Parametric Design Optimization of Soft Pneumatic Network Actuators for Rehabilitation

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While rehabilitation gloves created by Soft Pneumatic Network Actuators (SPNAs) are cheaper, more flexible, and more resistant to water/fall damage, these SPNAs can easily tear or even explode from high internal pressures. For this reason, the purpose of this project was to design, fabricate, and test SPNAs made of rectangular, trapezoidal, and triangular shaped cavities to see if SPNA cavity shapes with sloping sides could reduce the air pressure needed for SPNAs to function. To create the SPNAs, three molds were designed using Solidworks. These molds were then 3D printed and a silicone-rubber solution was poured into each mold. After 24 hours, the SPNAs were taken out of their molds and attached to a base made of silicone, rubber, and paper. Tubing was then inserted into each SPNA, and any points of weakness were reinforced using Sil-Poxy. After testing each SPNA for curvature from 15-75 kilopascals (kPa), the data shows that the triangular SPNA starts to consistently have the best curvature from 55-75 kPa. The trapezoidal SPNA starts to have better curvature than the rectangular SPNA after 65 kPa. The results indicate that at higher pressures SPNAs with cavity shapes that have sloping sides create greater bend than SPNAs with no sloping sides in their cavities. This makes rehabilitation gloves that use SPNAs with sloping sides more durable and safe.

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