026–now **Zhentao Fan**, CS M.S. student, GWU.

Undergraduate Researchers

2025–now **Matthew Chapin**, ME undergraduate researcher, GWU: plane-aware online 3D Gaussian splatting.
2026–now **Lucas Tovar-Gaytan**, MAE undergraduate researcher, GWU.
2026–now **William Wang**, MAE undergraduate researcher, GWU.

Graduate Research Mentoring

2025–now **Yizhi Zhou**, CS graduate researcher, GMU: plane-aided state estimation.
2025–now **Jie Fu**, CS graduate researcher, William & Mary: foundation models for legged robots.

Prior Mentoring at UD

2024 **Jeremy Hsu**, HS intern: 2D LiDAR SLAM. Green Lemons: Pennsylvania FTC State Championship.
2024 **Wenxuan (Owen) Li**, UD Robotics M.S.: sensor calibration.
2023 **Jonas Ho**, UPenn ME B.S.: micro aerial vehicles.

Awards & Honors

2024 **WAFR Travel Grant**
2024 **Best Paper Award Finalist (Robot Vision)**, International Conference on Robotics and Automation (ICRA)
2024 **University of Delaware Doctoral Fellowship for Excellence**
University-wide doctoral fellowship recognizing research excellence.
2023 **Best Student Paper Award Finalist**, Robotics: Science and Systems (RSS)

Publications

Complete list: Google Scholar | website | ORCID: 0000-0001-6903-6405

Book Chapters

[B1] **C. Chen**‡, Y. Peng‡, and G. Huang, Visual-Inertial State Estimation with Decoupled Error and State Representations, in *Algorithmic Foundations of Robotics XVI*, Volume 2, Springer Proceedings in Advanced Robotics, N. Amato, K. Driggs-Campbell, C. Ekenna, M. Morales, and J. O'Kane (Eds.), Springer, 2026.
Link: link.springer.com/book/9783032099693

Journal Articles

[J7] Y. Peng, **C. Chen**, and G. Huang, $\sqrt{\text{VINS}}$: Robust and Ultrafast Square-Root Filter-based 3D Motion Tracking, IEEE Transactions on Robotics (TRO), 2025. doi: 10.1109/TRO.2025.3626607.

[J6] **C. Chen**, Y. Peng, and G. Huang, FEJ++: Extended FEJ-based Design Rules for Visual-Inertial Navigation, International Journal of Robotics Research (IJRR), 2025 [under revision].

[J4] N. Merrill, P. Geneva, S. Katragadda, **C. Chen**, and G. Huang, Fast and Robust Learned Depth-aided Monocular Visual-Inertial Initialization, International Journal of Robotics Research (IJRR), 2024. doi: 10.1177/02783649241262452.

[J3] W. Lee, P. Geneva, **C. Chen**, and G. Huang, MINS: Efficient and Robust Multisensor-aided Inertial Navigation System, Journal of Field Robotics (JFR), 2025. doi: 10.1002/rob.22546.

[J2] C. Wei*, **C. Chen***, and H. G. Tanner, Navigation Functions with Moving Destinations and Obstacles, Autonomous Robots, 2023. doi: 10.1007/s10514-023-10088-7.

[J1] Y. Yang, **C. Chen**, W. Lee, and G. Huang, Decoupled Right Invariant Error States for Consistent Visual-Inertial Navigation, IEEE Robotics and Automation Letters (R-AL), 2022. doi: 10.1109/LRA.2021.3140054.

Conference Papers

[C21] S. Zhou, Y. Peng, Y. Du, M. Chapin, **C. Chen**, and G. Huang, Rapid Monocular Plane Reconstruction and Rendering, under review at the IEEE International Symposium on Mixed and Augmented Reality (ISMAR), 2026.

[C20] Y. Peng, **C. Chen**, T. Ke, R. DuToit, S. Yamazaki, H. Guo, and G. Huang, miniVIO: A Minimalist Visual-Inertial Odometry Algorithm with Implicit Motion Constraints, under review at the International Conference on Intelligent Robots and Systems (IROS), 2026.

