Qiuyang Tao

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EDUCATION

Georgia Institute of Technology Jan. 2016 - Dec. 2020
Ph.D. in Electrical and Computer Engineering
-- Minor: Mechanical Engineering
-- Thesis: Design and Control of an Indoor Miniature Autonomous Blimp
-- Advisor: Prof. Fumin Zhang (Co-Chair of IEEE Marine Robots Tech Committee)
-- Research Interests: robotic systems and mechanisms, miniature aerial robots, underwater and surface vehicles, subsea communications, system identification, motion control, machine learning and computer vision

Georgia Institute of Technology Jan. 2012 - Dec. 2016
B.S. in Electrical Engineering
Graduated with highest honors (top 5%)

RESEARCH EXPERIENCE

ROBOTIC PLATFORM DESIGN

Indoor Miniature Autonomous Blimp May. 2015 - Present
-- Multi-hour flight endurance
-- Among the smallest autonomous blimps in the world
-- Operates safely near human, cause no threat or damage even with collisions
-- Lightest-weight onboard electronics and lowest communication latency
-- The only indoor miniature blimp with swing-stabilizing flight controller
-- Testbed for experiments including swarming and human-robot interaction
-- 3rd prize winner of the IEEE CSS Video Clip Contest
-- Reported by the IEEE Spectrum

Omnidirectional Surface Vehicle Aug. 2017 - Present
-- Symmetrical over-actuated design for better maneuverability and redundancy
-- Subsurface object detection with onboard hardware neural network accelerator
-- Centimeter-level localization and multiple surface/subsea communication modes
-- Testbed for aquaculture inspection and acoustic communication experiments
-- Video demonstration is available [here]

Miniature Underwater Robot Aug. 2014 - Present
-- Approx. 30cm overall length
-- Subsea computer vision and onboard neural network inference capabilities
-- Acoustic, infrared and radio communication for dive and surface scenarios
-- Winner of the Warren Batts and Austin Brown Innovation Award
-- Testbed for underwater human-robot interaction and subsea communication experiments
-- Video demonstration available [here]

CONTROL SYSTEM DESIGN

Autopilot System for Indoor Miniature Autonomous Blimps May. 2015 - Present
-- Established the motion model of saucer-shaped miniature blimps without tail fin or control surface
-- Developed a procedure to identify model parameters of indoor blimps via multiple means, including physical measurements and experimental data captured during flight
-- First realized attitude stabilization among indoor miniature blimps
-- Video demonstration available [here]

Planning and Control Software for Underwater Gliders Jul. 2016 - Jun. 2017

-- Developed interface to acquire local flow field near the glider from multiple sources including ocean models, HF radar, and onboard flow velocity measurements
-- Designed a path-tracking controller to achieve navigation tasks of underwater gliders
-- Conducted real-world glider deployments on the southeastern coast of U.S. and the Gulf of Mexico

UNDERWATER COMMUNICATIONS

Underwater Acoustic Communication Experiments Aug. 2017 - Aug. 2018

-- Identified the major disturbances of underwater acoustic communication in confined water space while the robot is stationary and in movement
-- Video demonstration available [here]

Underwater Infrared Communication Devices Jan. 2015 - May. 2015

-- Capable of outdoor operation under severe disturbance, e.g. sunlight
-- Winner of the Warren Batts and Austin Brown Innovation Award for the development of the infrared modem and its carrier underwater robot
-- Video demonstration available [here]

MACHINE LEARNING APPLICATIONS

Aquaculture Fish Cage Inspection Aug. 2017 - Aug. 2018

-- Developed a fish cage damage detection and localization algorithms
-- Achieved real-time detection using neural network acceleration hardware

Underwater Human-Robot Interaction Jan. 2017 - May. 2017

-- Developed algorithms to detect divers and estimate their positions relative to the robot
-- Designed control strategies to enable HRI activities including diver's companion

3D Localization for Indoor Miniature Robots Jan. 2019 - May. 2019

-- Developed a real-time visual based localization method in GPS-denied environment using convolutional neural network

PATENTS

[P8] **Q. Tao**, F. Zhang, Z. Xu, T. Lin, J. Wang, "Lightweight Flight Control System for Miniature Indoor Aerial Robots," US Provisional Patent App., 63/112,467, 2020.

[P7] **Q. Tao**, F. Zhang, T. Lin, Z. Xu, "Active Motion Capture Marker for Miniature Indoor Aerial Robots," US Provisional Patent App., 63/060,836, 2020.

