

Yujiong Liu

Robotics & Mechatronics Lab

Department of Mechanical Engineering
Virginia Tech
Blacksburg, VA 24060

Home Address

1740 Donlee Dr
Blacksburg, VA 24060
(218) 940-1085

EDUCATION

Doctor of Philosophy, Mechanical Engineering

Virginia Tech, Blacksburg, VA

expected May 2022

DISSERTATION - Serpentine Robotic Tail: Modeling, Control, and Implementations

Advisor: Prof. Pinhas Ben-Tzvi

GPA 4.00/4.00

Master of Science, Applied and Computational Mathematics (Minoring in Computer Science)

University of Minnesota, Duluth, MN

May 2017

THESIS - A Connection Between Analytic and Nonanalytic Singular Perturbations of the Quadratic Map

Advisor: Prof. Bruce Peckham

GPA 4.00/4.00

Master of Engineering, Mechatronics Engineering

Harbin Institute of Technology, Harbin, China

July 2015

THESIS - Research on the Nonlinear Control of High-Speed Delta Robot

Advisor: Prof. Minxiu Kong

GPA 82.5/100

Bachelor of Engineering, Mechanical Engineering

Tongji University, Shanghai, China

July 2013

SENIOR PROJECT - Research on Flow Rate Pulsation of Piston Pump in Airplane Hydraulic System

Advisor: Prof. Jing Li

GPA 4.11/5 or 86.09/100

RESEARCH INTEREST

I enjoy exploring uncharted areas of human knowledge and I am always eager to learn new things. I am interested in all areas of robotics and have a special interest on bioinspired robots and how to build these robots. I am good at combining both the analytical methods and the hands-on experience to solve problems.

PROFESSIONAL EXPERIENCE

GRA & Lab Manager (2020-present) @Robotics & Mechatronics Lab
Virginia Tech, Blacksburg, VA

August 2017 – Present

GTA @ Mathematics & Statistics Department
University of Minnesota Duluth, Duluth, MN

September 2015 – May 2017

GRA @Medical Robot Lab
State Key Laboratory of Robotics and System, Harbin, China

September 2013 – July 2015

PROFESSIONAL SKILLS

[Math] Mathematical Modeling and Analysis, System Dynamics and Control, Optimization
 [Hardware] Mechanical Design (e.g. Solidworks), Mechanical Manufacturing (e.g. CNC), Electrical Design (e.g. PCB)
 [Embedded System Development] Bare-metal (e.g. Arduino, ARM/Mbed OS), Embedded Linux (e.g. Buildroot, Yocto)
 [Software] ROS, Linux, GNU toolchain
 [Coding] C/C++, Matlab, Qt

ACADEMIC MEMBERSHIPS

Mathematical Association of America (MAA), Student Member (2015-2017)
 American Society of Mechanical Engineers (ASME), Student Member (2019-present)
 Institute of Electrical and Electronics Engineers (IEEE), Student Member (2019-present)

ACADEMIC SERVICES

I serviced as reviewers for several international journals and conferences

IEEE Transactions on Robotics
 IEEE/ASME Transactions on Mechatronics
 Autonomous Robots
 Journal of Mechanisms and Robotics, Transactions of the ASME
 ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC/CIE) 2018-2021
 ASME Dynamic Systems and Control Conference (DSCC) 2019
 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2020
 IEEE International Conference on Robotics and Automation (ICRA) 2022

TEACHING EXPERIENCE

GTA@Mechanical Engineering Department, Virginia Tech, Blacksburg, VA August 2018 – May 2019

- ME4006 Mechanical Engineering Lab II (2018 Fall)
- ME4005 Mechanical Engineering Lab I (2019 Spring)

GTA@Math Department, University of Minnesota Duluth, Duluth, MN September 2015 – May 2017

- MATH3298 Calculus III (2015 Fall, 2017 Spring)
- MATH1160 Finite Math (2016 Spring, 2016 Fall)
- MATH3810 Numerical Analysis (2017 Spring)

HONORS AND AWARDS

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| Distinction in Comprehensive Examination, Math Dep., University of Minnesota Duluth | 2016 |
| Outstanding Graduate, Mechatronics School, Harbin Institute of Technology | 2015 |
| First Class Scholarship (Twice), Harbin Institute of Technology | 2013, 2014 |
| First Prize of the 5th National College Mechanical Innovation Design Competition, Xian, China | 2012 |
| National Encouragement Scholarship, Ministry of Education, P.R. China | 2011 |
| Learning Scholarship (Twice), ME Dep., Tongji University | 2011, 2012 |
| Outstanding Student, ME Dep., Tongji University | 2010 |

