Fiber-Reinforced Elastomeric Material for Soft Robotic Applications

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Technology description

Causes Elastomer to Move in Desired Direction with Fewer Actuators, Increasing Range of Movement or Improving Energy Efficiency

This fiber-reinforced elastomeric material improves the range of motion for soft robotics, allowing passive control over strain relationships in multiple directions without deforming elastomers. In soft robotics, such qualities improve soft actuator performance and efficiency, reduce the number of required actuators, and customize material properties. Soft robotics is an emerging field where robots are made with compliant materials that mimic the organic materials that make-up living organisms. Unlike traditional rigid robotic structures, soft structures are capable of bending to accommodate high stresses and return to an operational state without succumbing to critical failure. The greater flexibility, safety, and stress-resistance of soft robots promise to revolutionize fields from medicine to manufacturing. Commercially available components used for soft robotics are extremely limited due to the field's infancy.
Researchers at the University of Florida have developed a fiber-reinforced elastomer designed to allow control over the direction and magnitude of desired material deformation under compression forces.

Technology

This fiber-reinforced elastomeric material is made by embedding inextensible fibers in an elastomeric sheet in specific orientations.. This material was designed to operate under Poisson style soft actuators, such as Electro-Active Polymer (EAP) actuators (also known as Dielectric Elastomer Actuators or DEA), which generate a compressive force over a region of elastomeric material in order to drive an orthogonal expansion as governed by the material's Poisson ratio. When compressed, the embedded fibers must be re-oriented rather than stretched, due to their inextensibility, which leads to asymmetric deformation within the sheet plane. The fiber reinforcement increases extension in the desired direction, not just by preventing elongation in the perpendicular direction, but by actually driving compression in that direction. Therefore, the reinforced elastomer moves further in the desired direction, increasing efficiency and output motion. The optimal fiber orientations have been discovered to create a variety of different material properties and control the magnitude of desired material

Application area

Fiber-reinforced elastomeric material for the construction of energy–efficient, soft robots with an improved range of movement and minimal required actuators

Advantages

Enhances the performance of soft actuators, increasing output motion as much as 14 times that of an unreinforced sample under the same compression
Increase in performance increases the actuator efficiency by up to 70 percent in some applications, reducing operating costs
Has fibers aligned for optimal strain placement, allowing for the direction and magnitude of desired material deformation to be controlled
Passively reduces the possible deformations of the material in unwanted directions, reducing energy consumption and the number of required actuators
Provides tunable non-linear strain relationships, allowing customized vibration damping and energy absorption properties

Institution

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