Curtis C. Johnson

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Education

Brigham Young University — Provo, Utah
Ph.D. in Mechanical Engineering — April 2020–Current

- Advisor: Dr. Marc Killpack
- Emphasis in Robotics, AI, and Controls
- Dissertation Topic: Modeling, Planning, and Control for Whole-Body Manipulation of Unknown Objects with Large-Scale Soft Robots

Brigham Young University — Provo, Utah
B.S. in Mechanical Engineering — April 2020

Experience

Robotics and Dynamics Laboratory — Provo, Utah
PhD Candidate — 2020-Current

- Designed and built a large-scale soft robot named Baloo, covered by university and local news.
- Implemented novel Model Predictive/adaptive controllers for pneumatic actuators.
- Developed tactile sensing, MuJoCo simulation, and reinforcement learning pipeline for learned whole-body manipulation.

Brain Inspired Robotics Laboratory, BioRobotics Institute — Pisa, Italy
Visiting Researcher — May 2023-Aug 2023

- Developed and applied reinforcement learning algorithms for whole-body manipulation of large objects using a soft robotic torso

BYU Mars Rover Team — Provo, Utah
Mechanical Team Lead — 2019-2020

- Led a team of 15 students for the University Rover Challenge (URC), an international competition challenging student teams to design and build the next generation of Mars rovers.
- Responsible for the design and control of a dexterous robotic manipulator capable of pushing buttons, opening doors, and typing. (https://youtu.be/BoTr3ki3cUQ?si=bgCk1xxJlxLNuYpq)

IM Flash Technologies (an Intel-Micron Joint Venture) — Lehi, Utah
Automation Engineering Intern — Summer 2019

- Designed and implemented an automated cleaning system to clean toxic chemicals from semiconductor manufacturing equipment, saving thousands of dollars daily in cleaning fees and increasing worker safety.

National University of Singapore — Singapore
International Product Design — May 2017

- Worked with an international team to understand and solve local sanitation challenges by designing a custom trash collection system.

Publications

1. Hyatt, P., **Johnson, C. C.**, and Killpack, M. D. (2020). "Model Reference Predictive Adaptive Control for Large-Scale Soft Robots." *Frontiers in Robotics and AI*, 7:558027. doi:10.3389/frobt.2020.558027

2. **Johnson, C. C.**, Quackenbush, T., Sorensen, T., Wingate, D., and Killpack, M. D. (2021). "Using First Principles for Deep Learning and Model-Based Control of Soft Robots." *Frontiers in Robotics and AI*, 8:654398. doi:10.3389/frobt.2021.654398

3. Jensen, S. W., **Johnson, C. C.**, Lindberg, A. M., and Killpack, M. D. (2022). "Tractable and Intuitive Dynamic Model for Soft Robots via the Recursive Newton-Euler Algorithm." In *Proceedings of the IEEE International Conference on Soft Robotics (RoboSoft)*, pp. 7.

4. Sherrod, V., **Johnson, C. C.**, and Killpack, M. D. (2022). "Design Optimization for a Compliant, Continuum-Joint, Quadruped Robot." *Frontiers in Robotics and AI*, p. 31.

5. **Johnson, C. C.**, Cheney, D. G., Cordon, D. L., and Killpack, M. D. "PneuDrive: An Embedded Pressure Control System and Modeling Toolkit for Large-Scale Soft Robots." *2024 IEEE 7th International Conference on Soft Robotics (RoboSoft).*

6. Zwane, S., Cheney, D., **Johnson, C. C.**, Luo, Y., Bekiroglu, Y., Killpack, M. D., and Deisenroth, M. P. (2024). "Learning Dynamic Tasks on a Large-Scale Soft Robot in a Handful of Trials." In *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).*

Publications Under Review / In Preparation

1. **Johnson, C. C.**, Clawson, A., and Killpack, M. D. "Baloo: A Large-Scale Soft Robotic Torso for Whole-Arm Manipulation." Submitted to *IEEE Transactions on Mechatronics*.

2. Sanders, H., and **Johnson, C. C.** "Adaptive Control and Optimal Trajectory Generation for Highly Dynamic Tasks on a Soft Robot." Submitted to *Soft Robotics*.

3. **Johnson, C. C.**, Alessi, C., Falotico, E., and Killpack, M. D. "Zero-Shot Whole-Body Manipulation with a Large-Scale Soft Robotic Torso via Guided Reinforcement Learning." In preparation for submission to *IEEE Transactions on Robotics*.

4. **Johnson, C. C.**, Webb, D., Hill, D., and Killpack, M. D. "A Distributed Whole-Body Tactile Sensing System for Closed-Loop Control Using Fabric-Based Resistive Arrays." In preparation.

Teaching and Mentoring

- **Research Mentor** at Brigham Young University 2021-Present
  Various Projects
  - Led and advised several teams of undergraduate students (20-30 in total) on a variety of projects, including robot linkage design, tactile sensing, and embedded controls.
- **Teaching Assistant** at Brigham Young University 2017-2019
  Introduction to Mechatronics
  - Instructed over 150 students in the design and control of small mobile robots for a class competition.
  - Oversaw weekly labs involving PCB design, embedded programming, and signal processing.

Skills

- **Programming and Software:** Python, C++/C, MATLAB, LaTeX, ROS, PyTorch, MuJoCo, Autodesk Eagle, Drake
- **Technical:** Model Predictive Control, Linear/Nonlinear Optimization, Deep Learning, Dynamical System modeling, Adaptive Control, Force Control, Path Planning, Physics Simulation, Genetic Algorithms, Reinforcement Learning, PCB Design, Tactile Sensing
- Fluent Spanish Speaker

Projects

For more details see curtiscjohnson.github.io/projects. Projects include autonomous RC city driving, stereo vision baseball catcher, autonomous flight simulation, implementations of various SLAM algorithms, etc.

Awards

- BYU Mechanical Engineering Department Graduate Student Award: Impact 2025
  - Given to one PhD student annually for demonstrating the desire, faith, and persistence to seek out and solve meaningful technical and societal challenges.
  - "Every project that Curtis touches in our lab is improved. He has led multiple teams of undergrads, mentored multiple other MS and PhD students, and does all of this without recognition or assignment by me. He is truly an independent researcher in many ways, while still caring deeply for the success of the lab and other students around him." - Dr. Marc Killpack

Media Coverage

- "BYU engineers are accelerating the 'helpful robot' revolution", *BYU University Communications*.
- "Watch: Spring-like humanoid robot lifts ladders, kayaks, car tires, chairs with ease", *Interesting Engineering*.
- "BYU students invent 2 robots that could help first responders", *KSL TV*.
- "Meet Baloo, A BYU Student's Able-Bodied 'Soft' Robot", *Advanced Manufacturing*.
- "BYU student creates robot capable of lifting heavy items", *Fox 13 News*.