

# Lucas Tiziani

## PhD Candidate

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## Research Focus

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|-----------------------|---|
| Robot Motion Planning | Trajectory planning of dynamic maneuvers for compliantly-actuated robots                                  |
| Robot Optimization    | Optimization of robot morphologies to enhance the agility and adaptability of compliantly-actuated robots |

## Education

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### Georgia Institute of Technology

PhD, Mechanical Engineering, GPA: 3.92

Thesis: *Sensing, Design Optimization, and Motion Planning for Agile Pneumatic Artificial Muscle-Driven Robots*

Atlanta, GA

May 2021 (expected)

### Georgia Institute of Technology

MS, Mechanical Engineering, GPA: 4.0

Atlanta, GA

May 2019

### Union College

BS, Mechanical Engineering, GPA 3.95

Schenectady, NY

June 2011

## Experience

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### Georgia Institute of Technology

Graduate Research Assistant

Atlanta, GA

Aug 2015–Present

Creating hardware, design optimization strategies, and motion planning algorithms to maximize the dynamic performance of compliantly-actuated robots

- Constructed a trajectory optimization framework to plan high-speed motion sequences for pneumatic muscle-actuated robots
- Developed a legged robot simulation with ground-contact modeling, pneumatic system dynamics, and muscle force dynamics; utilized the model to optimize robot morphology for jumping tasks
- Developed low-level controller and overall system architecture for a pneumatically-actuated knee exoskeleton, run on an ARM microcontroller and a Raspberry Pi
- Designed high-strain conductive liquid metal and optical reflectance sensors for position and force estimation of 'pneumatic artificial muscle' actuators

### Waters Corporation

Mechanical Engineer II, R&D

Milford, MA

March 2014–July 2015

Developed an analytical-scale fraction collector instrument for integration with Ultra Performance Liquid Chromatography (UPLC) systems

- Optimized instrument fluidics to achieve lower sample dispersion than any competitive product
- Assisted in the development of a peak detection algorithm for real-time detection/collection of chromatographic peaks; created a Python-based app to evaluate and improve the algorithm
- Devised several patented features to significantly improve fraction recovery and reduce cross-fraction contamination

## **Waters Corporation**

Milford, MA

*Mechanical Engineer I, R&D*

Oct 2011–Marc 2014

Led the development of a low-dispersion flow-splitting interface between UPLC systems and mass spectrometry instruments

- Created an analytical flow model to characterize key splitter parameters—split ratio, pressure drop, and split flow time offset—over full range of chromatographic operating conditions (varying flow rates, compositions, temperatures, pressures, etc.); verified model accuracy via experimental data
- Optimized splitter design using analytical model to maximize chromatographic operating range
- Performed computational fluid dynamics analysis and chromatographic testing to reduce fluidic dispersion of splitter

## **General Electric Global Research Center**

Niskayuna, NY

*Edison Intern*

Summer 2010

Supported the development of a carbon fiber composite aircraft engine fan case for fan blade failure containment

- Performed automation of carbon fiber fan case layups
- Assisted with design, fabrication, testing, and analysis of prototype cases

## **Recognition**

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Honorable Mention, NSF Graduate Research Fellowship Program 2018

Mortimer F. Sayre Prize, Awarded by Union College ME faculty to student with best potential for furthering the ideals of the mechanical engineering profession 2011

Daniel F. Pullman Engineering Prize, First in graduating engineering class 2011

All-Academic Team, Upper New York State Collegiate Swimming Association 2009–2011

Presidential Scholarship, Union College 2007–2011

## **Teaching & Mentorship**

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**Graduate Teaching Practicum** Atlanta, GA

*ME8843: Biomechatronics of Wearable Robotic Systems* Spring 2020

For this special topics course at Georgia Tech, I helped develop lectures on mechatronic system design and control for wearable systems; I taught lectures to graduate students and led literature discussions.

**Undergraduate Research Mentor** Atlanta, GA

*Adaptive Robotic Manipulation Lab* 2016–2021

I guided undergraduate students through various research projects, from performing literature reviews, to formulating research questions and evaluating potential solutions.