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| Third Prize of the 27th National Physics Competition (Shanghai Area), Shanghai, China | 2010 |
| Third Prize of Tongji Physics Competition, Tongji University | 2010 |
| First Prize in the Chinese Chemistry Olympiad (Provincial), Ministry of Education, P.R. China, | 2008 |
| Second Prize in the Chinese Physics Olympiad (Provincial), Ministry of Education, P.R. China, | 2008 |
| Third Prize in the Chinese Mathematics Olympiad (Provincial), Ministry of Education, P.R. China, | 2008 |

PUBLICATIONS

Peer Reviewed Journal Articles

- [J11] Yang, J., Saab, W., **Liu, Y.** and Ben-Tzvi, P., “Reuleaux Triangle Based Two Degree of Freedom Bipedal Robot”, *Robotics*, In Press, Oct. 2021.
- [J10] **Liu, Y.** and Ben-Tzvi, P., 2021, “Dynamic Modeling, Analysis, and Design Synthesis of a Reduced Complexity Quadruped with a Serpentine Robotic Tail”, *Integrative and Comparative Biology*, 61(2), pp. 464–477.
- [J9] **Liu, Y.** and Ben-Tzvi, 2021, “A New Extensible Continuum Manipulator Using Flexible Parallel Mechanism and Rigid Motion Transmission”, *Journal of Mechanisms and Robotics, Transactions of the ASME*, 13(3), p. 031112.
- [J8] **Liu, Y.** and Ben-Tzvi, P., 2021, “Dynamic Modeling, Analysis, and Comparative Study of a Quadruped with Bio-inspired Robotic Tails”, *Multibody System Dynamics*, 51(2), pp. 195-219.
- [J7] Wang, J., **Liu, Y.** and Ben-Tzvi, P., 2021 “Robust Adaptive Input-Output Control for a Class of Modular Robotic Systems via Inverse Optimality Theory”, *International Journal of Control*, Published Online, DOI: 10.1080/00207179.2021.1885741.
- [J6] **Liu, Y.** and Ben-Tzvi, P., 2020, “An Articulated Closed Kinematic Chain Planar Robotic Leg for High Speed Locomotion”, *Journal of Mechanisms and Robotics, Transactions of the ASME*, 12(4), p. 041003.
- [J5] **Liu, Y.** and Ben-Tzvi, P., 2020, “Design, Analysis, and Integration of a New Two-DOF Articulated Multi-link Robotic Tail Mechanism”, *Journal of Mechanisms and Robotics, Transactions of the ASME*, 12(2), p. 021101.
- [J4] **Liu, Y.**, Wang, J. and Ben-Tzvi, P., 2019, “A Cable Length Invariant Robotic Tail Using a Circular Shape Universal Joint Mechanism”, *Journal of Mechanisms and Robotics, Transactions of the ASME*, 11(5), p. 051005.
- [J3] Wan, N., Yao, W., Fang, X. and **Liu, Y.**, 2019, “Partially Independent Control Scheme for Spacecraft Rendezvous in Near-Circular Orbits”, *Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering*, p. 0954410018776418.
- [J2] Rone, W., **Liu, Y.** and Ben-Tzvi, P., 2019, “Maneuvering and Stabilization Control of a Bipedal Robot with a Universal-Spatial Robotic Tail”, *Bioinspiration & Biomimetics*, 14(1), p. 016014.
- [J1] **Liu, Y.**, Kong, M., Wan, N. and Ben-Tzvi, P., 2018, “A Geometric Approach to Obtain the Closed-Form Forward Kinematics of H4 Parallel Robot”, *Journal of Mechanisms and Robotics, Transactions of the ASME*, 10(5), p. 0510113.

Peer Reviewed Conference Proceedings

- [C6] **Liu, Y.** and Ben-Tzvi, P., “Systematic Development of a Novel, Dynamic, Reduced Complexity Quadruped Robot Platform for Robotic Tail Research”, *2022 IEEE International Conference on Robotics and Automation (ICRA)*, May 23-27, 2022, Philadelphia, PA, USA, Submitted.
- [C5] **Liu, Y.** and Ben-Tzvi, P., “Feedback Control of the Locomotion of a Tailed Quadruped Robot”, *Proceedings of the ASME 2021 IDETC/CIE, 45th Mechanisms & Robotics Conference*, Virtual, Online, Aug. 17-20, 2021.
- [C4] **Liu, Y.** and Ben-Tzvi, P., “A New Extensible Continuum Manipulator Using Flexible Parallel Mechanism and Rigid Motion Transmission”, *Proceedings of the ASME 2020 IDETC/CIE, 44th Mechanisms & Robotics Conference*, St. Louis, MO, USA, p. V010T10A065, Aug. 16-19, 2020.

