Boyang Li

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PROFESSIONAL EXPERIENCE

Research Associate at School of Engineering *Jul. 2019 - now*
The University of Edinburgh, UK

Research Fellow at Air Traffic Management Research Institute *Jan. 2019 - Jul. 2019*
Nanyang Technological University, Singapore

Intern at Propulsion System Research Department *July. 2014 - Sep. 2014*
DJI, Shenzhen, China

EDUCATION

Ph.D. in Mechanical Engineering *Mar. 2019*
The Hong Kong Polytechnic University, Kowloon, Hong Kong
Thesis: *Model Predictive Hover Control and Transition Optimization for a Tail-Sitter Unmanned Aerial Vehicle*
Supervisor: Prof. Chih-Yung Wen

M.Eng. in Flight Vehicle Design *Apr. 2015*
School of Aeronautics, Northwestern Polytechnical University, Xi'an, China
Thesis: *Experimental Study of a High-Lift Mechanism for 3-DOF Flapping Wings*
Supervisor: Prof. Bifeng Song

B.Eng. in Flight Vehicle Design and Engineering *Jun. 2012*
Honors College, Northwestern Polytechnical University, Xi'an, China

RESEARCH EXPERIENCE

1. **Motion planning for mobile robotics including an unmanned underwater vehicle (UUV) and an industrial self-configurable modular robot** *Jul. 2019 - now*

- Developing the optimization-based path planning algorithm for a UUV platform BlueROV2
- Conducting underwater experiments at the indoor ocean energy research facility 'FloWave'
- Developing the control and simulation environment for a hydraulic self-configurable robot

2. **Detect and Avoid (DAA) for vehicles in urban air mobility (UAM)** *Jan. 2019 - Jul. 2019*

- Built obstacle-free path generation and optimization algorithm with receding horizon principle
- Developed a simulation environment with MoveIt, Open Motion Planning Library (OMPL), and Gazebo based on robot operation system (ROS)
- Developed the experimental platform with Intel RealSense depth camera for environment

perception and mapping

- System integration of unmanned aerial vehicles (UAV) to in-house developed UAS Traffic Management (UTM) platform

3. **Design, Modeling, and Control of a VTOL Tail-sitter UAV** *Jul. 2015 - Dec. 2018*

- Designed and built a quad-rotor vertical takeoff and landing (VTOL) tail-sitter UAV prototype
- Developed a hardware-in-loop (HIL) simulation environment based on wind tunnel experiments
- Developed a model predictive controller (MPC) for hovering and deployed it into onboard flight computer Odroid XU4 to improve its disturbance rejection capability
- Trajectory optimization of hover-level flight transition, using a numerical collocation method
- Conducted indoor Vicon flights and outdoor field experiments to verify performance improvement

4. **Search and Rescue UAV System** (Awarded First Prize) *Jan. 2016 - Apr. 2016*

- Built a high-efficiency fixed-wing UAV system equipped with image acquisition equipment
- Integrated onboard and post-image processing program to identify targets with OpenCV-Python
- Developed a two-UAV communication relay system to ensure long-distance telemetry quality

5. **Experimental Study about High-Efficiency Flapping Wings** *Mar. 2012 - Jun. 2015*

- Designed and built an experimental flapping wing mechanism with 3 degrees-of-freedom (DOF)
- Developed software for measuring and controlling of the flapping wing with LabVIEW
- Carried out force/torque measurement experiments in a wind tunnel and water tank

6. **China Robot Competition and Freescale Smart Car Competition** *Jun. 2010 - Sep. 2011*

- Built a deformable robot with 24 DOF (transforms from the shape of a hand to that of a dog)
- Designed a printed circuit board (PCB) to control the movement of 24 servo-motors
- Built a model car with a camera that recognizes the road line, and tuned the PID control system

PUBLICATIONS (Google Scholar)

Journals

[1] J. Li, K. H. Low, J. Yong, **B. Li,** H. Xie, "Nonlinear Image-based Visual Tracking and Landing for Rotorcraft UAVs," *IEEE/ASME Transactions on Mechatronics*, *Under Revision* [VIDEO]

[2] **B. Li,** J. Sun, W. Zhou, C.Y. Wen, K.H. Low, and C.K. Chen, "An Optimal Transition Control Method for Tail-sitter VTOL UAVs," *IEEE/ASME Transactions on Mechatronics*, *Accepted* [VIDEO]

[3] W. Zhou, **B. Li,** J. Sun, C.Y. Wen, C.K. Chen, "Adaptive Model Predictive Control Method for a Tail-Sitter VTOL UAV", *Control Engineering Practice*, vol. 91, pp. 104-125, 2019.

