

# LI WANG

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## EDUCATION

<b>Georgia Institute of Technology</b> , Atlanta, GA	August 2014 - May 2018 (expected)
<b>Doctor of Philosophy</b> in Department of Electrical & Computer Engineering	GPA: 4.00/4.00
<b>Clemson University</b> , Clemson, SC	July 2012 — May 2014
<b>Master of Science</b> in Department of Electrical & Computer Engineering	GPA: 4.00/4.00
<b>Huazhong University of Sci. &amp; Tech.</b> , Wuhan, China	July 2008 — June 2012
<b>Bachelor of Science</b> (with honor) in Department of Mechanical Engineering	GPA: 91.60/100    Ranking: 1/54

## RESEARCH EXPERIENCE

<b>Graduate Research Assistant, Georgia Institute of Technology</b>	August 2014 - Present
<i>Topic: Safe Learning and Control of Multi-robot Systems</i> (Video Link 1,2) 3)	<i>Advisor: Magnus Egerstedt</i>
<ul style="list-style-type: none"><li>Developed safety control certificates to ensure safe aggressive maneuvers of multi-quadrotor and mobile robot swarms.</li><li>Designed online safe learning algorithm for quadrotor dynamics using recursive Gaussian Process with safety guarantees.</li><li>Implemented safety certificates on teams of quadrotors and robots with Robot Operating System (ROS) (C++, Python).</li><li>Integrated a multi-robot test-bed with multiple quadrotors, mobile robots, joystick/Iphone, and motion capture system</li><li>Programmed stable hovering and trajectory tracking of quadrotors with Extended Kalman Filter and sensor fusion.</li></ul>	
<b>Graduate Research Assistant, Clemson University</b>	May 2013 - May 2014
<i>Topic: Online Control, Estimation and Sensor Fusion of Bioreactor</i>	<i>Advisor: Richard Groff</i>
<ul style="list-style-type: none"><li>Developed and implemented nonlinear adaptive state estimator for online tracking of oxygen uptake rate in bioreactor.</li><li>Designed and implemented a Kalman filter and particle filter for bioreactor sensing data filtering and fusion</li><li>Implemented bioreactor real-time control and data acquisition with xPC-target, OPC, UDP and serial communication</li></ul>	
<b>Undergraduate Research Group Leader, HUST</b>	March 2011 - June 2012
<i>Topic: Geometric error modelling and compensation for multi-axis machine tools</i>	<i>Advisor: Fangyu Peng</i>
<ul style="list-style-type: none"><li>Used CAD/CAM software for machine tools and parts modeling and tool cutting path generation and optimization</li><li>Modeled kinematics of multi-axis machine tools with geometric error and developed tool path post-processing algorithms</li></ul>	

## WORK EXPERIENCE

<b>Summer Research Intern, Siemens Corporate Technology</b>	May 2017 - August 2017
<i>Project: Planning and Scheduling of Flexible Manufacturing Systems</i>	<i>Advisor: Ulrich Muenz</i>
<ul style="list-style-type: none"><li>Developed Model Predictive Control based planning and scheduling algorithm for flexible manufacturing systems.</li><li>Implemented the MPC graph-based planner in C++ and interfaced with Siemens Tecnomatix plant simulator.</li></ul>	
<b>Summer Research Intern, OFS Fitel LLC</b>	June 2014 - August 2014
<i>Project: Software Development for Plasma-based Optical Fiber Manufacturing Process</i>	<i>Advisor: David Braganza</i>
<ul style="list-style-type: none"><li>Worked on hardware&amp;software integration for Siemens PLC, HMI, RF power circuit, and other periphery devices.</li><li>Developed software for manufacturing recipe optimization and automation in multi-programming language environment</li></ul>	
<b>Summer Research Intern, DEPUH Robotic Education Technology</b>	June 2011 - August 2011
<i>Project: Educational reconfigurable mechatronical platform</i> (Video Link)	<i>Advisor: Kevin Rong</i>
<ul style="list-style-type: none"><li>Developed a modular mechatronic platform with mechatronic transmission, micro-controller and Labview interface</li></ul>	
<b>Lab Teaching Assistant, Georgia Tech, Clemson University</b>	July 2012 - August 2015
<i>Courses: Mechatronic System, Electronics Lab</i>	<i>Advisors: Allen Robinson, John Wagner</i>
<ul style="list-style-type: none"><li>Taught signal acquisition/processing with transistor circuit, PLC programming, Labview sampling, and CNC operation</li></ul>	

## SOFTWARE AND HARDWARE SKILLS

<b>Programming Tools:</b>	Python, C and C++, Matlab&Simulink, ROS (in Ubuntu Linux), PLC, Labview
<b>System&amp;Controls:</b>	Linear/nonlinear/optimal/networked control, regular/cascaded PID control, LQR control
<b>Machine Learning:</b>	Gaussian Process, Hidden Markov Model, PCA, Expectation-Maximization, KNN/Q learner
<b>Signal Processing:</b>	Complementary/Kalman/Extended-Kalman/Particle Filtering, SVD, Convex optimizations
<b>Robotic Hardware:</b>	Crazyflie Quadrotor, AR Drone, Segway/Khepera III/Magellan Pro Robots, GRIST bots
<b>Robotic Software</b>	ROS, MQTT, Player/Stage, Vrep simulator, Rviz, Optitrack/Vicon Motion Capture System
<b>Robotics</b>	Quadrotor dynamics, manipulator forward/inverse kinematics, path planning (PRM, A*)
<b>Sensors&amp;Hardware</b>	x-PC Target, Servo/step motor, Laser range sensor, Accelerometer, Analog IO, Gas sensor
<b>CAD/CAM</b>	Solidworks(3 yrs), AutoCAD(3 yrs), UG(3 yrs), Inventor(2 yrs), Mastercam(1 yr)
<b>Engineering Skills</b>	Siemens PLC, CNC, Micro-Controller, Oscilloscope, Signal generator, 3D printing, Laser cutter

