Xiangyu Wu

Phone: +86 13269182529 Email: wu_xiangyu@outlook.com

EDUCATION

University of California, Berkeley *August 2017 - June 2022*
Ph.D. in Robotics GPA: 3.91/4.00
Advisor: Prof. Mark W. Mueller
Field: Unmanned Aerial Vehicles (UAVs), Path Planning, Control, State Estimation

Beijing Institute of Technology *September 2013 - June 2017*
Bachelor of Science in Vehicle Engineering GPA: 3.96/4.00
Department of Mechanical Engineering Ranking: top 1%

AWARDS

Winner of the DARPA Subterranean Challenge (member of team CERBERUS) *September 2021*
J.K. Zee Fellowship and the Graduate Division Block Grant Award (UC Berkeley) *December 2020*
Graduate Division Block Grant Award (UC Berkeley) *November 2018*
Graduate Division Block Grant Award (UC Berkeley) *April 2018*
Outstanding Graduate of Beijing *July 2017*
Outstanding Graduate Award (Beijing Institute of Technology) *July 2017*
Chinese National Scholarship *November 2014*

PUBLICATIONS

[1] W. Park, **X. Wu**, D. Lee, S.J. Lee, "Design, Modeling and Control of a Top-loading Fully-Actuated Cargo Transportation Multirotor", *submitted to IEEE Robotics and Automation Letters (RA-L)*

[2] J. Zha, **X. Wu**, R. Dimick, M. W. Mueller, "Design and control of a collision-resilient aerial vehicle with an icosahedron tensegrity structure", *submitted to IEEE/ASME Transactions on Mechatronics*.

[3] M. Tranzatto, M. Dharmadhikari, L. Bernreiter, M. Camurri, S. Khattak, F. Mascarich, P. Pfreundschuh, D. Wisth, S. Zimmermann, M. Kulkarni, V. Reijgwart, B. Casseau, T. Homberger, P. De Petris, L. Ott, W. Tubby, G. Waibel, H. Nguyen, C. Cadena, R. Buchanan, L. Wellhausen, N. Khedekar, O. Andersson, L. Zhang, T. Miki, T. Dang, M. Mattamala, M. Montenegro, K. Meyer, **X. Wu**, A. Briod, M. Mueller, M. Fallon, R. Siegwart, M. Hutter, K. Alexis, "Team CERBERUS Wins the DARPA Subterranean Challenge: Technical Overview and Lessons Learned", *submitted to Field Robotics*, 2022.

[4] D. Zhang, A. Loquercio, **X. Wu**, A. Kumar, J. Malik, M .W. Mueller, "A Zero-Shot Adaptive Quadcopter Controller", *accepted by 2023 International Conference on Robotics and Automation (ICRA)*.

[5] **X. Wu**, S. Chen, K. Sreenath, and M. W. Mueller, "Perception-aware receding horizon trajectory planning for multicopters with visual-inertial odometry", *IEEE Access*, 2022.

[6] **X. Wu**, J. Zeng, A. Tagliabue, and M. W. Mueller, "Model-free online motion adaptation for energy efficient flights of multicopters", *IEEE Access*, 2022.

[7] M. Tranzatto, F. Mascarich, L. Bernreiter, C. Godinho, M. Camurri, S. Khattak, T. Dang, V. Reijgwart, J. Löje, D. Wisth, S. Zimmermann, H. Nguyen, M. Fehr, L. Solanka, R. Buchanan, M. Bjelonic, N. Khedekar, M. Valceschini, F. Jenelten, M. Dharmadhikari, T. Homberger, P. De Petris, L. Wellhausen, M. Kulkarni, T. Miki, S. Hirsch, M. Montenegro, C. Papachristos, F. Tresoldi, J. Carius, G. Valsecchi, J. Lee, K. Meyer, **X. Wu**, J. Nieto, A. Smith, M. Hutter, R.

Siegwart, M. Mueller, M. Fallon, and K. Alexis, "CERBERUS: Autonomous Legged and Aerial Robotic Exploration in the Tunnel and Urban Circuits of the DARPA Subterranean Challenge", *Field Robotics*, 2022.

[8] S. Chen, **X. Wu**, M. W. Mueller, and K. Sreenath, "Real-time Geo-localization Using Satellite Imagery and Topography for Unmanned Aerial Vehicles", *in 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).*

[9] J. Lee*, **X. Wu***, S. J. Lee, and M. W. Mueller, "Autonomous flight through cluttered outdoor environments using a memoryless planner", *in 2021 International Conference on Unmanned Aircraft Systems (ICUAS).* (∗ Share first authorship. Names alphabetical ordered.)

