Weisong Wen, Member of IEEE, Member of ION
Intelligent Positioning and Navigation Laboratory
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Web, Google Scholar, LinkedIn, ORCID, GitHub, Zhihu
Research Interest: Autonomous Driving, Mapping, and Localization, Robotics

Education:

- Ph.D. in Mechanical Engineering, The Hong Kong Polytechnic University, Hong Kong, China — 2020
- Visiting Ph.D. in Mechanical Engineering, University of California, Berkeley, U.S — 2018
- M.Sc.in Mechanical Engineering, China Agricultural University, China — 2017
- B.Sc. in Mechanical Engineering, Beijing Information Science and Technology University, China — 2015

Selected Awards and Fellowships:

- TechConnect World Innovation Conference and Expo, Innovation Award, U.S. — 2021
- Best Presentation Award, ION GNSS+ 2020, U.S. — 2020
- First Prize in Hong Kong Section in Qianhai-Guangdong-Macao Youth Innovation and Entrepreneurship Competition, Shenzhen, China. — 2020
- Excellent Project Award in Songshan Lake Innovation and Entrepreneurship Competition, Dongguan, Guangdong, China. — 2018
- National Scholarship for Graduate Students, Beijing, China — 2016
- Excellent Graduate of Beijing, China. — 2015
- China Telecom Scholarship. (Only One Candidate per University) — 2014

Selected Working Experience:

The Hong Kong Polytechnic University, Hong Kong
Apr 2021 – Present, Research Assistant Professor, Aviation and Aeronautical Engineering
Jan 2021 – Apr 2021, Senior Research Fellow, AAE

Idriverplus (Autonomous Driving Startups), Beijing, China
2016 – 2017, Research Algorithm Engineer with the autonomous driving research group

Institute of Automation, Chinese Academy of Sciences, Beijing, China
2014 – 2015, Research Assistant with the autonomous driving research group

Selected Professional Service:

Session Chair, *ION GNSS+ 2022* (to be held), Special Session: ALTERNATIVE TECHNOLOGIES FOR GNSS-DENIED ENVIRONMENTS, Colorado, U.S.
Workshop Leading Chair, *IEEE ITSC 2022* (to be held), Workshop: intelligent Vehicle Meets Urban: Safe and Certifiable Navigation and Control for Intelligent Vehicles in Complex Urban Scenarios, Macau, China.
Session Chair, *ICGNC 2022* (to be held), Special Session: Intelligent Navigation and Advanced Information Fusion Technology, Harbin, China.
Leading Guest Editor in *Frontiers in Robotics and AI*, Navigation, Perception, Control for Unmanned Autonomous Systems in Dynamic Urban Scenarios, 2021.
Leading Guest Editor in *Electronics*, Advanced Integrated Navigation Methods, 2022.
Young Editorial Board Member in *Journal of Marine Science and Application*. (2021~)
Editorial Board Member in *The Open Transportation Journal*. (2022~)
Regular reviewer in *IEEE Transactions on Intelligent Transportation System* (2017~), *IEEE Intelligent Transportation Systems Magazine* (2017~), *IEEE Sensors Journal* (2018~), *IEEE*

Transactions on Vehicular Technology (2017~). *IEEE International Conference on Robotics and Automation* (2019, 2020, 2021), *IEEE International Conference on Intelligent Robots and Systems* (2019, 2020, 2021).

Selected Invited Talks:

- Navigation Research group in Wuhan University, Wuhan, China. 2020
- Riemann Laboratory, Huawei Technologies, Dongguan, China 2020
- Shenzhen Institutes of Advanced Technology, Chinese Academic of Sciences, China. 2019
- Mechanical System Control (MSC) Lab, University of California, Berkeley, CA, U.S. 2018
- Autonomous Driving Research Groups in Baidu.inc, Jingchi. inc, Deepmap.ai, CA, U.S. 2018

Selected Research Grants (Past 5 Years):

- **PI**, Natural Science Foundation of Guangdong, *Research on 3D LiDAR Aided Urban GNSS Positioning Algorithm* (Project amount: RMB$100,000; Project period: Oct 1, 2021–Sept 30, 2024; Status: On-going)
- **PI**, Huawei Technologies, *Huawei-PolyU High-accuracy Localization Project (second phase)* (Project amount: HK$2,150,000; Project period: Aug 27, 2021–Aug 28, 2022; Status: On-going)
- **PI**, PolyU AAE Startup Fund, *Gaussian Mixture Models for GNSS Error Noise Characterization in Urban Canyons for Autonomous Systems* (Project amount: HK$50,000; Project period: Apr 26, 2021–Apr 25, 2023; Status: On-going)
- **PI**, PolyU Startup Fund, *Resilient GNSS Positioning for Autonomous Aerial Vehicle in Urban Scenarios* (Project amount: HK$200,000; Project period: Apr 26, 2021–Apr 25, 2023; Status: On-going)
- **Co-PI**, Huawei Technologies, *Factor Graph Optimization for GNSS Positioning* (Project amount: HK$1,260,000; Project period: Apr 20, 2021– Feb 20, 2022; Status: On-going)