[P6] J. Wei, **Q. Tao**, C. Zhou, Y. Zhang, J. Zhang, W. Zhang, "Tri-Axial Coreless Search Coil for Magnetic Field Direction Measurement," CN Patent App. 202020048401.5, 2020

[P5] J. Wei, **Q. Tao**, C. Zhou, Y. Zhang, J. Zhang, W. Zhang, C. Shang, R. Hu, "Electromagnetic Line-Following Guidance System for Autonomous Underwater Vehicles," CN Patent App. 333,333,795, 2019

[P4] F. Zhang, **Q. Tao**, T.J. Tan, P.S.T Cheng, S. Cho, V. Mishra, and J.P. Varnell, "Miniature Autonomous Robotic Blimp," U.S. Utility Patent App. 16/280,579, 2019

[P3] **Q. Tao**, S. Maxon, L. Seguin, J. Zheng, J. Cha, C. Qin, X. Chen, H. Xie, and F. Zhang, "Miniature Underwater Robot for Research and Education," U.S. Provisional Patent App., 62/669,571, 2018

[P2] **Q. Tao**, V. Mishra, P.S.T. Cheng, S. Cho, J.P. Varnell, and F. Zhang, "Autonomous Indoor Robotic Blimps for Research and Education," U.S. Provisional Patent App., 62/632,624, 2018

[P1] **Q. Tao**, V. Mishra, P.S.T. Cheng, S. Cho, J.P. Varnell, and F. Zhang, "Autonomous Indoor Robotic Blimps for Research and Education," U.S. Provisional Patent App., 62/462,790, 2017

PUBLICATIONS

JOURNAL ARTICLES

[J5] **Q. Tao,** J. Wang, Z. Xu, T. X. Lin and F. Zhang, "Swing-Reducing Flight Control System for an Underactuated Indoor Miniature Autonomous Blimp," in *IEEE/ASME Transactions on Mechatronics,* submitted.

[J4] **Q. Tao**, T.J. Tan, J. Cha, Y. Yuan, and F. Zhang, "Modeling and Control of Swing Oscillation of Underactuated Indoor Miniature Autonomous Blimps," in *Unmanned Systems*, in press.

[J3] S. Zheng, F. Tong, B. Li, **Q. Tao**, A. Song, and F. Zhang, "Design and Evaluation of an Acoustic Modem for a Small Autonomous Unmanned Vehicle," in *Sensors (Basel, Switzerland)*, 19(13), 2923-2034, 2019.

[J2] N. Yao, **Q. Tao**, W. Liu, Z. Liu, Y. Tian, P. Wang, T. Li and F. Zhang, "Autonomous Flying Blimp Interaction with Human in an Indoor Space," in *Frontiers of Information Technology & Electronic Engineering,* 20(1), 45-59, 2019.

[J1] **Q. Tao**, Y. Zhou, F. Tong, A. Song, and F. Zhang, "Evaluating Acoustic Communication Performance of Micro Autonomous Underwater Vehicles in Confined Space," in *Frontiers of Information Technology & Electronic Engineering,* 19(8), 1013-1023, 2018.

CONFERENCE PROCEEDINGS

[C13] **Q. Tao**, M. Hou, and F. Zhang, "Modeling and Identification of Coupled Translational and Rotational Motion of Underactuated Indoor Miniature Autonomous Blimps," in *Proc. International Conference on Control, Automation, Robotics and Vision (ICARCV)*, in press.

[C12] L. Seguin, J. Zheng, A. Li, **Q. Tao*** and F. Zhang, "A Deep Learning Approach to Localization for Navigation on a Miniature Autonomous Blimp," in *Proc. IEEE International Conference on Control & Automation (ICCA)*, pp. 1130-1136, 2020.

[C11] T. Lin, **Q. Tao** and F. Zhang, "Planning for Fish Net Inspection with an Autonomous OSV," in *Proc. International Conference on System Science and Engineering (ICSSE)*, pp. 1-5, 2020

[C10] D. Chen, B. Li, F. Tong, **Q. Tao** and F. Zhang, "R&D of a Low-Complexity OFDM Modem for Micro-AUV," in *Proc. ACM International Conference on Underwater Networks & Systems (WUWNET)*, pp. 1-5, 2019

[C9] **Q. Tao**, J. Lobley, Y. Yu, Y. M. Aung, F. Zhang, Y. Zhou, F. Tong and A. Song, "Omnidirectional Surface Vehicle for Evaluating Underwater Acoustic Communication Performance in Confined Space," in *Proc. ACM International Conference on Underwater Networks & Systems (WUWNET)*, pp. 1-2, 2019

[C8] Q. Fu, A. Song, **Q. Tao**, F. Zhang and M. Pan, "Virtual MIMO for Multiuser Underwater Acoustic communications with Moving Platforms," in *Proc. ACM International Conference on Underwater Networks & Systems (WUWNET)*, pp. 1-8, 2019

[C7] M. Hou, **Q. Tao**, P. Varnell and F. Zhang, "Modeling Pointing Tasks in Human-Blimp Interactions," in *Proc. IEEE Conference on Control Technology and Applications (CCTA)*, pp. 73-78, 2019

[C6] X. Wang, S. Zheng, **Q. Tao**, F. Zhang, A. Song and F. Tong, "Doppler Correction of Mobile Acoustic Communication via Adjustable AD Sampling Rate," in *Proc. ACM International Conference on Underwater Networks & Systems (WUWNET)*, pp. 1-5, 2018