[C19] Y. Liang, Y. Peng, G. Huang, W. Cao, and **C. Chen**, ORBCam: Toward Ultra-Low-Power Quantized VIO via In-Sensor ORB Feature Processing, under review at the International Conference on Intelligent Robots and Systems (IROS), 2026.

[C18] Y. Du, **C. Chen**, Z. Sha, and G. Huang, VINS3R: Online Visual-Inertial Navigation and 3D Reconstruction, under review at the International Conference on Intelligent Robots and Systems (IROS), 2026.

[C17] Y. Zhou, X. Wang, and **C. Chen**, Analysis of Optimization-Based Monocular Point–Plane VINS: Formulation, Information, and Marginalization, under review at the International Conference on Intelligent Robots and Systems (IROS), 2026.

[C16] **C. Chen**, Y. Peng, and G. Huang, Is Iteration Worth It? Revisit Its Impact in Sliding-Window VIO, International Conference on Robotics and Automation (ICRA), 2025. doi: 10.1109/ICRA55743.2025.11127352.

[C15] Y. Peng*, **C. Chen**, and G. Huang, QVIO2: Quantized MAP-based Visual-Inertial Odometry, International Conference on Robotics and Automation (ICRA), 2025. doi: 10.1109/ICRA55743.2025.11127636.

[C14] **C. Chen***, Y. Peng*, and G. Huang, Visual-Inertial State Estimation with Decoupled Error and State Representations, International Workshop on the Algorithmic Foundations of Robotics (WAFR), 2024.

[C13] **C. Chen**, Y. Peng, and G. Huang, Fast and Consistent Covariance Recovery for Sliding-window Optimization-based VINS, International Conference on Robotics and Automation (ICRA), 2024. doi: 10.1109/ICRA57147.2024.10610360.

[C12] Y. Peng, **C. Chen**, and G. Huang, Ultrafast Square-Root Filter-based VINS, International Conference on Robotics and Automation (ICRA), 2024. **Best Paper Award Finalist (Robot Vision)**. doi: 10.1109/ICRA57147.2024.10610916.

[C11] Y. Peng, **C. Chen**, and G. Huang, Quantized Visual-Inertial Odometry, International Conference on Robotics and Automation (ICRA), 2024. doi: 10.1109/ICRA57147.2024.10610513.

[C10] W. Lee, **C. Chen**, and G. Huang, Degenerate Motions of Multisensor Fusion-based Navigation, International Conference on Robotics and Automation (ICRA), 2024. doi: 10.1109/ICRA57147.2024.10610255.

[C9] S. Katragadda, W. Lee, Y. Peng, P. Geneva, **C. Chen**, C. Guo, M. Li, and G. Huang, NeRF-VINS: A Real-time Neural Radiance Field Map-based Visual-Inertial Navigation System, International Conference on Robotics and Automation (ICRA), 2024. doi: 10.1109/ICRA57147.2024.10610051.

[C8] **C. Chen**, P. Geneva, Y. Peng, W. Lee, and G. Huang, Optimization-based VINS: Consistency, Marginalization, and FEJ, International Conference on Intelligent Robots and Systems (IROS), 2023. doi: 10.1109/IROS55552.2023.10341637.

[C7] N. Merrill, P. Geneva, S. Katragadda, **C. Chen**, and G. Huang, Fast Monocular Visual-Inertial Initialization Leveraging Learned Single-View Depth, Robotics: Science and Systems (RSS), 2023. **Best Student Paper Award Finalist**.

[C6] **C. Chen***, P. Geneva*, Y. Peng, W. Lee, and G. Huang, Monocular Visual-Inertial Odometry with Planar Regularities, International Conference on Robotics and Automation (ICRA), 2023. doi: 10.1109/ICRA48891.2023.10160620.

[C5] **C. Chen**, Y. Yang, P. Geneva, W. Lee, and G. Huang, Visual-Inertial-Aided Online MAV System Identification, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2022. doi: 10.1109/IROS47612.2022.9982263.

