Trevor W. Exley

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Personal Statement

Soft robotics researcher specializing in architected, monolithic systems where structure and function are co-designed. My current work investigates material architectures that integrate actuation and sensing within a single body, enabling pathways toward printable, assembly-free soft robotic systems.

Education

Ph.D., Biomedical Engineering, University of North Texas   2021–2024
Dissertation: "Thermo-Reversible Phase-Change Actuators for Physical
Human–Robot Interactions. Supervisor: Amir Jafari. " GPA: 4.00/4.00.

M.S., Biomedical Engineering, University of North Texas   2020–2021
Thesis: "Parkinson's Disease and UPDRS-III Prediction Using Quiet
Standing Data and Applied Machine Learning."

B.S., Biomedical Engineering, University of North Texas   2017–2020
Minors: Mathematics, Mechanical Engineering.
Senior Capstone: "Hercules: Low Cost Trans-Humeral Prosthetic Capable of
Power and Precision Grip Controlled Through Foot and Upper-Body Movement"

Appointments

Postdoctoral Researcher, Soft Biorobotics Perception Research Line, Istituto   2024–Present
Italiano di Tecnologia (IIT), Genova
PhD Researcher, Advanced Robotic Manipulators Lab, University of North   2021–2024
Texas
Lab Affiliated, Biomedical AI Lab, University of North Texas   2020–2023

Peer-Reviewed Publications

(* = corresponding author; † = co-corresponding author)

Submitted / Under Revision

[J.13] D. Q. Nguyen, **T. Exley**, S. Ghosh, L. Beccai. *Jamming Assisted Lattice Continuum Arm (JALCA) for Lightweight High Payload Manipulators* Submitted to *IEEE Robotics and Automation Letters submitted*

[B.1] D. Cafiso, **T. Exley**, P. Trunin, A. B. Nardin, S. Hajaresab Ladakhana, L. Beccai. *Monolithic Strategies for Soft Robotics: Towards Fully Integrated 4D-Printed Systems.* In *Smart Materials in Additive Manufacturing, Volume 3: 4D-Printed Robotic Materials, Sensors, and Actuators. (submitted)*

[C.6] **T. Exley**, A. B. Nardin, P. Trunin, D. Cafiso, L. Beccai. Monolithic Units: Actuation, Sensing, and Simulation for Integrated Soft Robot Design. Submitted to *IEEE RoboSoft* 2026. *(submitted)*

[J.12] P. Trunin, D. Cafiso, A. B. Nardin, **T. Exley**[†], L. Beccai. MELEGROS: Monolithic Elephant-inspired Gripper with Optical Sensors. Submitted to *Advanced Science* (2025). *(accepted)*

[J.11] D. Johnson, **T. Exley**, M.-A. Torres, J. Slayton, M. Ecker, A. Jafari. Tailoring Silicone Mixtures for Soft Robotics: Predictive Modeling and Experimental Validation in Pneumatic Soft Actuators. Original Manuscript Ref: BMM-106977. *(under revision)*

In Press / Published

[J.10] **T. Exley**, D. Johnson, A. Jafari. Estimating Stiffness and Damping of a Novel Variable Impedance Actuator based on Adjusting Viscoelastic Properties of Thermoresponsive Polycaprolactone in Harmonic Motions. *Scientific Reports.* (2025)

[J.9] **T. Exley**, R. Wijesundara, S. Wang, A. Moridani, T. Nilforooshan, A. Jafari. TVIM: Thermoactive Variable Impedance Module Evaluating Shear-Mode Capabilities of Polycaprolactone. *IEEE Access* (2025).

[C.5] J. Jenkins, O. Madera, C. Guerrero, K. Humes, A. Malmquist, C. Renfrew, Q. Bakker, K. Siu, **T. Exley**, A. Jafari. Design and Implementation of a High-Precision Motor Control System for Adjustable-Stiffness Biomedical Treadmills. In *Proc. IEEE 18th Dallas Circuits and Systems Conf. (DCAS)*, 1–6 (2025).

[C.4] F. Tajomi, **T. Exley**, A. Jafari. Development of a Miniature Thermal-Based Variable Impedance Actuator Using Thermoplastic Polymers for Scalable and Compact Robotic Applications. In *Proc. IEEE 18th Dallas Circuits and Systems Conf. (DCAS)*, 1–6 (2025).

[C.3] **T. Exley**, R. Wijesundara, N. Tan, A. Sunkara, X. He, S. Wang, B. Chan, A. Jain, L. Espinosa, A. Jafari. Agonist–Antagonist Pouch Motors: Bidirectional Soft Actuators Enhanced by Thermally Responsive Peltier Elements. In *IEEE/RSJ IROS* (2024).

