Design and Evaluation of a Soft Robot for Analyzing the Effect of Silicone Texture on Robot Performance

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Soft robotics, robots made of flexible materials, offer advantages in adaptability, and safer interactions. This study examines a pneumatically actuated soft gripper, investigating the effects of surface texture, inflation time, and object type on the performance, specifically maximum grip strength. Fingers of three different textures (smooth, half-sphere, and triangular) were cast with silicone in 3D-printed molds to create grippers. An Arduino-controlled pneumatic actuator and testing setup were created to grip various objects, measuring the maximum force exerted just before the object slipped from the gripper. 2-way ANOVA and post-hoc tests determined statistical significance, with p-values of less than 0.05 considered statistically significant. Results showed that surface texture, object held, and their interaction affected gripping force. It was concluded that the smooth gripper with the balloon has the best performance compared to all other combinations. While the smooth gripper performed better with the balloon, the half-sphere gripper performed better with the tennis ball than the smooth gripper did. Inflation time also influenced performance, with the half-sphere and triangular grippers holding the tennis ball seeing generally improved performance at higher inflation times. These results highlight the importance of design choices such as surface texture and inflation time for soft grippers. These factors should be considered to optimize grip performance for varying objects in real world applications.

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