**Lab Guide** Atlanta, GA

*National Robotics Week* 2015–2020

For National Robotics Week every Spring, I led demonstrations of robots in the ARM Lab at Georgia Tech for students from elementary to high school.

## Service

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**Reviewer**    Soft Robotics Journal (SoRo)  
IEEE International Conference on Robotics and Automation (ICRA) 2020  
IEEE International Conference on Soft Robotics (RoboSoft) 2020  
IEEE International Conference on Soft Robotics (RoboSoft) 2019

## Publications

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- [1] **Lucas Tiziani**, Yetong Zhang, Frank Dellaert, and Frank L. Hammond III. Factor Graph-Based Trajectory Optimization for a Pneumatically-Actuated Jumping Robot. Accepted for publication, *IEEE International Conference on Robotics and Automation (ICRA) 2021*.
- [2] Alexander Ambrose, **Lucas Tiziani**, Donald Ward, Maxwell Weinmann, and Frank L. Hammond III. A Pneumatic Compression Vest for Transthoracic Manipulation of Ventilation-Perfusion in Critical Care Patients with Acute Respiratory Distress Syndrome Caused by COVID-19. Accepted for publication, *Design of Medical Devices Conference (DMD) 2021*.
- [3] Donald Ward, Brian Epstein, **Lucas Tiziani**, and Frank L. Hammond III. Optimal Design of a Mechatronic Lever Arm for Pneumatic Exoskeleton: Design and Validation. Accepted for publication, *Design of Medical Devices Conference (DMD) 2021*.
- [4] **Lucas Tiziani** and Frank L. Hammond III. Optical Sensor-Embedded Pneumatic Artificial Muscle for Position and Force Estimation. *Soft Robotics Journal*, August 2020.
- [5] Jennifer Molnar, Ching-An Cheng, **Lucas Tiziani**, Byron Boots, and Frank L. Hammond III. Optical Sensing and Control Methods for Soft Pneumatically Actuated Robotic Manipulators. *IEEE International Conference on Robotics and Automation (ICRA) 2018*.
- [6] Alexander Hart, **Lucas Tiziani**, Ji Hwan Jung, and Frank L. Hammond III. Deformable reflective diaphragm sensors for control of soft pneumatically actuated devices. *IEEE International Conference on Soft Robotics (RoboSoft) 2018*.
- [7] **Lucas Tiziani**, Alexander Hart, Thomas Cahoon, Faye Wu, H. Harry Asada, and Frank L. Hammond. Empirical characterization of modular variable stiffness inflatable structures for supernumerary grasp-assist devices. *The International Journal of Robotics Research*, July 2017.
- [8] **Lucas Tiziani**, Thomas Cahoon, and Frank L. Hammond. Sensorized pneumatic muscle for force and stiffness control. *IEEE International Conference on Robotics and Automation (ICRA) 2017*.

## Patents

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- [1] J. A. Burnett, J. Usowicz, M. Lemelin, **L. O. Tiziani**, A. Lebeau. *Liquid flow rate measurement device*. US 10175209 B2. 2019.
- [2] M. R. Jackson, J. E. Usowicz, **L. O. Tiziani**, J. A. Jarrell, D. P. Wittmer. *Flow splitting in supercritical fluid chromatography systems*. US 10183238 B2. 2019.
- [3] T. Dourdeville, J. A. Burnett, J. Usowicz, M. Lemelin, **L. O. Tiziani**. *Dispensing needle for a fraction collector*. US 10001463 B2. 2018
- [4] J. A. Burnett, J. Usowicz, M. Lemelin, **L. O. Tiziani**, J. Lamoureux, A. Lebeau. *Method of fraction collection for a liquid chromatography system (application)*. Appl. No. 14632049. 2015.

## Technical

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**Proficiency:** Robot Design & Control, Design Optimization, Mechatronics, Embedded Systems

**Design:** SolidWorks, Siemens NX, ANSYS, EAGLE

**Programming:** Python, C/C++, ROS, MATLAB & Simulink, Git, PyQt GUI dev., Web app dev.