Selected Representative Journal Publications (Past 5 Years):

1. **Wen, W**., and Hsu, L.T., 2021. 3D LiDAR Aided GNSS NLOS Mitigation in Urban Canyons. *IEEE transactions on intelligent transportation systems*. [***Accepted***] (Paper, Video)
2. Bai, X., **Wen, W**.* and Hsu, L.T., 2021. Time-correlated Window Carrier-phase Aided GNSS Positioning in Urban Canyons, *IEEE Transactions on Aerospace and Electronic Systems*. (Paper)
3. Bai, X., **Wen, W**. and Hsu, L.T., 2021. Degeneration-Aware Outlier Mitigation for Visual Inertial Integrated Navigation System in Urban Canyons. *IEEE Transactions on Instrumentation and Measurement*, 70, pp.1-15. (Paper)
4. **Wen, W.**, Zhang, G. and Hsu, L.T., 2021. Gnss outlier mitigation via graduated non-convexity factor graph optimization. *IEEE Transactions on Vehicular Technology*, 71(1), pp.297-310. (Paper)
5. Yue, J., **Wen, W**. *, Han, J. and Hsu, L.T., 2021. 3D Point Clouds Data Super Resolution-Aided LiDAR Odometry for Vehicular Positioning in Urban Canyons. *IEEE Transactions on Vehicular Technology*, 70(5), pp.4098-4112. (Paper)
6. **Wen, W**., Pfeifer, T., Bai, X. and Hsu, L.T., 2021. Factor graph optimization for GNSS/INS integration: A comparison with the extended Kalman filter. *NAVIGATION, Journal of the Institute of Navigation*, 68(2), pp.315-331. (Paper, Video)
7. **Wen, W**., and Hsu, L.T., 2021. AGPC-SLAM: Absolute Ground Plane Constrained 3D LiDAR SLAM. *NAVIGATION, Journal of the Institute of Navigation*. [***Accepted***] (Paper, Video)
8. Huang, F., **Wen, W**., Zhang, J. and Hsu, L.T., 2021. Point-wise or Feature-wise? Benchmark Comparison of Public Available LiDAR Odometry Algorithms in Urban

Canyons. *IEEE Intelligent Transportation Systems Magazine*. [***Accepted***] (Paper)

9. Zhang, J., **Wen, W. ***, Huang, F., Chen, X. and Hsu, L.T., 2021. Coarse-to-Fine Loosely-Coupled LiDAR-Inertial Odometry for Urban Positioning and Mapping. *Remote Sensing*, 13(12), p.2371. (Paper)
10. Bai, X., **Wen, W**. and Hsu, L.T., 2020. Robust visual-inertial integrated navigation system aided by online sensor model adaption for autonomous ground vehicles in urban areas. *Remote Sensing*, 12(10), p.1686. (Paper)
11. **Wen, W**., Bai, X., Zhang, G., Chen, S., Yuan, F. and Hsu, L.T., 2020. Multi-agent collaborative GNSS/camera/INS integration aided by inter-ranging for vehicular navigation in urban areas. *IEEE Access*, 8, pp.124323-124338. (Paper)
12. Zhang, G., Ng, H.F., **Wen, W**. and Hsu, L.T., 2020. 3D mapping database aided GNSS based collaborative positioning using factor graph optimization. *IEEE Transactions on Intelligent Transportation Systems*. (Paper)
13. Zhang, G., **Wen, W**., Xu, B. and Hsu, L.T., 2020. Extending shadow matching to tightly-coupled GNSS/INS integration system. *IEEE Transactions on Vehicular Technology*, 69(5), pp.4979-4991. (Paper)
14. **Wen, W**., Zhang, G. and Hsu, L.T., 2020. Object-Detection-Aided GNSS and Its Integration With Lidar in Highly Urbanized Areas. *IEEE Intelligent Transportation Systems Magazine*, 12(3), pp.53-69. (Paper)
15. Bai, X., **Wen, W. *** and Hsu, L.T., 2020. Using Sky-pointing fish-eye camera and LiDAR to aid GNSS single-point positioning in urban canyons. *IET Intelligent Transport Systems*, 14(8), pp.908-914. (Paper)
16. **Wen, W**., Bai, X., Kan, Y.C. and Hsu, L.T., 2019. Tightly coupled GNSS/INS integration via factor graph and aided by fish-eye camera. *IEEE Transactions on Vehicular Technology*, 68(11), pp.10651-10662. (Paper)
17. **Wen, W**., Zhang, G. and Hsu, L.T., 2019. GNSS NLOS exclusion based on dynamic object detection using LiDAR point cloud. *IEEE transactions on intelligent transportation systems*. (Paper)
18. **Wen, W**., Zhang, G. and Hsu, L.T., 2019. Correcting NLOS by 3D LiDAR and building height to improve GNSS single point positioning. *Navigation*, 66(4), pp.705-718. (Paper)
19. Zhang, G., **Wen, W**. and Hsu, L.T., 2019. Rectification of GNSS-based collaborative positioning using 3D building models in urban areas. *GPS solutions*, 23(3), pp.1-12. (Paper)
20. **Wen, W**., Hsu, L.T. and Zhang, G., 2018. Performance analysis of NDT-based graph SLAM for autonomous vehicle in diverse typical driving scenarios of Hong Kong. *Sensors*, 18(11), p.3928. (Paper)
21. **Wen, W**., Bai, X., Zhan, W., Tomizuka, M. and Hsu, L.T., 2019. Uncertainty estimation of LiDAR matching aided by dynamic vehicle detection and high definition map. *Electronics letters*, 55(6), pp.348-349. (Paper)