[4] J. Sun, **B. Li**, C.Y. Wen, and C.K. Chen, "Wind Estimation Method for a Tail-Sitter UAV in all Flight Phases," *IEEE Transactions on Aerospace and Electronic Systems*, Online published.

[5] J. Sun, **B. Li,** C.-Y. Wen, and C.-K. Chen, "Design and Implementation of a Real-time Hardware-in-the-loop Testing Platform for a Dual-rotor Tail-sitter Unmanned Aerial Vehicle," *Mechatronics*, vol. 56, pp. 1-15, 2018. [VIDEO]

[6] **B. Li,** W. Zhou, J. Sun, C. Y. Wen, and C. K. Chen, "Development of Model Predictive Controller for a Tail-Sitter VTOL UAV in Hover Flight," *Sensors*, vol. 18, no. 9, 2018. [VIDEO]

[7] J. Sun, **B. Li**, Y. Jiang, and C. Y. Wen, "A Camera-Based Target Detection and Positioning UAV System for Search and Rescue (SAR) Purposes," *Sensors*, vol. 16, no. 11, 2016. [VIDEO]

[8] **B. Li**, Y. Jiang, J. Sun, L. Cai, and C. Y. Wen, "Development and Testing of a Two-UAV Communication Relay System," *Sensors*, vol. 16, no. 10, 2016. [VIDEO]

Conferences

[1] C. Lim, **B. Li,** E. M. Ng, X. Liu and K. H. Low, "Three-dimensional Dynamic Obstacle Perception in a Detect-and-Avoid Framework for Unmanned Aerial Vehicles," *2019 International Conference on Unmanned Aircraft Systems (ICUAS)*, Atlanta, GA, USA, 2019. [VIDEO]

[2] **B. Li**, W. Zhou, J. Sun, C. Y. Wen, and C. K. Chen, "Model Predictive Control for Path Tracking of a VTOL Tailsitter UAV in an HIL Simulation Environment," in *AIAA Modeling and Simulation Technologies Conference*, Kissimmee, FL, USA, 2018.

[3] J. Sun, **B. Li**, L. Shen, C. K. Chen, and C. Y. Wen, "Dynamic Modeling and Hardware-In-Loop Simulation for a Tail-Sitter Unmanned Aerial Vehicle in Hovering Flight," in *AIAA Modeling and Simulation Technologies Conference*, Grapevine, TX, USA, 2017.

[4] **B. Li**, B. Song; L. Wang, "A Three-dimensional Flapping Wing Mechanism for Wind Tunnel Experiments," in *29th Congress of the International Council of the Aeronautical Sciences (ICAS)*, St. Petersburg, Russian, 2014. [VIDEO]

HONORS & AWARDS

- Gold Medal, 45th International Exhibition of Inventions of Geneva, Geneva, Switzerland, 2017
- Talent Development Scholarship, the Hong Kong SAR Government, Hong Kong, 2017
- Second Prize, Search and Rescue Group, Taiwan UAV Competition, Tainan, Taiwan, 2017
- First Prize, Search and Rescue Group, Taiwan UAV Competition, Tainan, Taiwan, 2016
- First Prize, Innovation Group, Taiwan UAV Competition, Tainan, Taiwan, 2016
- Third Prize, AVIC Cup - International UAV Innovation Grand Prix, Beijing, China, 2013
- Second Prize, Walking Robot Competition, China Robot Competition, Lanzhou, China, 2011
- First Prize, Dancing Robot Competition, China Robot Competition, Erdos, China, 2010

SKILLS

- Matlab/Simulink, ROS, LabView, C/C++, Python, Gazebo, PX4, Git, LaTeX
- Pilot of fixed-wing/multi-rotor/helicopter/hybrid UAVs