- [C3] **Liu, Y.** and Ben-Tzvi, P., “A New Approach to Model the Constant Curvature Continuum Robot Dynamics”, *Proceedings of the ASME 2019 Dynamic Systems and Control Conference*, Park City UT, USA, p. V003T20A001, Oct. 8–11, 2019.
- [C2] **Liu, Y.** and Ben-Tzvi, P., “Design, Analysis, and Optimization of a New Two-DOF Articulated Multi-link Robotic Tail”, *Proceedings of the ASME 2019 IDETC/CIE, 43rd Mechanisms & Robotics Conference*, Anaheim CA, USA, p. V05BT07A008, Aug. 18–21, 2019.
- [C1] **Liu, Y.** and Ben-Tzvi, P., “Dynamic Modeling of the Quadruped with a Robotic Tail Using Virtual Work Principle”, *Proceedings of the ASME 2018 IDETC/CIE, 42nd Mechanisms & Robotics Conference*, Quebec City, Canada, pp.V05BT07A021-V05BT07A021, Aug. 26-29, 2018.

Other Publications

- [O4] **Liu, Y.** and Ben-Tzvi, P., “A Systematic Approach to Develop a Reduced Complexity Quadruped Robot with a Serpentine Robotic Tail”, *Southeast Control Conference 2021*, Blacksburg VA, USA, Nov. 29-30, 2021. [Abstract Submission]
- [O3] Ben-Tzvi, P. and **Liu, Y.**, “Robots With Tails”, *ASME Mechanical Engineering Magazine*, 143(6), pp. 32-37, Available Online at: <https://www.asme.org/topics-resources/content/engineers-could-put-tails-on-robots>
- [O2] **Liu, Y.** and Ben-Tzvi, P., “Towards Dynamic Locomotion of Legged Robots Using Biomimetic Articulated Robotic Tails”, *2021 Society for Integrative and Comparative Biology Annual Meeting (SICB 2021)*, Washington D.C., USA, Jan. 3-7, 2021. [Abstract Submission]
- [O1] **Liu, Y.** and Ben-Tzvi, P., “Maneuvering and Stabilization of Reduced Complexity Legged Robots Using Bioinspired Robotic Tails”, *2019 Do Good Robotics Symposium*, College Park MD, USA, October 3-4, 2019. [Extended Abstract Submission]

Patents

- [P5] Ben-Tzvi, P., **Liu, Y.**, 2021, Extensible Continuum Manipulator, Patent App. No. 63/032,200, INTERNATIONAL (PCT), 5/28/2021
- [P4] Ben-Tzvi, P., Saab, W., Rone, W., **Liu, Y.**, 2019, Articulated Multi-Link Robotic Tail Systems and Methods, Patent App. No. 16/428,732, UNITED STATES, Publication Date 12/5/2019
- [P3] Wang, S., **Liu, Y.**, Gong, P., Sun, T., Pan, Q., Yin, Y., 2014, A Quadruped Walking Robot, Patent No. CN 201410214222.3, P.R. CHINA.
- [P2] Ji, C., **Liu, Y.**, Kong, M., 2014, An O-ring Gripper Used for Automatic Assembly, Patent No. CN 201410145847.9, P.R. CHINA.
- [P1] Ji, C., **Liu, Y.**, Kong, M., 2014, A Novel Fourth Axis of Delta Robot with an Upper Placed Ball Joint Clamping a Square Shaft, Patent No. CN 201410126057.6, P.R. CHINA.

Thesis and Dissertation

- [T2] **Liu, Y.**, “A Connection Between Analytic and Nonanalytic Singular Perturbations of the Quadratic Map”, *University of Minnesota*, May 2017.
- [T1] **Liu, Y.**, “Research on the Nonlinear Control of High-Speed Delta Robot”, *Harbin Institute of Technology*, July 2015.

OTHERS

Mentoring

Senior Design Team (7 students)
Shikhar Kashyap (M.Eng)

Isaac Pressgrove (M.S)
Alex Broz (Undergraduate)
Logan Stevenson (Undergraduate)

Proposal Writing

National Science Foundation (NSF) CMMI 1906727: Control of Dynamically Coupled Agile Legged Robots and Bioinspired Robotic Tails ROLE = participating author, STATUS = funded
National Science Foundation (NSF) NRI3.0: Utilizing Serpentine Robotic Tails to Achieve Dexterous and Agile Legged Locomotion ROLE = leading author, STATUS = writing

Invited Talks

"Serpentine Robotic Tails: Modeling, Control, and Implementations", School of Astronautics, Northwestern Polytechnical University, China 04/07/2021