[C.2] K. Ruiz, S. Ryan, S. Stutsman, T. Tirumala, J. Williams, R. Wijesundara, **T. Exley**, A. Jafari. Design considerations of Peltier-Integrated Therapeutic Wrist Wrap for Medical Applications. *2024 46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)* (2024)

[J.8] **T. Exley**, D. Johnson, A. Jafari. Comparative Analysis of Peltier Devices and Flexible Heater Strips for Enhancing Bandwidth in Thermo-Active Soft Actuators. *Journal of Medical Robotics Research* 9(03n04):2450002 (2024).

[J.7] **T. Exley**, E. Hays, D. Johnson, A. Moridani, R. Motati, A. Jafari. Toward a Unified Naming Scheme for Thermo-Active Soft Actuators: A Review of Materials, Working Principles, and Applications. *Robotics Reports* 2(1):15–28 (2024).

[J.6] **T. Exley**, D. Johnson, A. Jafari. A Novel Variable Impedance Actuator Utilizing Adjustable Viscoelastic Properties of Thermoresponsive Polycaprolactone. *Robotics Reports* 1(1):57–66 (2023).

[J.5] **T. Exley**, D. Johnson, A. Jafari. Towards a Novel Thermal-Based Variable Impedance Module through Adjusting Viscoelastic Properties of a Thermoresponsive Polymer. *IEEE Transactions on Medical Robotics and Bionics*, 1–1 (2023).

[J.4] **T. Exley**, D. Johnson, A. Jafari. Utilizing the Peltier Effect for Actuation of Thermo-Active Soft Robots. *Smart Materials and Structures* (2023).

[J.3] E. Hays, J. Slayton, G. Tejeda-Godinez, E. Carney, K. Cruz, **T. Exley**, A. Jafari. A Review of Rehabilitative and Assistive Technologies for Upper-Body Exoskeletal Devices.

Actuators 12 (Soft Robotics in Biomedical Application):178 (2023).

[C.1] Z. Liu, **T. Exley**, A. Meek, R. Yang, H. Zhao, M. V. Albert. Predicting GPU Performance and System Parameter Configuration Using Machine Learning. In *IEEE ISVLSI*, 253–258 (2022).

[J.2] **T. Exley**, S. Moudy, R. M. Patterson, J. Kim, M. V. Albert. Predicting UPDRS Motor Symptoms in Individuals with Parkinson's Disease from Force Plates Using Machine Learning. *IEEE Journal of Biomedical and Health Informatics* 26(7):3486–3494 (2022).

[J.1] **T. Exley**, A. Jafari. Increasing Robustness and Output Performance of Variable Stiffness Actuators in Periodic Motions. *Mechanism and Machine Theory* 169:104645 (2022).

[J.0] **T. Exley**, A. Jafari. Maximizing Energy Efficiency of Variable Stiffness Actuators through an Interval-Based Optimization Framework. *Sensors and Actuators A: Physical* 332:113123 (2021).

Grants & Funding

NIH G-RISE (T32GM136501)   2021-2024
Amount: $109,318 USD.

Patents

[P.4] R. Kaleigh, S. Ryan, S. Stutsman, T. Tirumala, J. Williams, R. Wijesundara, **T. Exley**, A. Jafari. **Peltier-integrated therapeutic wrap**. US Patent App. 18/649,757 (2024).

[P.3] E. Hays, E. Carney, K. Cruz, J. Slayton, G. Tejeda-Godinez, **T. Exley**, A. Jafari. **Devices for biomechanical assistance including an exoskeleton and a robotic glove**. US Patent App. 18/649,708 (2024).

[P.2] A. Jafari, **T. W. Exley**. **Thermal-based variable impedance actuator**. US Patent App. 18/418,008 (2024).

[P.1] A. Jafari, **T. W. Exley**. **Thermoactivate modular soft actuator based on phase transition**. US Patent App. 18/417,801 (2024).

Workshops

[W.1] **T. Exley**, M. Taghavi, F. Vanneste, L. Beccai (organizers). "Monolithic Soft Systems: Co-design components, tools, materials, and fabrication strategies for next-generation robotics." *IEEE RAS RoboSoft 2026 Workshop* (full day), Kanazawa, Japan. *(submitted)*.

Projects

Deliverables, presentations, multi-partner coordination

PROBOSCIS (PROBOSCIdean Sensitive Soft Robot for Versatile Gripping)   2024–2025
European Union Horizon Grant, Agreement No. 863212.

