Soft Origami-Inspired 3D Print-In-Place Artificial Intelligence Robots

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Covid-19 pandemic leads to an increased need for automation in food industries. Current soft robots require cast molding, high assembly effort, large actuators and upfront actuation awareness due to absence of artificial intelligence. Our goals are to develop 3D print-in-place easy assembly under-actuated soft origami inspired grippers and soft legged robot with artificial intelligence object pose estimation to grasp objects with high repeatability of success under different conditions and mobility. Soft origami structures exhibit high levels of compliance. We developed a 3D print-in-place soft origami zigzag gripper using TPU. Grasping performance tests were conducted using different gripper designs, robot arm speed on objects with different mass and morphology. Soft origami zigzag gripper has better grasping performance than the hard gripper as analyzed by paired t-test. The logistic model of soft origami zigzag gripper's grasping performance achieved accuracy of 0.940 and AUC=0.911. Jetson Nano running AI CNN Resnet18, enhanced grasping performance with vision object classification achieved accuracy of 0.922 and F1 score of 0.998. Our soft legged robot is an endurance application adapted from the soft origami zigzag gripper. This novel and innovative design is inspired by the rigid joint Theo Jansen legged robot with highly adaptive 3D print-in-place soft origami legs capable of fluid motion and even surviving drop tests. This increases its durability while having flexibility, simplicity and safety. We have combined robots with soft origami structure, 3D print-in-place technique and artificial intelligence to improve automation in food processing, food handling and avoid contamination.

Awards Won:

First Award of $5,000

University of Arizona: Renewal Tuition Scholarship

Association for Computing Machinery: Fourth Award of $500

EU Contest for Young Scientists Award