## SELECTED HONORS

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- Best Multi-Robot Paper Award:** Best Multi-Robot Systems Paper Award at top Robotics conference ICRA 2017
- Jenny H. Krauss Fellowship:** Awarded to top Georgia Tech graduate students with excellent academic record
- Top winner of BlueCompetition:** A worldwide competition sponsored by BlueSens Gas Sensor GmbH(Germany)
- Chinese National Scholarship:** Awarded to top 2% college students by the Chinese Ministry of Education
- China National Innovation Grants:** Awarded to teams of undergraduates with innovative research projects

## MEDIA COVERAGE

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- D1. *IEEE spectrum*, “Swarms of Robots Manage to Not Run Into Each Other”, Web link
- D2. *Engadget*, “Virtual ‘top hats’ ensure swarming drones won’t crash”, Web link
- D3. *Robohub*, “The Robotarium: A remotely accessible swarm robotics research testbed”, Web link
- D4. *Digital trends*, “This swarm of drones uses virtual force fields to avoid crashing into each other”, Web link

## SERVICE

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- Tour Organizer*, showed live robotic demos (quadrotor swarm and mobile robot swarm experiments) during 2014-2017 to
- Industrial visitors from: BMW, United Technologies Research Center, Siemens Corporate Technology, Littler Mendelson, Denso Corporation, Texas Instrument, Marvel Studios, Walmart, Samsung Electronics, Ford Motor, etc.
  - Academical visitors from: NASA, ONR, 2016 Robotics Roadmap, the Ray Foundation, Cristo Rey High School, CMU, UCLA, University of Maryland, University of Tennessee at Chattanooga, 2016/2017 Robotics Open House, Clayton State University, AIAA Technical Committee, George Walton Academy, Tuskegee university, etc.

*Session Co-Chair*, IFAC Conference on Analysis and Design of Hybrid Systems, Atlanta, 2015.

## PUBLICATIONS

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### A. Master’s Thesis

- A1. “Design and Implementation of a Real-time Adaptive Oxygen Transfer Rate Estimator”, Clemson University, 2014

### B. Peer-reviewed Journal Papers

- B1. **L. Wang**, A. Ames, and M. Egerstedt, “Super-Ellipsoidal Barrier Certificates for Safe Maneuvers in Teams of Quadrotors”, *IEEE Transactions on Robotics (T-RO)*, under review.
- B2. **L. Wang**, A. Ames, and M. Egerstedt, “Safety Barrier Certificates for Collisions-Free Multi-robot Systems”, *IEEE Transactions on Robotics (T-RO)*, vol. 33, no. 3, pp. 661-674, 2017.
- B3. F. Peng, J. Ma, **L. Wang**, R. Yan and B. Li, “Post-processing Algorithm Based on Total Differential Method for Multi-axis Machine Tools with Arbitrary Configuration”, *Chinese Journal of Mechanical Engineering*, vol. 48, no. 13, pp. 121-127, 2012.

### C. Peer-reviewed Conference Papers

- C1. **L. Wang**, E. A. Theodorou, and M. Egerstedt, “Safe Learning of Quadrotor Dynamics Using Barrier Certificates”, *IEEE International Conference on Robotics and Automation (ICRA)*, 2018, under review.
- C2. **L. Wang**, A. Ames, and M. Egerstedt, “Safe Certificate-Based Maneuvers for Teams of Quadrotors Using Differential Flatness”, *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 3293-3298, 2017.
- C3. D. Pickem, P. Glotfelter, **L. Wang**, M. Mote, A. Ames, E. Feron, and M. Egerstedt, “The Robotarium: A Remotely Accessible Swarm Robotics Research Testbed”, *IEEE International Conference on Robotics and Automation (ICRA)*, **Best Multi-Robot Systems Paper Award, Best Conference Paper Finalist**, pp. 1699-1706, 2017.
- C4. **L. Wang**, D. Han, and M. Egerstedt, “Permissive Barrier Certificates for Safe Stabilization Using Sum-of-squares”, *2018 American Control Conference (ACC)*, under review.
- C5. **L. Wang**, A. Ames, and M. Egerstedt, “Multi-objective Compositions for Collision-free Connectivity Maintenance in Teams of Mobile Robots”, *2016 Decision and Control Conference (CDC)*, pp. 2659-2664, Dec. 2016.
- C6. **L. Wang**, A. Ames, and M. Egerstedt, “Safety Barrier Certificates for Heterogeneous Multi-robot System”, *2016 American Control Conference (ACC)*, pp. 5213-5218, July 2016.
- C7. U. Borrmann, **L. Wang**, A. Ames, and M. Egerstedt, “Control Barrier Certificates for Safe Swarm Behavior”, *2015 IFAC Conference on Analysis and Design of Hybrid Systems (ADHS)*, Oct. 2015.
- C8. **L. Wang**, M. E. Pepper, A. Padmakumar, T. C. Burg, S. W. Harcum, and R. E. Groff, “A Real-time Adaptive Oxygen Transfer Rate Estimator for Metabolism Tracking in Escherichia coli Cultures”, *IEEE Engineering in Medicine and Biology Conference*, pp. 6191-6194, 2014
- C9. M. E. Pepper, **L. Wang**, A. Padmakumar, T. C. Burg, S. W. Harcum, and R. E. Groff, “A CMI(Cell Metabolic Indicator)-based Controller for Achieving High Growth Rate E.coli Cultures”, *IEEE Engineering in Medicine and Biology Conference*, pp. 2911-2915, 2014