Journal Publications In Submission or Under Revision:

1. **Wen, W**.*, Bai, X., and Hsu, L.T., 2021. 3D Vision Aided GNSS Real-time Kinematic Positioning for Autonomous Systems in Urban Canyons, *IEEE transactions on intelligent transportation systems*. [*In Submission*]
2. Li, X., Li, S., Shen, Z., Zhou, Y., Wang, X., Li, X., and **Wen, W**., 2021. Continuous and precise positioning in urban environments by tightly coupled integration of GNSS, INS, and Vision, *Journal of Geodesy*. [*In Submission*]
3. Zhang, J., **Wen, W. ***, Huang, F., Wang, Y., Chen, X. and Hsu, L.T., 2021. GNSS-RTK Adaptively Integrated with LiDAR/IMU Odometry for Continuously Global Positioning in Urban Canyons. *Remote Sensing*. [*In Submission*]
4. Zhong, Y., Huang, F., Zhang, J., **Wen, W. *** and Hsu, L.T., 2021. Low-cost Solid-state

LiDAR/Inertial Based Localization with Prior Map for Autonomous Systems in Urban Scenarios. *IET Intelligent Transport Systems*. [*In Submission*]

5. Hsu, L.T*, Cheng, M., **Wen, W**., Li, B., and Wen, C., 2021. Using GitHub as a Supplementary Educational Tool to Improve Problem-solving and Learning-to-learn Attributes, *IEEE transactions education*. [*In Submission*]

Selected Representative Conference Publications (Past 5 Years):

1. **Wen, W**. and Hsu, L.T., 2021, September. 3D LiDAR Aided GNSS Real-time Kinematic Positioning. In *Proceedings of the 34th International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2021)* (pp. 2212-2220). (Paper, Video)
2. **Wen, W**., Meng, Q. and Hsu, L.T., 2021, September. Integrity Monitoring for GNSS Positioning Via Factor Graph Optimization in Urban Canyons. In *Proceedings of the 34th International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2021)* (pp. 1508-1515). (Paper, Video)
3. Zhang, J., **Wen, W**., Huang, F., Chen, X. and Hsu, L.T., 2021, September. Continuous GNSS-RTK Aided by LiDAR/Inertial Odometry with Intelligent GNSS Selection in Urban Canyons. In *Proceedings of the 34th International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2021)* (pp. 4198-4207). (Paper)
4. Huang, F., Shen, D., **Wen, W**., Zhang, J. and Hsu, L.T., 2021, September. A Coarse-to-Fine LiDAR-Based SLAM with Dynamic Object Removal in Dense Urban Areas. In *Proceedings of the 34th International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2021)* (pp. 3162-3172). (Paper, Video)
5. Ng, H.F., Zhang, G., **Wen, W**. and Hsu, L.T., 2021, September. 3D Mapping Aided GNSS Using Gauss-Newton Algorithm: An Example on GNSS Shadow Matching. In *Proceedings of the 34th International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2021)* (pp. 1954-1960). (Paper)
6. Hsu, L.T., Kubo, N., **Wen, W**., Chen, W., Liu, Z., Suzuki, T. and Meguro, J., 2021, September. UrbanNav: An open-sourced multisensory dataset for benchmarking positioning algorithms designed for urban areas. In *Proceedings of the 34th International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2021)* (pp. 226-256). (Paper)
7. **Wen, W**. and Hsu, L.T., 2021, May. Towards Robust GNSS Positioning and Real-time Kinematic Using Factor Graph Optimization. In 2021 *IEEE International Conference on Robotics and Automation (ICRA)*. IEEE. (Paper, Video, Code)
8. **Wen, W**., 2020, September. 3D LiDAR Aided GNSS and Its Tightly Coupled Integration with INS Via Factor Graph Optimization. In *Proceedings of the 33rd International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2020)* (pp. 1649-1672). (Paper, Video)
9. Fang, W., Li, H., Dang, S., Huang, H., Peng, L., Hsu, L.T. and **Wen, W**., 2019, December. Combining deep gaussian process and rule-based method for decision-making in self-driving simulation with small data. In 2019 15th *International Conference on Computational Intelligence and Security (CIS)* (pp. 267-271). IEEE. (Paper)
10. Bai, X., Zhang, B., **Wen, W**., Hsu, L.T. and Li, H., 2020, April. Perception-aided visual-inertial integrated positioning in dynamic urban areas. In 2020 *IEEE/ION Position, Location and Navigation Symposium (PLANS)* (pp. 1563-1571). IEEE. (Paper)

