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Dielectric elastomer actuator with dual mechanical stiffness response

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ABSTRACT

Inspired by bat wings which exhibit compliant response at lower stretch level to expand and a drastic stiffness change at higher stretch level to enable flapping. The bat-wing skin is highly anisotropic. The skin is more stretchable on spanwise direction and its stiffness becomes more than two orders of magnitude higher after stretched on chordwise direction. On the other hand, the skin on chordwise direction itself is less stretchable and with one order of magnitude of stiffness increase. A new composite dielectric elastomer actuator is developed to mimic such complex mechanical response of the bat through sets of variable stiffness reinforcement ligaments. The composite actuator is capable of initial large predetermined stretch, then exhibiting an order of magnitude increase in the actuator structural stiffness. The stiffners dimensions and geometric layout controls both the initial stretch and the final actuator stiffness. Details of the design, fabrication, and structural performance will be given in this study. Design domain limitations will also be explored.