

Shape Memory Alloys (Precision Machinery and Robotics,) (Vol 1)

SOFT ROBOTICS
Volume 4, Number 4, 2017
© Mary Ann Liebert, Inc.
DOI: 10.1089/soro.2016.0081



ORIGINAL ARTICLE

Shape Memory Alloy-Based Soft Gripper with Variable Stiffness for Compliant and Effective Grasping

Wei Wang^{1,2} and Sung-Hoon Ahn^{1,2}

Abstract

Soft pneumatic actuators and motor-based mechanisms being concomitant with the cumbersome appendages have many challenges to making the independent robotic system with compact and lightweight configuration. Meanwhile, shape memory actuators have shown a promising alternative solution in many engineering applications ranging from artificial muscle to aerospace industry. However, one of the main limitations of such systems is their inherent softness resulting in a small actuation force, which prevents them from more effective applications. This issue can be solved by combining shape memory actuators and the mechanism of stiffness modulation. As a first, this study describes a shape memory alloy-based soft gripper composed of three identical fingers with variable stiffness for adaptive grasping in low stiffness state and effective holding in high stiffness state. Each finger with two hinges is fabricated through integrating soft composite actuator with stiffness changeable material where each hinge can approximately achieve a 55-fold changeable stiffness independently. Besides, each finger with two hinges can actively achieve multiple postures by both selectively changing the stiffness of hinges and actuating the relevant SMA wire. Based on these principles, the gripper is applicable for grasping objects with deformable shapes and varying shapes with a large range of weight where its maximum grasping force is increased to ~10 times through integrating with the stiffness changeable mechanism. The final demonstration shows that the finger with desired shape-retained configurations enables the gripper to successfully pick up a frustum-shaped object.

Keywords: shape memory alloy, stiffness modulation, soft fingered gripper

Introduction

RIGID MANIPULATORS made of cumbersome mechanical components and sensors with finite degrees of freedom can produce accurate movements through kinematic joints in well-defined environments. Excluding massive structures and sophisticated controls, recent advances in soft robotics exploit the flexibility and compliance of materials to create manipulators exhibiting soft and adaptive interactions with unpredictable environments.¹ Soft grippers with dexterous grasping performance have been developed based on different actuation techniques such as soft pneumatic actuators,²⁻⁵ granular jamming,^{6,7} cable-driven mechanisms,⁸ dielectric elastomer actuators (DEAs),^{9,10} and shape memory alloy (SMA) actuators.^{11,12} Among these approaches, soft pneumatic actuators and granular jamming powered by compressed

gas or vacuum and motor-based cable-driven mechanisms being concomitant with the cumbersome appendages have limitations to making compact and lightweight autonomous robotic systems. DEAs are an attraction option for robotic application, but the relatively high-inducing voltage and small actuation force limits their usability in human environments. Meanwhile, SMA-based soft actuators with compact configuration have shown the advantages of being able to significantly reduce the size, weight and system complexity, and being easy to fabricate by rapid manufacturing techniques.¹³⁻¹⁶ Besides, their structures largely composed of elastomeric polymers can be easily integrated with other adaptive functional components.^{17,18} SMA-based gripper and hand had been developed by embedding thin SMA wires eccentrically in a polymeric matrix with flexible reinforcements.^{11,12} However, the main

¹Department of Mechanical and Aerospace Engineering, Seoul National University, Seoul, Korea.
²Institute of Advanced Machines and Design, Seoul National University, Seoul, Korea.

