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Development of Curling Actuations in HASEL Actuators

Soft robotic actuators have become an attractive alternative to executing biomimetic movement in robotics. Hydraulically amplified self-healing electro-static (HASEL) actuators have exhibited impressive actuation strain, speed, and efficiency, curbing competitive actuators through the alternative characteristic of self-healing from dielectric breakdown. The intent of this work is to use the efficiency and self-healing characteristics of HASEL actuators to achieve bio-inspired movements like those of prehensile functions in animals. Overall, this work involved refining and experimenting with three actuator designs (straight, scrunched, and s-shaped tails) in conjunction with four different strain limiting materials. An important finding of the research is the strain increase associated with a scrunched edge as compared to a straight edge actuator tail. Both the tails with a scrunched edge had strain rates that were approximately 8% higher than those of the straight edged tail. Additionally, the plastic adhesive strain limiting layer had the largest height deformation for the tip of the actuator tails. The plastic adhesive exhibited a 25% larger height deformation between the straight edge and the scrunched edge, and a 33% higher height deformation between the scrunched edge and the s-tail. After completing the experimentation curling actuation characteristics, a preliminary self-sensing circuit is currently being built. Although incomplete, the creation of a self-sensing circuit according to the unique geometries of the actuators would allow for more precise manipulation of the actuator after modeling [3]. Further, capacitance characteristics in the actuator can be monitored to better control curling actuation. Controlling this curling actuation would allow for a more robust robotic actuator that could complete more complex biomimetic movements that are currently limited by rigid actuation in space robotics. Further, the manipulation and modeling of these curling movements could allow robots to complete tasks as efficiently as humans for NASA missions in space environments unfit for human life.