[C4] **C. Chen**, Y. Yang, P. Geneva, and G. Huang, FEJ2: A Consistent Visual-Inertial State Estimator Design, International Conference on Robotics and Automation (ICRA), 2022. doi: 10.1109/ICRA46639.2022.9811831.

[C3] **C. Chen**, L. Li, and H. G. Tanner, Navigation Functions with non-Point Destinations and Moving Obstacles, American Control Conference (ACC), 2020. doi: 10.23919/ACC45564.2020.9147243.

[C2] P. Geneva*, N. Merrill*, Y. Yang, **C. Chen**, W. Lee, and G. Huang, Versatile 3D Multi-Sensor Fusion for Lightweight 2D Localization, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020. doi: 10.1109/IROS45743.2020.9341264.

[C1] Y. Yang, B. P. W. Babu, **C. Chen**, G. Huang, and L. Ren, Analytic Combined IMU Integration (ACI^2) for Visual-Inertial Navigation, International Conference on Robotics and Automation (ICRA), 2020. doi: 10.1109/ICRA40945.2020.9197280.

Workshop Papers

[W1] Y. Liang, Y. Peng, G. Huang, W. Cao, and **C. Chen**, ORBCam: Toward Ultra-Low-Power Quantized VIO via In-Sensor ORB Feature Processing, under review at the CVPR 2026 Workshop on On-Sensor Vision. [website]

Open Source

[O4] $\sqrt{\text{VINS}}$**:** Robust and Ultrafast Square-Root Filter-based 3D Motion Tracking [ICRA 2024, TRO 2025].
GitHub: github.com/rpng/sqrtVINS

[O3] **MINS:** Efficient and Robust Multisensor-aided Inertial Navigation System [JFR].
GitHub: github.com/rpng/MINS

[O2] **ov_plane:** Monocular Visual-Inertial Odometry with Planar Regularities [ICRA 2023].
GitHub: github.com/rpng/ov_plane

[O1] **RPNG AR Table Dataset:** Indoor AR Table Visual-Inertial Datasets [ICRA 2023].
GitHub: github.com/rpng/ar_table_dataset

Dissertations

2025 **Chuchu Chen**, *Rethinking the Foundations of Visual-Inertial State Estimation*, Ph.D. Dissertation, University of Delaware. Advisor: Guoquan (Paul) Huang.

Technical Reports

[T11] **C. Chen**, Y. Peng, and G. Huang, Is Iteration Worth It? Revisit Its Impact in Sliding-Window VIO [to appear].

[T10] **C. Chen**, Y. Peng, and G. Huang, Supplementary Materials: Visual-Inertial State Estimation with Decoupled Error and State Representations [to appear].

[T9] **C. Chen**, Y. Peng, and G. Huang, Technical Report: Fast and Consistent Covariance Recovery for Sliding-window Optimization-based VINS. [PDF]

[T8] Y. Peng, **C. Chen**, and G. Huang, Ultrafast Square-Root Filter-based VINS. [PDF]

[T7] W. Lee, **C. Chen**, and G. Huang, Technical Report: Degenerate Motions of Multisensor Fusion-based Navigation. [PDF]

[T6] N. Merrill, P. Geneva, S. Katragadda, **C. Chen**, and G. Huang, Supplementary Materials: Fast Monocular Visual-Inertial Initialization Leveraging Learned Single-View Depth. [PDF]

[T5] **C. Chen**, Y. Yang, W. Lee, P. Geneva, and G. Huang, Supplementary Materials: Visual-Inertial-aided Online MAV System Identification. [PDF]

[T4] **C. Chen**, Y. Yang, P. Geneva, and G. Huang, Technical Report: FEJ2: A Consistent Visual-Inertial State Estimator Design. [PDF]

[T3] Y. Yang, **C. Chen**, W. Lee, and G. Huang, Supplementary Materials: Decoupled Right Invariant Error States for Consistent Visual-Inertial Navigation. [PDF]

[T2] Y. Yang, **C. Chen**, and G. Huang, Supplementary Materials: Analytic Combined IMU Integration (ACI^2) for Visual-Inertial Navigation. [PDF]