Teaching

Traditional Courses

[1] Teaching Fellow, UNT BMEN 2320 – *Biomedical Instrumentation*   Summer 2021

[2] Teaching Assistant, UNT BMEN 2210 – *Biomedical Data Acquisition*;   2020–2021
BMEN 2320 – *Biomedical Instrumentation*

External courses, tutorials, and workshops

[1] **Soft Robotics in i4.0** Robotics in Industry 4.0: Challenges and Opportunities
University of Texas at San Antonio, Summer 2022

Research Supervised

Direct, Individual

Anita Stephanie Akpu — Undergraduate	Sep 2023 – May 2024
→ BME B.S. at University of North Texas	
Rachel Evers — Undergraduate	Sep 2023 – May 2024
→ Biology B.S. at University of St. Thomas	
Kendra Green — Undergraduate	Sep 2023 – May 2024
→ BME B.S. at University of North Texas	
Joanna Thirunilathu — Undergraduate	Sep 2023 – May 2024
→ BME B.S. at University of North Texas	
Bonnie Chan — TAMS Student [C.3]	Sep 2023 – May 2024
→ B.A. at Harvard University	
Luis Espinosa — TAMS Student [C.3]	Sep 2023 – May 2024
→ Aerospace B.S. at Georgia Tech	
Xinyu (Hebe) He — TAMS Student [C.3]	Sep 2023 – May 2024
→ CSCE B.S. at UT Austin	
Aditya Jain — TAMS Student [C.3]	Sep 2023 – May 2024
→ Neuroscience/CSCE B.S. Pre-Med at UT Austin	
Akshay Sunkara — TAMS Student [C.3]	Sep 2023 – May 2024
→ EECS B.S. at UC Berkeley	
Nathan Tan — TAMS Student [C.3]	Sep 2023 – May 2024
→ MEEN at UT Austin	
Shuopu Wang — TAMS Student [C.3]	Sep 2023 – May 2024
→ ECE B.S. at UT Austin	
Arian Moridani — Undergraduate [J.8]	Mar 2023 – May 2024
→ CSCE M.S. at Georgia Tech	
Ramya Motati — TAMS Student [J.8]	Apr 2023 – Dec 2023
→ Biochem B.S. at Rice University	
Kalyan Adhikari — TAMS Student	Jun 2022 – Feb 2023
→ CSCE B.S. at Texas A&M	

Direct, Group

Omar Madera, Cristian Guerrero, James Jenkins [C.5]	Aug 2023 – Aug 2024
EE Senior Capstone	

Jack Slayton, Emilly Hays, Emily Carney, Kobe Cruz, Gary Aug 2022 – May 2023
Tejeda-Godinez [*P*.3] [*J*.4]
BME Senior Capstone

Sarah Stutsman, Tanya Tirumala, Samantha Ryan, Jatara Aug 2022 – May 2023
Williams, Kayleigh Ruiz [*P*.4] [*C*.2]
BME Senior Capstone

Service

Editorial

Co–Guest Editor, *Actuators* Special Issue "Soft Robotics in Biomedical Application"   2024

Reviewer

Actuators
Applied Sciences
Biomimetics
IEEE Access
IEEE Intl. Conference on Rehabilitation Robotics (ICORR)
IEEE/RSJ Intl. Conference on Intelligent Robots and Systems (IROS)
IEEE RoboSoft Conference
IEEE Robotics and Automation Letters (RA–L)
IEEE Transactions on Medical Robotics and Bionics (T–MRB)
IEEE Transactions on Robotics (T–RO)
Journal of NeuroEngineering and Rehabilitation (JNER)
Robotics Reports
Soft Robotics

Talks (selected)

[2] Global Ethicon: "Thermo-Reversible Phase-Change Actuators for pHRI"   Feb 15, 2023

[1] UNT Health Science Center: "Introduction to Machine Learning"   Jun 11, 2021

Awards

[4] Outstanding Ph.D. Graduate, University of North Texas (2024)

[3] Outstanding M.S. Student, University of North Texas (2021)

[2] Outstanding Senior; Distinguished Honors College Scholar; UNT Excellence Scholarship (2020)

[1] Esports Scholarship, UNT Varsity League of Legends Team (2019–2020)

Professional Memberships

Institute of Electrical and Electronics Engineers (IEEE)   2020–Present
Biomedical Engineering Society (BMES)   2020–2024
American Society of Biomechanics (ASB)   2020-2021