PATRICK F. GENEVA

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http://udel.edu/~pgeneva/
https://github.com/goldbattle/

EDUCATION

University of Delaware, Department of Computer Science May 2022 (expected)
Doctoral Degree in Computer Science
Research in Robotics and Computer Vision

University of Delaware, Department of Mechanical Engineering May 2017
Bachelor in Mechanical Engineering
Computer Science & Mathematics Minors

RESEARCH EXPERIENCE

University of Delaware - Dr. Guoquan Huang
Co-Advisor Dr. Christopher Rasmussen June 2017 - Present
Graduate Research Assistant *Newark, DE*

- Key study area in simultaneous localization and mapping (SLAM)
- Developing efficient localization algorithms for deployment on resource constrained devices.
- Exploring integration of machine learning with visual-inertial navigation systems (VINS)

University of Delaware - Dr. Guoquan Huang May 2015 - May 2017
Undergraduate Researcher *Newark, DE*

- Design and implement of visual-inertial navigation systems (VINS)
- Studied robotic 6 DoF localization and multi-session mapping.
- Worked with team to deliver localization system for autonomous vehicles

Jug Bay Wetlands Sanctuary - Dr. Patricia Delgado June 2014 - August 2014
Research Assistant *Lothian, MD*

- Assisted with representative sample collection for national climate change research
- Identified and recorded aquatic plant and biological species
- Collected data for ongoing state stream water chemical monitoring

WORK EXPERIENCE

Apple June 2020 - September 2020
Internship *(Remote) Cupertino, CA*

- Developed and improved state-of-the-art visual-inertial SLAM algorithms used in Apple products.
- Worked under supervision of Stergios Roumeliotis along with other team members to implement features within the codebase.

N3RDFUSION, Inc July 2015 - August 2017
Web Designer & Developer *(Remote) Seattle, WA*

- Designed and implemented a charity system, receiving $1.2M in total donations
- Integrated and coordinated with remote team and external sponsors
- Deployed and managed PHP-based system in a production environment (≈ 35k LOC)

Soartex Fanver / Invictus Graphics May 2012 - September 2015
Web Designer & Developer *(Remote) Global*

- Created a Minecraft modded texture system for applying texture patches
- Design and implemented a CMS, user system, and continuous integration build system

University of Delaware Student Centers September 2013 - July 2015
AV Technician *Newark, DE*

- Provided video-audio technical equipment support for the execution of events
- Coordinated with clients and resolved unforeseen problems during events

Jug Bay Wetlands Sanctuary June 2014 - August 2014
Web Designer & Developer *Lothian, MD*

- Co-lead for QR-code project developed to introduce an enhanced trail experience
- Design and developed a lightweight mobile website for serving visual-audio elements
- Created and edited training videos on both QR-code system and main website

OPEN SOURCE RESEARCH CODE

vicon2gt: Vicon-IMU fusion for groundtruth trajectory generation 2020

- Source repository: https://github.com/rpng/vicon2gt
- Utilities which fuses 6 DoF poses and inertial information to generate groundtruth trajectories for evaluating visual-inertial algorithms.
- Spacial-temporal calibration parameters between the two sensors is performed along with estimate of the motion capture world frame to gravity aligned.

OpenVINS: An open source platform for visual-inertial navigation research 2019

- Source repository: https://github.com/rpng/open_vins
- 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/

CPI: Closed-form Preintegration for Graph-based Visual-Inertial Navigation 2018

- Source repository: https://github.com/rpng/cpi
- Open-source IMU preintegration code from "Closed-form Preintegration Methods for Graph-based Visual-Inertial Navigation" published in the International Journal of Robotics Research.
- Contains a simulator to test existing discrete method to the proposed different preintegration models.

LIPS: LiDAR-Inertial 3D Plane Simulator 2018

- Source repository: https://github.com/rpng/lips
- Open-source LiDAR-inertial simulator from "LIPS: LiDAR-Inertial 3D Plane SLAM" published in the International Conference on Intelligent Robots and Systems..
- Contains simulator for generating LiDAR clouds and inertial measurements in an indoor enviroment.

HONORS AND AWARDS

- University Doctoral Fellowship Award
  University of Delaware 2021
- Delaware Space Grant (DESG) Graduate Fellowship
  NASA DE Space Grant/NASA DE EPSCoR 2019
- IROS 2019 FPV Drone Racing VIO Competition – 1st Place
  University of Zurich, Switzerland 2019
- Mary and George Nowinski Award for Excellence in Undergraduate Research
  University of Delaware 2017
- ASME Outstanding Senior Design Award - Team FSAE Chassis
  University of Delaware 2017
- University of Delaware Dean's List
  University of Delaware 2013 - 2017
- University of Delaware Scholar Scholarship
  University of Delaware 2013 - 2017
- Undergraduate Research Summer Scholars
  University of Delaware 2015 - 2016
- Eagle Scout
  Boy Scouts of America 2010

TECHNICAL STRENGTHS

Computer Languages	C++, Java, PHP, Python
Markups & APIs	HTML, CSS, JSON, REST, SQL
Data Processing	MATLAB, Microsoft Excel
Tools & Externals	Git, Github, Microsoft Office Products

RESEARCH PUBLICATIONS

Journal Papers

[J5] Eckenhoff, K., **Geneva, P.**, Huang, G., "MIMC-VINS: A Versatile and Resilient Multi-IMU Multi-Camera Visual-Inertial Navigation System". In: *IEEE Transactions on Robotics* (2020).