[C5] **Q. Tao**, J. Cha, M. Hou and F. Zhang, "Parameter Identification of Blimp Dynamics through Swinging Motion," in *Proc. International Conference on Control, Automation, Robotics and Vision (ICARCV)*, pp. 1186-1191, 2018

[C4] **Q. Tao**, K. Huang, C. Qin, B. Guo, R. Lam and F. Zhang, "Omnidirectional Surface Vehicle for Fish Cage Inspection," in *Proc. MTS/IEEE OCEANS,* pp. 1-6, 2018

[C3] **Q. Tao**, Y. Zhou, F. Tong, A. Song and F. Zhang, "Evaluating Acoustic Communication Performance of Micro AUV in Confined Space," in *Proc. MTS/IEEE OCEANS,* pp. 1-6, 2018

[C2] S. Cho, V. Mishra, **Q. Tao**, P. Varnell, M. King-Smith, A. Muni, W. Smallwood and F. Zhang, "Autopilot Design for a Class of Miniature Autonomous Blimps," in *Proc. IEEE Conference on Control Technology and Applications (CCTA),* pp. 841-846, 2017

[C1] N. Yao, E. Anaya, **Q. Tao**, S. Cho, H. Zheng and F. Zhang, "Monocular Vision-based Human Following on Miniature Robotic Blimp," in *Proc. IEEE International Conference on Robotics and Automation (ICRA)*, pp. 3244-3249, 2017

INDUSTRY EXPERIENCE

Deepinfar (Sublue) Ocean Technology Co., Ltd. May. 2019.5 - Aug. 2019

Research Intern, Supervisor: Yongqiang Zhang

Lead team of hardware and software engineers on developing an electromagnetic line-following guidance system for autonomous underwater vehicles. The system has received two patents.

TEACHING EXPERIENCE

ECE Special Topics Courses - *Project Mentor* Aug. 2019 - Present
Advised students on the development of unmanned surface vehicles and their autopilot systems.

NSF REU Program - *Project Mentor* May. 2015 - Aug. 2018
Guided students on marine robotics research, including underwater infrared communication, sub-surface localization, submerged object detection, and feedback control of marine robots.

Vertically Integrated Projects (VIP) Program - *Teaching Assistant* Jan. 2017 - Dec. 2019
Prepared and ran class projects, graded lab notebooks and final reports, held tutorial and help sessions.

ECE 4011/4012: Undergraduate Senior Design - *Teaching Assistant* Jan. 2016 - Jan. 2019
Proposed senior design topics, graded class deliverables, hosted weekly meetings and support sessions.

ECE 4560: Autonomous Control of Robotic Systems - *Teaching Assistant* May. 2018 - Aug. 2018
Graded homework and class projects.

ECE 2031: Digital Design Laboratory - *Teaching Assistant* May. 2014 - Dec. 2016
Conducted check-offs in lab sessions and held office hours. Graded quizzes, lab reports and final projects. Hosted sessions on the professional communication program. Instructed usage of lab instruments.

ECE 2035: Programming for HW/SW Systems - *Teaching Assistant* Aug. 2014 - May. 2015
Graded class homework, held office hours, guided final projects with ARM Cortex-M microcontrollers.

SELECTED HONORS

3rd Price in the World Intelligence Underwater Robots Challenge Jun. 2019
-- Team leader of four students from Georgia Institute of Technology
-- The competition was broadcasted by the China Central Television (CCTV)
-- Received travel support and 5000 RMB cash award

NSF Innovation Corps (I-Corps) Jun. 2018
-- Completion of the NSF I-Corps curriculum on technology commercialization
-- Received 50,000 USD support for customer discovery and entrepreneurship training

3rd Prize in the IEEE CSS Video Clip Contest Aug. 2015
-- For the development of the Georgia-Tech Miniature Autonomous Blimp (GT-MAB)
-- Video clip entitled "Control Theory-Autonomous Blimp"

The Warren Batts and Austin Brown Innovation Award Mar. 2015
-- For the development of the Georgia-Tech Miniature Underwater Vehicle (GT-MUR) and its underwater infrared communication system
-- Received 1000 USD cash award

PROFFESIONAL ACTIVITIES & MEMBERSHIP

PUBLICATION REVIEWER

-- Journal of Oceanic Engineering (JOE)
-- IEEE Trans. on Automatic Control (TAC)
-- IEEE Trans. on Control of Network Sys. (TCNS)
-- Frontiers of Information Technology & Electronic Engineering (FITEE)
-- International Conference on Automation, Control and Robotics Engineering (CACRE)
-- American Control Conference (ACC)
-- International Conference on Robotics and Automation (ICRA)
-- SIAM Conference on Control and its Applications (SIAM CT)
-- International Conference on Control and Automation (ICCA)

MEMBERSHIP

-- Student Member of the Institute of Electrical and Electronics Engineers (IEEE)
-- Student Member of the American Society of Mechanical Engineers (ASME)