NRI: FND: Smart Material Composites and Design of Internal Structural Geometry for Tunably-Compliant Soft Robots

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https://labs.wsu.edu/m3robotics/research/

M3 ROBOTICS LABORATORY
Modeling . Motion . Medical

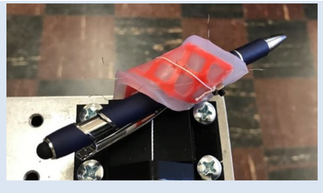
WASHINGTON STATE UNIVERSITY

Summary and Motivation

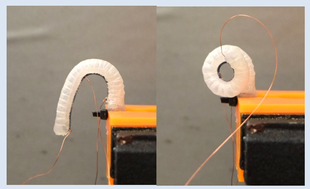
Traditionally, robotic systems have followed the paradigm of being comprised primarily of rigid structures with relatively few degrees of freedom and well-characterized motion driven by actuators directly connected to the rigid links. In recent years, there has been an explosion of research in the area of soft robotics, as they provide the promise of allowing robots and humans to work and collaborate in the same workspace. Hence there is a great need for materials and mechanisms that can dynamically change between acting as a soft or a rigid robotic component. This work focuses on the directional control of stiffness within soft robotics materials using smart material composites.

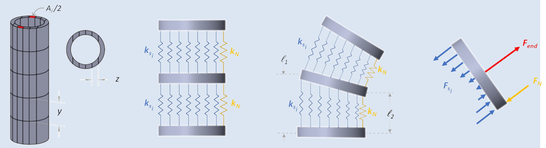
Prior Year Results

Selective melting of a lattice "skeleton" of low-melting point materials in elastometer.



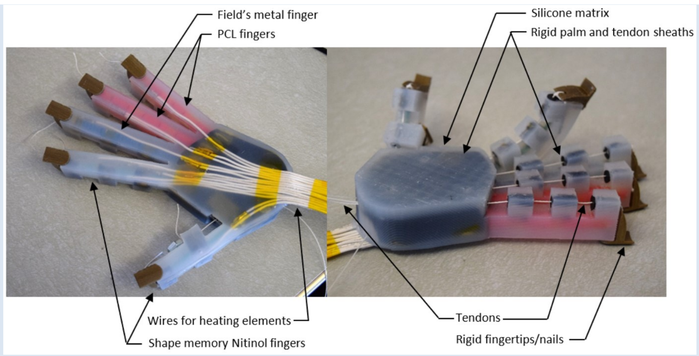
Composite of pneumatic chamber and longitudinal shape memory alloy fibers (PneuSMA). Simplified Modeling for control of static equilibrium using dual mode actuation of pressure and heat.





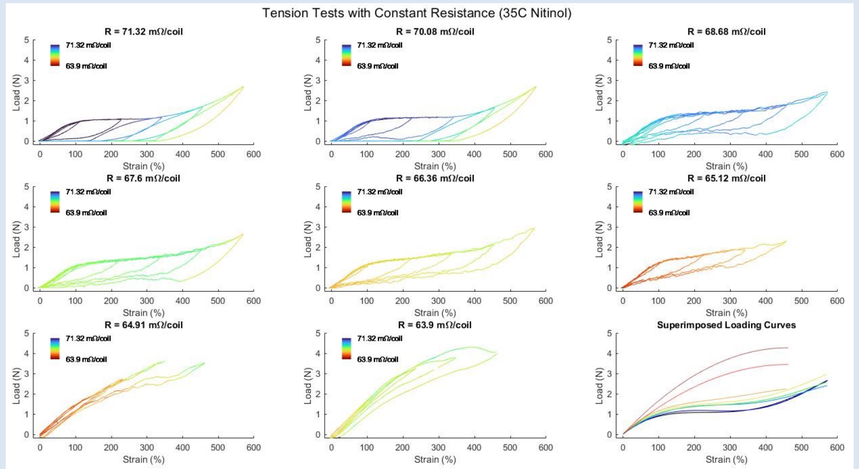
Education and Outreach

Learning modules to teach techniques for compositing smart materials in soft robots



Current Year Results

- Closed-loop control of measured resistance in SMA reinforcements.
- Resistance serves as a surrogate for temperature, thus enabling predictable models of curvature and forces.



Impacts and Observations

- Smart materials are an enabling technology in soft robots to increase geometric complexity of devices and geometric complexity of actuation
- Smart materials serve better as a means of modifying the underlying mechanics of the device, as opposed to real-time control
- Compositing of material plus compositing of control modalities are ideal.

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