[J4] **Geneva, P.**, Zuo, X., Yang, Y., Ye, W., Liu, Y., Huang, G., "Visual-Inertial Localization with Prior LiDAR Map Constraints". In: *IEEE Robotics and Automation Letters (RA-L)* (2019).

[J3] Eckenhoff, K., Yang, Y., **Geneva, P.**, Huang, G., "Tightly-Coupled Visual-Inertial Localization and 3D Rigid-Body Target Tracking". In: *IEEE Robotics and Automation Letters (RA-L)* (Jan. 2019).

[J2] Yang, Y., **Geneva, P.**, Eckenhoff, K., Huang, G., "Degenerate Motion Analysis for Aided INS with Online Spatial and Temporal Calibration". In: *IEEE Robotics and Automation Letters (RA-L)* (Jan. 2019).

[J1] Eckenhoff, K., **Geneva, P.**, Huang, G., "Closed-form Preintegration Methods for Graph-based Visual-Inertial Navigation". In: *International Journal of Robotics Research* 38.5 (2019), pp. 563–586.

Conference Papers

[C19] **Geneva, P.**, Merrill, N., Huang, G., "Robust Monocular Visual-Inertial Depth Completion for Embedded Systems". In: *Proc. of the IEEE International Conference on Robotics and Automation*. Xi'an, China, 2021.

[C18] Yang, Y., **Geneva, P.**, Zuo, X., Huang, G., "Online IMU Intrinsic Calibration: Is It Necessary?" In: *Proc. of the Robotics: Science and Systems*. Paris, France, 2020.

[C17] **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/RSJ International Conference on Intelligent Robots and Systems*. Las Vegas, NV, 2020.

[C16] Zuo, X., Yang, Y., **Geneva, P.**, Lv, J., Liu, Y., Huang, G., Pollefeys, M., "LIC-Fusion 2.0: LiDAR-Inertial-Camera Odometry with Sliding-Window Plane-Feature Tracking". In: *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems*. Las Vegas, NV, 2020.

[C15] Lee, W., Eckenhoff, K., Yang, Y., **Geneva, P.**, Huang, G., "Visual-Inertial-Wheel Odometry with Online Calibration". In: *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems*. Las Vegas, NV, 2020.

[C14] **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. URL: `https://github.com/rpng/open_vins`.

[C13] Eckenhoff, K., **Geneva, P.**, Merrill, N., Huang, G., "Schmidt-EKF-based Visual-Inertial Moving Object Tracking". In: *Proc. of the IEEE International Conference on Robotics and Automation*. Paris, France, 2020.

[C12] 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.

[C11] Zuo, X., **Geneva, P.**, Lee, W., Liu, Y., Huang, G., "LIC-Fusion: LiDAR-Inertial-Camera Odometry". In: *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*. Macau, China, Nov. 2019.

[C10] Yang, Y., **Geneva, P.**, Eckenhoff, K., Huang, G., "Visual-Inertial Navigation with Point and Line Features". In: *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*. Macau, China, Nov. 2019.

[C9] **Geneva, P.**, Maley, J., Huang, G., "An Efficient Schmidt-EKF for 3D Visual-Inertial SLAM". In: *Proc. Conference on Computer Vision and Pattern Recognition (CVPR)*. Long Beach, CA, June 2019.

[C8] **Geneva, P.**, Eckenhoff, K., Huang, G., "A Linear-Complexity EKF for Visual-Inertial Navigation with Loop Closures". In: *Proc. International Conference on Robotics and Automation*. Montreal, Canada, May 2019.

[C7] Eckenhoff, K., **Geneva, P.**, Bloecker, J., Huang, G., "Multi-Camera Visual-Inertial Navigation with Online Intrinsic and Extrinsic Calibration". In: *Proc. International Conference on Robotics and Automation*. Montreal, Canada, May 2019.

[C6] Eckenhoff, K., **Geneva, P.**, Huang, G., "Sensor-Failure-Resilient Multi-IMU Visual-Inertial Navigation". In: *Proc. International Conference on Robotics and Automation*. Montreal, Canada, May 2019.

[C5] Yang, Y., **Geneva, P.**, Zuo, X., Eckenhoff, K., Liu, Y., Huang, G., "Tightly-Coupled Aided Inertial Navigation with Point and Plane Features". In: *Proc. International Conference on Robotics and Automation*. Montreal, Canada, May 2019.