11. **Wen, W**., Bai, X., Hsu, L.T. and Pfeifer, T., 2020, April. GNSS/LiDAR integration aided by self-adaptive Gaussian mixture models in urban scenarios: An approach robust to non-Gaussian noise. In 2020 *IEEE/ION Position, Location and Navigation Symposium (PLANS)* (pp. 647-654). (Paper)
12. **Wen, W**., Zhou, Y., Zhang, G., Fahandezh-Saadi, S., Bai, X., Zhan, W., Tomizuka, M. and Hsu, L.T., 2020, May. Urbanloco: a full sensor suite dataset for mapping and localization in urban scenes. In 2020 *IEEE International Conference on Robotics and Automation (ICRA)* (pp. 2310-2316). IEEE. (Paper, Video, Code)
13. **Wen, W**., Kan, Y.C. and Hsu, L.T., 2019, September. Performance comparison of GNSS/INS integrations based on EKF and factor graph optimization. In *Proceedings of the 32nd International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2019)* (pp. 3019-3032). (Paper, Video)
14. Bai, X., **Wen, W**., Zhang, G. and Hsu, L.T., 2019, April. Real-time GNSS NLOS detection and correction aided by sky-pointing camera and 3D LiDAR. In *Proceedings of the ION 2019 Pacific PNT Meeting* (pp. 862-874). (Paper)
15. Zhang, G., **Wen, W**. and Hsu, L.T., 2018, September. Collaborative GNSS positioning with the aids of 3D city models. In *Proceedings of the 31st International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2018)* (pp. 143-149). (Paper)
16. **Wen, W**., Zhang, G. and Hsu, L.T., 2018, September. Correcting GNSS NLOS by 3D LiDAR and building height. In *Proceedings of the 31st International Technical Meeting of the Satellite Division of The Institute of Navigation (ION GNSS+ 2018)* (pp. 3156-3168). (Paper)
17. **Wen, W**., Zhang, G. and Hsu, L.T., 2018, April. Exclusion of GNSS NLOS receptions caused by dynamic objects in heavy traffic urban scenarios using real-time 3D point cloud: An approach without 3D maps. In 2018 *IEEE/ION Position, Location and Navigation Symposium (PLANS)* (pp. 158-165). IEEE. (Paper)
18. Zhang, G., **Wen, W**. and Hsu, L.T., 2018, April. A novel GNSS based V2V cooperative localization to exclude multipath effect using consistency checks. In 2018 *IEEE/ION Position, Location and Navigation Symposium (PLANS)* (pp. 1465-1472). (Paper)

Selected Open-sourced Code and Datasets to the Community

- **Wen, W**, et al, UrbanLoco: A Full Sensor Suite Dataset for Mapping and Localization in Urban Scenes, *ICRA 2020*, Paris, France. (*Collaborative with the team in UC Berkeley, **118 Stars in Github***)
- Hsu, L.T., Kubo, N., **Wen, W**., et al, 2021, September. UrbanNav: An open-sourced multisensory dataset for benchmarking positioning algorithms designed for urban areas., *ION GNSS+ 2021*, MO, U.S. (*Collaborative with the research group in Japan, **174 Stars in Github***)
- GraphGNSSLib: An Open-source Package for GNSS Positioning and Real-time Kinematic Using Factor Graph Optimization (*Accepted and presented in ICRA 2021, **215 Stars in Github***).