[T1] W. Lee, K. Eckenhoff, Y. Yang, P. Geneva, **C. Chen**, and G. Huang, Visual-Inertial-Wheel Odometry with Online Calibration. [PDF]

Presentations & Talks

[P19] Reliable and Efficient Visual-Inertial Estimation and Spatial Perception, UW CSE Robotics Colloquium, University of Washington, April 17, 2026

[P18] Toward Reliable and Deployable Intelligent Robots, UDC CAM-STAR Guest Lecture, April 2026

[P17] Reliable and Efficient Visual-Inertial Estimation and Spatial Perception, Department of Electrical and Computer Engineering, GWU, March 2026

[P16] Is Iteration Worth It? Revisit Its Impact in Sliding-Window VIO, International Conference on Robotics and Automation (ICRA), Atlanta, GA, May 2025

[P15] Consistent and Efficient Visual-Inertial State Estimation and Perception, The George Washington University (GWU), April 2025

[P14] Consistent and Efficient Visual-Inertial State Estimation and Perception, New York University, April 2025

[P13] Consistent and Efficient Visual-Inertial State Estimation and Perception, Florida Institute of Technology, March 2025

[P12] Consistent and Efficient Visual-Inertial State Estimation and Perception, Dartmouth College, March 2025

[P11] Consistent and Efficient Visual-Inertial State Estimation and Perception, Stanford University, March 2025

[P10] Consistent and Efficient Visual-Inertial State Estimation and Perception, University of Pennsylvania, November 2024

[P9] Consistent and Efficient Visual-Inertial State Estimation and Perception, West Virginia University, October 2024

[P8] Consistent and Efficient Visual-Inertial State Estimation and Perception, University of Delaware, October 2024

[P7] Visual-Inertial State Estimation with Decoupled Error and State Representations, International Workshop on the Algorithmic Foundations of Robotics (WAFR), September 2024

[P6] Fast and Consistent Covariance Recovery for Sliding-window Optimization-based VINS, International Conference on Robotics and Automation (ICRA), May 2024

[P5] Optimization-based VINS: Consistency, Marginalization, and FEJ, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Detroit, MI, USA, October 2023

[P4] Monocular Visual-Inertial Odometry with Planar Regularities, International Conference on Robotics and Automation (ICRA), May 2023

[P3] Visual-Inertial-Aided Online MAV System Identification, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), October 2022

[P2] FEJ2: A Consistent Visual-Inertial State Estimator Design, International Conference on Robotics and Automation (ICRA), Philadelphia, PA, USA, May 2022

[P1] Navigation Functions with non-Point Destinations and Moving Obstacles, July 2020

Professional Service

Program Chair and Organizer

2026 **Physical Intelligence: Systems and Applications (PISA)**, Chair, Detroit, MI, May 6, 2026. [website]

2025 **Physical Intelligence Initiative (PI^2) Workshop**, Co-organizer. [website]

Associate Editor

2025–now IEEE Robotics and Automation Letters (RA-L)

2025–now ICRA, IEEE International Conference on Robotics and Automation

Journal Reviewer

TR-O, IEEE Transactions on Robotics
RA-L, IEEE Robotics and Automation Letters
TIM, IEEE Transactions on Instrumentation & Measurement

Conference Reviewer

ICRA, IEEE International Conference on Robotics and Automation
IROS, IEEE/RSJ International Conference on Intelligent Robots and Systems
MED, Mediterranean Conference on Control and Automation

Professional Membership

IEEE; IEEE Robotics and Automation Society; IEEE Control Systems Society

University Service

2026 Member, MAE AI Inventory – Research Working Group (SEAS AI@GW Initiative)

2025–now Member, Laboratory Committee (Undergraduate Teaching Labs), Department of Mechanical & Aerospace Engineering

Ph.D. Thesis Committee

Yizhi Zhou, GMU Ph.D. (advisor: Xuan Wang).
Beomyeol (Ben) Yu, GWU Ph.D. (advisor: Taeyoung Lee).

References

Available upon request