[10] **X. Wu** and M. W. Mueller, "In-flight range optimization of multicopters using multivariable extremum seeking with adaptive step size", *in 2020 International Conference on Robotics and Automation (IROS).*

[11] J. Zha, **X. Wu**, J. Kroeger, N. Perez and M. W. Mueller, "A collision-resilient aerial vehicle with icosahedron tensegrity structure", *in 2020 International Conference on Robotics and Automation (IROS).*

[12] **X. Wu** and M. W. Mueller, "Using multiple short hops for multicopter navigation with only inertial sensors", *in 2020 International Conference on Robotics and Automation (ICRA).*

[13] A. Tagliabue, **X. Wu**, and M. W. Mueller, "Model-free online motion adaptation for optimal range and endurance of multicopters", in *2019 International Conference on Robotics and Automation (ICRA).*

[14] **X. Wu** and M. W. Mueller, "Towards a consequences-aware emergency landing system for unmanned aerial systems", in *2018 International Conference on Unmanned Aircraft Systems (ICUAS).*

[15] G. Zhang, J. Alcala, J. Ng, M. Chen, **X. Wu**, M. W. Mueller and Y. Chen, "Embedding Consequence Awareness in Unmanned Aerial Systems with Generative Adversarial Networks", in *2018 International Conference on Unmanned Aircraft Systems (ICUAS).*

RESEARCH PROJECTS

Perception-aware motion planning of quadcopters with visual inertial odometry
HiPeRLab, University of California, Berkeley *Auguest 2021 - August 2022*

- Introduced a planner that improves the state estimation quality of visual inertial odometry (VIO) and reduces its failure rate.
- The planner generates collision-free trajectories that navigate the vehicle towards the goal, while avoiding regions with few visual features and overly aggressive flight.
- We propose a perception cost function considering both the motion blur of the features and their locations, with a natural adaptation of the trajectory's aggressiveness under environments with different light levels

Model-free online motion adaptation for energy efficient flights of multicopters
HiPeRLab, University of California, Berkeley *May 2018 - December 2021*

- Introduced an approach that allows a multicopter to find the optimal flight time and optimal flight range velocities and heading angles.
- This method is based on Extremum Seeking Control with adaptive step size and does not require any power consumption model of the vehicle, can be executed on-line, and guarantees adaptation to unknown disturbances. It also converges faster than the traditional Extremum Seeking Control.
- This method is especially useful in applications where a multicopter carries an unknown payload.

Collision-resilient tensegrity quadcopter design and control
HiPeRLab, University of California, Berkeley *March 2020 - November 2022*

- Designed a novel icosahedron tensegrity quadcopter that is light-weight and can withstand collisions with speed up to 7.2 m/s.
- Adopted the inertial navigation method (using only the inertial measurement unit for sensing) in the previous inertial navigation project, so that the tensegrity vehicle can perform autonomous operations without external sensing in challenging environments.

DARPA Subterranean Challenge
Member of the CERBERUS team, winner of the challenge. *December 2018 - August 2021*

- Developed a ultra-wideband (UWB) based localization system for robot localization.
- Developed an algorithm for localizing electronic artifacts based on Bluetooth.
- Implemented a computationally-efficient collision avoidance path planner for aerial robots in cluttered environments.

Motion planning for the inertial navigation of multicopters
HiPeRLab, University of California, Berkeley *March 2019 - March 2020*

- Proposed a motion planning strategy for drastically reducing the inertial navigation state estimation error of multicopters. The strategy breaks a long-duration flight into multiple short-duration hops, between which the vehicle remains stationary on the ground.
- When the vehicle is stationary, zero-velocity pseudo-measurements are introduced to an Extended Kalman Filter to reduce the state estimation error.
- This method is useful in certain challenging environments, such as inside buildings on fire, where the main sensors used for multicopter localization can become unavailable.

Consequences-aware Emergency Landing for multicopters
HiPeRLab, University of California, Berkeley *August 2017 - May 2018*

- Presented an algorithm with which an aerial robot is capable of planning consequence-aware flight paths and performing emergency landings.
- Focused on faults that would force the vehicle to land in a short time, and created a system that allows the vehicle to reason about its ability to execute a safe emergency landing from its current state.
- Such a system can improve the safety and reduce the economic cost of aerial robots, by allowing them to operate more flexibly while still achieving suitable safety.

WORK EXPERIENCE

Autel Robotics
Path planning Algorithm Engineer *September 2022 - December 2022*

- Improved the performance of the target estimation module using multiple sensors (e.g., the camera, radar, and lidar), which enables the drone to track and take photos of the target autonomously.
- Refactored the target estimation and tracking codes from ROS1 to ROS2, optimized and deployed the codes on the latest drone model EVO MAX.

University of California, Berkeley
Graduate Student Researcher *May 2017 - June 2022*

- Worked under Prof. Mark W. Mueller on the autonomy of aerial robots.
- Conducted research on the path planning, control, state estimation, and novel design of unmanned aerial vehicles (UAVs).

TECHNICAL SKILLS

- **Programming**: C++, Python, MATLAB, LabVIEW, LaTeX.
- **Robotics**: ROS1, ROS2.
- **Learning**: TensorFlow.
- **Modeling**: AutoCAD, CATIA, Solidworks.