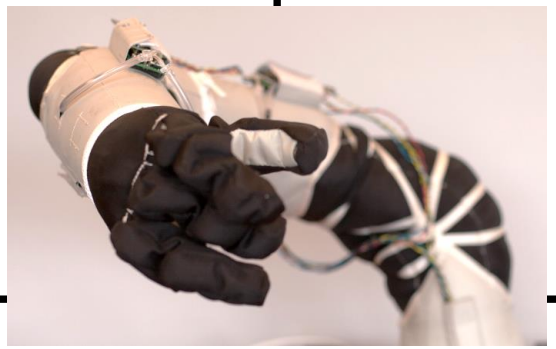
Model Predictive Control of an Underdamped, Pneumatically Actuated, Soft Robot with Flexible Links for Unmodeled Environments

- PI: Dr. Marc D. Killpack
  - Brigham Young University (BYU)
- Collaborators:
  - Dr. Larry L. Howell
    - BYU
  - Dr. Wayne J. Book
    - Georgia Tech

Research Objectives

- Develop optimal control methods for soft robots to enable fast, precise motion despite the difficult underdamped dynamics of the system.
- Apply these control methods to achieve unprecedented performance in real and unmodeled environments for soft robot manipulation and locomotion.
- Test the controllers in realistic and useful scenarios (such as equipment maintenance or installation, or exploration of rugged terrain), that will have wide applicability to future space missions.



Soft, underdamped, pneumatically controlled robot from Pneubotics.

Approach

- Model soft robots using approximate linear and non-linear models.
- Incorporate these models into Model Predictive Control (MPC) framework using state-of-the-art real-time optimization for robot manipulation in unmodeled environments.
- Compare MPC to other state-of-the-art controllers for underdamped systems.
- Build new capabilities on top of low-level MPC controllers such as 1) collaboration between different soft robots and 2) soft robot locomotion.

Potential Impact

- Capable robots can provide significant benefits for space exploration in terms of human assistance and collaboration, rugged terrain exploration, or equipment maintenance.
- The proposed controllers will enable cheaper, lighter (10 times lighter), smaller (10 times smaller packing volume) robots for important missions.
- The proposed control methods and testing will also be applicable in other important areas such as search and rescue or disaster relief.