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DEVELOPMENT OF SHAPE MEMORY ALLOY (SMA) BASED ARTIFICIAL MUSCLE FOR APPLICATION IN SOFT GRIPPER

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Abstract

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Abstract

Soft robotics is a branch of robotics that utilize soft materials instead of the common rigid links. Shape memory alloy (SMA) wire has the advantage of being compact and lightweight, as they only require simple control circuits and current input however has the drawback of low actuation force due to intrinsic softness. In this research, the use of SMA wire as artificial muscle embedded in silicone for application in a soft gripper is investigated. Simulation studies are done on different configurations of SMA wire embedded in silicone to determine the maximum tip displacement produced. It is found that single U-shape SMA wire configuration has the highest tip displacement compared to others. Experimental studies are conducted to see the mechanical response of various configurations of SMA wires embedded in silicone fingers. It is found that the double-planar-U-shape trapezoidal finger has the highest tip force followed by the single-U-shape and single-straight where the maximum tip force measured are 1.92 N, 1.03 N, and 0.44 N, respectively. For bending angle, the double-planar-U-shape trapezoidal finger produced the highest bending angle (270°) followed by the single-U-shape (88°) and single-straight (65°). Two different assemblies of SMA soft gripper which consists of three SMA fingers each are fabricated, complete with its actuation system. From performance measurement, it is found

that the individual SMA finger can withstand a maximum of 200g weight before deforming while the maximum weight the soft gripper can hold is 763 g before slipping. The capability of the grippers to grasp objects of different shapes is tested and it is found that the triangular gripper is better at grasping cubical and spherical objects while the parallel gripper is better at grasping cylindrical and long objects. The proposed SMA finger design and gripper assembly can help to improve the performance of SMA-based soft grippers for various applications. © School of Engineering, Taylor's University.

Author keywords

Artificial muscle; Shape memory alloy; Soft gripper; Soft robotics

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