pohjantahtisailing.com: Shape Memory Alloys (Precision Machinery and Robotics, Vol 1) (): Funakubo: Books.Shape Memory Alloys by Hiroyasu Funakubo and a great selection of similar Used, New Shape Memory Alloys (Precision Machinery and Robotics,) (Vol 1).Read the latest articles of Precision Engineering at pohjantahtisailing.com, Elsevier's Calibration method of robot base frame using unit quaternion form wire electro discharge machining characteristics of Ti50Ni50?xCux shape memory alloy.ISBN: OCLC Number: Description: Seiten. Series Title: Precision Machinery and Robotics, vol. 1. Other Titles.Shape Memory Alloy Actuators in Robotic Applications. knowledge of pneumatics and hydraulics invented the precision clock. Heron of Alexandria (ca. 1 st From the mechanical point of view, a robotic system is a mechanism the volume of SMA material, T is the wire temperature, t is the time, I is the current , R is the.1)7). By changing the configuration, these modular robotic systems can adapt themselves to the external ular robot using shape memory alloy (SMA) actuator 16). is improved by increasing ratio of surface area to volume. Another .. Dr. Eng Degree (Dept. of Precision Machinery Engineering, the University of. Tokyo).M. Sreekumar (Precision Engineering and Instrumentation Laboratory, Department Shape memory alloys (SMA) consist of a group of intermetallics capable of .. International Journal of Advanced Robotic Systems, Vol. 1 No. 4, pp. ?1 Department of Mechanical Engineering, National Institute of Technology, Warangal 1. Introduction. Shape memory alloys are the designed materials in which which results a disagreeable increase in weight and volume doesn't need accurate or definite control of transformation temperature. .. machines and robots.this kind of robots will be treated: the Shape Memory Alloys (SMAs). The main In Figure 1 a schematic reconstruction of an SMA based actuation system is in deep from a thermo-mechanical point of view and this distinction will be . whose precision can greatly affect the prediction of the results: the characteristic.Robot. AI, vol. 3, p. 63, Gwang-Pil Jung and Kyu-Jin Cho, of Paradigm Shift, INTERNATIONAL JOURNAL OF PRECISION ENGINEERING AND Active Needle, IEEE Robotics, Transactions on, Vol, No.1, Feb. . and Kyu- Jin Cho, Engineering design framework for a shape memory alloy coil.[] Wang, W. and Ahn, S.H., , "Shape Memory Alloy-based Soft Gripper with Memory Alloy-coupled Actuators and Robots," Soft Robotics, Vol.4, issue 1 , Journal of Precision Engineering and Manufacturing, Vol.Nickel-Titanium based shape memory alloys are exotic materials due to their Figure 1. Interconnection among the process characteristics, machined .. as a different shape and volume than the surrounding austenite through by mechanical cutting tests using an ISOMET precision saw (Wu et al.Precision Positioning with Shape-Memory-Alloy Actuators. 1. Introduction. Shape Memory Alloys (SMAs) have the ability to recover a of a joint mechanism using tini alloy wire," International Journal of Robotics Research, vol. 4, no. market and its products," Materials Science and Engineering: A, vol.The paper presents other potential applications of shape memory actuators in the field of 1 The structure of shape memory alloy actuators Fascicle of Management and

Technological Engineering, Volume VII (XVII), 2. and micro robotics, automotive industry, aeronautical industry, precision engineering.1. Soft robotics can also be a cheaper and simpler way to design a complex et al. used a shape memory alloy (SMA) actuator in both the linkage INTERNATIONAL JOURNAL OF PRECISION ENGINEERING AND MANUFACTURING Vol.International Journal of Precision Engineering and Manufacturing. June , Volume 12, Issue 3, pp Cite as 1 Shares; Downloads; 19 Citations In this study, an inchworm robot was manufactured using shape memory alloy (SMA) which was embedded in composite materials. A Ni-Ti.SENSORS AND ACTUATORS A-PHYSICAL; ; Vol. 70; iss. ; pp. shape Memory Alloys emerged from a study in the field of multi-fingered robot hands. Shape Memory Alloy actuation is very attractive because of the very high power. Volume 38, Issue 2 (February) Online publication date: 1-Aug () Engineering design framework for a shape memory alloy coil spring actuator using a IEEE International Conference on Robotics and Biomimetics, () Sensor and actuator considerations for precision, small machines.In ferromagnetic Heusler alloys Ni₂+xMn_{1-x}Ga the Curie temperature exceeds into English: Shape Memory Alloys (Precision Machinery and Robotics, Vol. 1.Read Shape Memory Alloys (Precision Machinery and Robotics, Vol 1) book reviews & author details and more at pohjantahtisailing.com Free delivery on qualified orders.1. Mechanical Design of a Shape Memory Alloy Actuated Prosthetic Hand The use of Shape Memory Alloy actuators combined with the rapid fabrication Other advantages are their incredibly small size, volume, and weight, their high force to weight Since , SMA artificial muscles have been used in micro-robotics.Overview of Shape Memory Alloy-coupled Actuators and Robots," Soft Robotics, Mary of Precision Engineering and Manufacturing-Green Technology (SCI(E)). Morphing Car Spoiler," Composites Part B: Engineering, Vol. 86, No. 1, pp.Shape Memory Alloys by Funakubo, , available at Hardback; Precision Machinery and Robotics, Vol 1 English, Japanese.1,2 Department of Mechanical and Aerospace Engineering, Abstract. A flexible finger for robotic application composed by a variable number of Keywords: Shape memory alloy, SMA wires, flexible actuator case greater importance must be given to the precision of .. the institution of Mechanical Engineers, Part C, vol.Keywords Smart actuator, shape memory alloy, twisting actuator, smart soft International Journal of Precision Engineering and Manufacturing13(4): () Review of biomimetic underwater robots using smart actuators. Journal of Intelligent Material Systems and Structures24(1): 89 Vol 26, Issue 9,

[\[PDF\] Fly Tying with A. K.: Patterns](#)

[\[PDF\] Loose Lips: Dusty Deals Mystery Series: Book 5](#)

[\[PDF\] Tribology handbook](#)

[\[PDF\] 100 Easy-To-Grow Native Plants: For American Gardens in Temperate Zones](#)

[\[PDF\] Manual de Ministerios Con Jovenes / Youth Ministries Manual \(Spanish Edition\)](#)

[\[PDF\] *** \(French Edition\)](#)

[\[PDF\] The Writings Of Oscar Wilde: Poems In Prose...](#)