NRI/Collaborative Research: Robust Design and Reliable Autonomy for Transforming Modular Hybrid Rigid-Soft Robots

Hunter B. Gilbert (Louisiana State University) and Isuru S. Godage (Texas A&M University)

https://gilberhb.github.io/NRI-TransformingModularHybridRigidSoftRobots/

Abstract

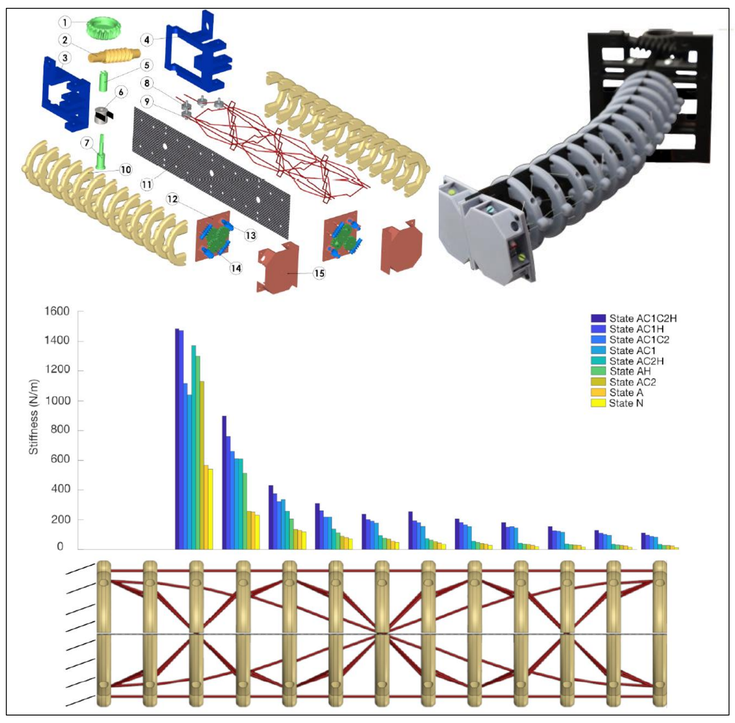
The research plan is aligned along two distinct but interconnected thrusts. The first thrust focuses on the challenges of modular soft robot design for space applications. The second thrust focuses on the challenges of robust and reliable non-collocated human-robot collaboration. The modular design will allow the soft robot design to make new connections and different shapes based on the conditions of the surrounding environment.

Key Challenges

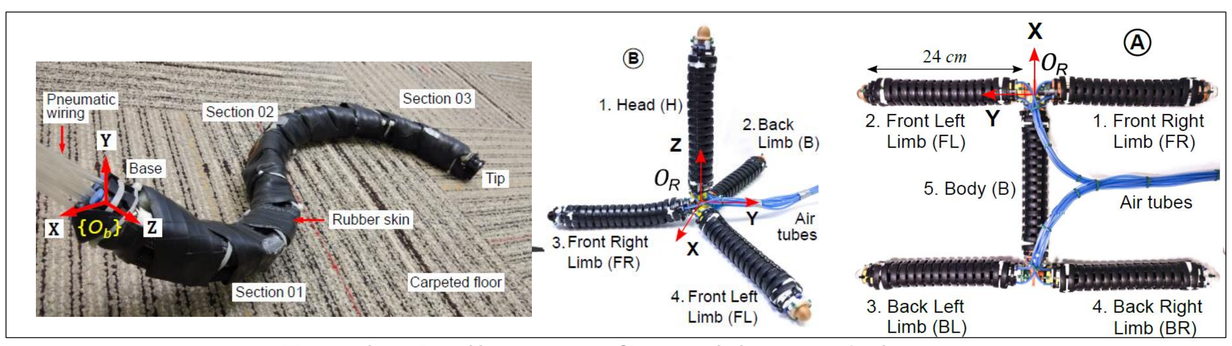
- Combine the advantages of rigid robots and soft robots, which are environmentally sealed yet topologically reconfigurable.
- Coordination of large numbers of both actuated and passive DoF in hybrid rigid-soft systems to provide robustness and reliability for non-collocated human-robot teams

Scientific and Technological Impact

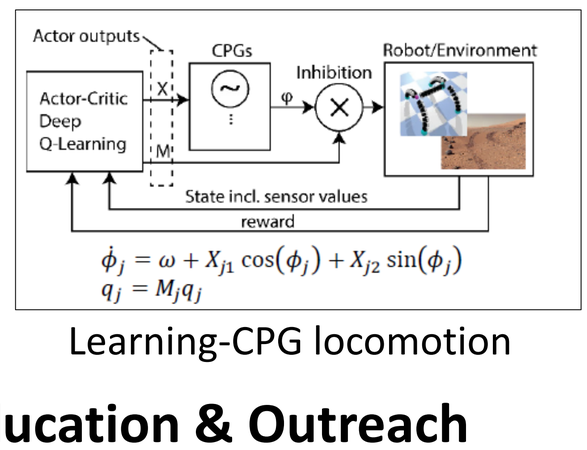
- New methods for modular robot connection and disconnection
- Physics-based simulation for discovery of compensatory gaits following module failure
- New methods for self-monitoring and redundancy in modular soft robots



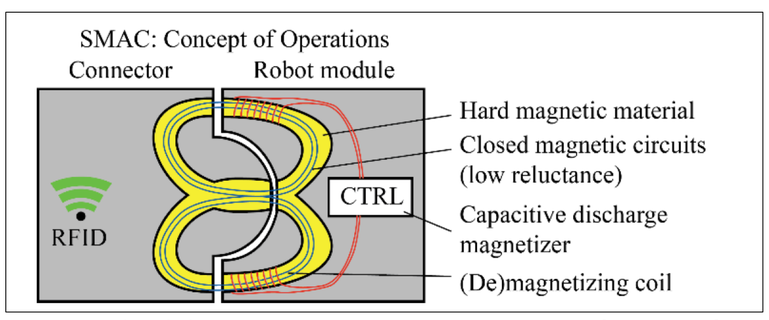
Stiffness-Controllable Continuum Robots



Topologically reconfigurable modules



Learning-CPG locomotion



Switchable MAgnetic Connector (SMAC)

Impacted Application Areas

- Scientific exploration
- Search and rescue
- Inspection
- Surveillance and reconnaissance

Education & Outreach

- 10 min tutorial YouTube videos https://bit.ly/3uBaV7z
- Building a snake-like soft robot (Gr 6-8)

Broader Impacts

- Enable soft robots to “leave the laboratory” and explore environments ranging from -100 to +100 C, 0-1 atm, and 10g accelerations

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