

WOOSIK LEE

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EDUCATION

University of Delaware Ph.D. candidate in Mechanical Engineering	<i>August 2017 – Present</i>
Korea University M. A. in Mechanical Engineering	<i>August 2015 – July 2017</i>
Korea University B. S. in Mechanical Engineering	<i>August 2009 – July 2015</i>

RESEARCH EXPERIENCE

Robot Perception and Navigation Group, University of Delaware *August 2017 – Present*
Research Assistant *Newark, DE*

- Robust navigation system with multi-sensor fusion
- Sensor calibration, system initialization, and observability analysis of the multi-sensor system
- System efficiency and consistency analysis

Intelligent Systems and Robotics Laboratory, Korea University *March 2015 - July 2017*
Research Assistant *Seoul, Korea*

- Experimental design of the GNSS sensor model for localization of autonomous vehicles in urban environment
- Transforming regular vehicles into vehicles capable of autonomous driving - through navigation system

Telerobotics and Control Laboratory, KAIST *May 2014 - August 2014*
Summer Internship *Daejeon, Korea*

- Distinguish human emotion through sensors and machine-learning

ACADEMIC SCHOLARSHIPS AND AWARDS

- **Summer Doctoral Fellowship:** University of Delaware 2018
- **Outstanding Graduate Student Scholarship:** Dr. Chung's Food Co., Ltd. 2015

OPEN SOURCE RESEARCH CODE

- **OpenVINS: An open source platform for visual-inertial navigation research**
 - Source repository: <http://www.openvins.com/>
 - Open-source modular on-manifold visual-inertial sliding window extended Kalman filter
 - Supports monocular and stereo, SLAM features, First-Estimates Jacobians, visual-inertial simulator, evaluate suite, camera intrinsic and extrinsic calibration and IMU-camera time offset.
 - Heavy documentation to support rapid development and research on top of the codebase and detailed derivations of implementation: <https://docs.openvins.com/>
- **iCalib: Inertial Aided Multi-Sensor Calibration**
 - Source repository: <https://github.com/rpng/icalib.github.io>
 - A holistic non-linear least squares (NLS) based multi-sensor calibration system.
 - Supports spatial-temporal parameter calibration of multiple sensors, including IMU, cameras, LiDAR and wheel encoders.

- [C10] **Lee, W.**, Geneva, P., Yang Y., Huang G., Tightly-coupled GNSS-aided Visual-Inertial Localization. In: Proc. of the IEEE International Conference on Robotics and Automation. Philadelphia, USA, 2022. (submitted)
- [C9] **Lee, W.**, Yang Y., Huang G., Efficient Multi-sensor Aided Inertial Navigation with Online Calibration. In: Proc. of the IEEE International Conference on Robotics and Automation. Xi'an, China, 2021.
- [C8] **Lee, W.**, Eckenhoff K., Yang Y., Geneva P., Huang G., Visual-Inertial-Wheel Odometry with Online Calibration. In: Proc. of the IEEE International Conference on Intelligent Robots and Systems. Las Vegas, USA, 2020.
- [C7] Geneva, P., Merrill, N., Yang, Y., Chen, C., **Lee, W.**, Huang, G., Versatile 3D Multi-Sensor Fusion for Lightweight 2D Localization. In: Proc. of the IEEE International Conference on Intelligent Robots and Systems. Las Vegas, USA, 2020.
- [C6] **Lee, W.**, Eckenhoff, K., Geneva, P., Huang, G., Intermittent GPS-aided VIO: Online Initialization and Calibration. In: Proc. of the IEEE International Conference on Robotics and Automation. Paris, France, 2020.
- [C5] Geneva, P., Eckenhoff, K., **Lee, W.**, Yang, Y., Huang, G., OpenVINS: A Research Platform for Visual-Inertial Estimation. In: Proc. of the IEEE International Conference on Robotics and Automation. Paris, France, 2020.
- [C4] Zuo, X., Geneva, P., **Lee, W.**, Liu, Y., Huang, G., LIC-Fusion: LiDAR-Inertial-Camera Odometry. IEEE/RSJ International Conference on Intelligent Robots and Systems, Macau, China, November 2019.
- [C3] **Lee, W.**, Chung, W., Position estimation using multiple low-cost GPS receivers for outdoor mobile robots. In 2015 12th International Conference on Ubiquitous Robots and Ambient Intelligence (pp. 460-461). IEEE.
- [C2] Jeon, J., **Lee, W.**, Cho, H. J., Lee, H., A big data system design to predict the vehicle slip. In 2015 15th International Conference on Control, Automation and Systems (pp. 592-596).
- [C1] Lee, H., **Lee, W.**, Kim, J., Jin, J., Kwon, H., Cha, D., Shin, Y., Moon, C., Chung, W., Drivable Road Region Detection and autonomous navigation of a Surveillance Robot in International Conference on Engineering and Applied Science, Hokkaido, Japan, June 2015.

[W] Workshop Papers

- [W2] Yang, Y., **Lee, W.**, Osteen, P., Geneva, P., Zuo, X., Huang, G. iCalib: Inertial Aided Multi-Sensor Calibration. In ICRA 2021 Workshop on Visual-Inertial Navigation Systems, Xi'an, China.
- [W1] Geneva, P., Eckenhoff, K., **Lee, W.**, Yang, Y., Huang, G. Openvins: A research platform for visual-inertial estimation. In IROS 2019 Workshop on Visual-Inertial Navigation: Challenges and Applications, Macau, China.

[R] Technical Reports

- [R4] Yang Y., Chen., C, **Lee, W.**, Huang G., Supplementary Materials: Decoupled Right Invariant Error States for Consistent Visual-Inertial Navigation. Tech. rep. RPNG-2021-DRI. University of Delaware, 2021.
- [R3] **Lee, W.**, Eckenhoff, K., Yang, Y., Geneva, P., Huang, G., Visual-Inertial-Wheel Odometry with Online Calibration. Tech. rep. RPNG-2020-VIWO. University of Delaware, 2020.

[R2] Geneva, P., Eckenhoff, K., **Lee, W.**, Yang, Y., Huang, G., OpenVINS Performance Evaluation on 2019 FPV Drone Racing VIO Dataset. IROS 2019 FPV Drone Racing VIO Competition, 2020.

[R1] **Lee, W.**, Eckenhoff, K., Geneva, P., Huang, G., GPS-aided Visual-Inertial Navigation in Large-scale Environments. Tech. rep. RPNG-2019-GPS. University of Delaware, 2019.

[T] **Invited Talks**

[T2] Visual-Inertial Navigation Systems: An Introduction, Motion2Ai, November, 2021

[T1] Global Positioning Systems: Introduction and Applications, Korea university, October, 2014

PATENTS

- Variable drive apparatus capable of traveling on the ground and flying in the air, Korea patent 10-1320464 (**Awarded by the Korean Intellectual Property Office in October 2013**)
- Method for measuring uncertainty of GNSS based localization, Korea patent 10-1921483
- Method for measuring uncertainty of GNSS based localization(pending), The Patent Cooperation Treaty