[C4] **Geneva, P.**, Eckenhoff, K., Yang, Y., Huang, G., "LIPS: LiDAR-Inertial 3D Plane SLAM". In: *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*. Madrid, Spain, Oct. 2018.

[C3] **Geneva, P.**, Eckenhoff, K., Huang, G., "Asynchronous Multi-Sensor Fusion for 3D Mapping and Localization". In: *Proc. of the IEEE International Conference on Robotics and Automation*. Brisbane, Australia, May 2018.

[C2] Eckenhoff, K., **Geneva, P.**, Huang, G., "Dense Visual-Inertial Navigation with Analytical Preintegration". In: *Proc. of the IEEE International Conference on Robotics and Automation*. Singapore, May 2017.

[C1] Eckenhoff, K., **Geneva, P.**, Huang, G., "High-Accuracy Preintegration for Visual-Inertial Navigation". In: *Proc. of International Workshop on the Algorithmic Foundations of Robotics*. San Francisco, CA, Dec. 2016.

Workshop Papers

[W2] **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, Nov. 2019. URL: `https://github.com/rpng/open_vins`.

[W1] **Geneva, P.**, Eckenhoff, K., Huang, G., "Asynchronous Multi-Sensor Fusion for 3D Mapping and Localization". In: *Proc. of the 9th Workshop on Planning, Perception and Navigation for Intelligent Vehicles*. Vancouver, Canada, Sept. 2017.

Technical Reports

[R11] **Geneva, P.**, Huang, G., *vicon2gt: Derivations and Analysis*. Tech. rep. RPNG-2020-VICON2GT. Available: `http://udel.edu/~ghuang/papers/tr_vicon2gt.pdf`. University of Delaware, 2020.

[R10] **Geneva, P.**, Eckenhoff, K., Lee, W., Yang, Y., Huang, G., *OpenVINS Performance Evaluation on 2019 FPV Drone Racing VIO Dataset*. Tech. rep. IROS 2019 FPV Drone Racing VIO Competition. 2019.

[R9] Lee, W., Eckenhoff, K., **Geneva, P.**, Huang, G., *GPS-aided Visual-Inertial Navigation in Large-scale Environments*. Tech. rep. RPNG-2019-GPS. Available: `http://udel.edu/~ghuang/papers/tr_gps-vio.pdf`. University of Delaware, 2019.

[R8] **Geneva, P.**, Eckenhoff, K., Huang, G., *Complexity Analysis: A Linear-Complexity EKF for Visual-Inertial Navigation with Loop Closures*. Tech. rep. RPNG-2019-LOOP. Available: `http://udel.edu/~ghuang/papers/tr_loop.pdf`. University of Delaware, 2019.

[R7] Eckenhoff, K., **Geneva, P.**, Bloecker, J., Huang, G., *Measurement Jacobians for Multi-Camera Visual-Inertial Navigation*. Tech. rep. RPNG-2019-MC. Available: `http://udel.edu/~ghuang/papers/tr_mc-vins.pdf`. University of Delaware, 2019.

[R6] Yang, Y., Eckenhoff, K., **Geneva, P.**, Huang, G., *Observability Analysis for Tightly-Coupled Visual-Inertial Rigidbody Target Tracking*. Tech. rep. RPNG-2018-OBSTT. Available: `http://udel.edu/~yuyang/downloads/tr_target.pdf`. University of Delaware, 2018.

[R5] Yang, Y., **Geneva, P.**, Eckenhoff, K., Huang, G., *Degenerate Motion Analysis for Aided INS with Online Spatial and Temporal Calibration*. Tech. rep. RPNG-2018-CALIB. Available: `http://udel.edu/~yuyang/downloads/tr_calib.pdf`. University of Delaware, 2018.

[R4] Eckenhoff, K., **Geneva, P.**, Huang, G., *Continuous Preintegration Theory for Visual-Inertial Navigation*. Tech. rep. RPNG-2018-CPI. Available: `http://udel.edu/~ghuang/papers/tr_cpi.pdf`. University of Delaware, 2018.

[R3] **Geneva, P.**, Eckenhoff, K., Yang, Y., Huang, G., *LIPS: Lidar Inertial 3D Plane SLAM*. Tech. rep. RPNG-2018-LIPS. Available: `http://udel.edu/~ghuang/papers/tr_lips.pdf`. University of Delaware, 2018.

[R2] **Geneva, P.**, Eckenhoff, K., Huang, G., *Asynchronous Multi-Sensor Fusion for 3D Mapping and Localization*. Tech. rep. RPNG-2017-ASYNC. Available: `http://udel.edu/~ghuang/papers/tr_async.pdf`. University of Delaware, 2017.

[R1] Eckenhoff, K., **Geneva, P.**, Huang, G., *High-Accuracy Preintegration for Visual Inertial Navigation*. Tech. rep. RPNG-2016-HAPI. Available: `http://udel.edu/~ghuang/papers/tr_hapi.pdf`. University of Delaware, 2016.