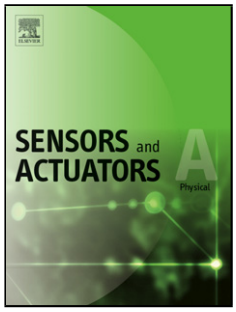

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Author: Mehdi Modabberifar Matthew Spenko

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A Shape Memory Alloy-Actuated Gecko-Inspired Robotic Gripper

Mehdi Modabberifar[a,*], Matthew Spenko[b]

[a]*Department of Mechanical Engineering, Faculty of Engineering, Arak University, Arak 38156-88849, Iran*
[b]*Department of Mechanical, Materials, and Aerospace Engineering, Illinois Institute of Technology, Chicago, IL 60616, USA*

Abstract

This paper introduces a shape memory alloy-based gripper for grasping flat objects with gecko-inspired adhesives. Compared to other grippers that utilize gecko-inspired adhesives, the gripper presented here is less expensive, lighter, simpler, and smaller, while still maintaining the ability to control the adhesive pressure. To verify the applicability of proposed gripper, experiments were conducted on a variety of substrates. Experimental results demonstrated 3.3, 2.75, 2.3, and 2.2 kPa average normal adhesion pressure on the surface of carbon fiber, acrylic, glass, and steel, respectively. These adhesion levels are on par with other grippers that use microstructured, gecko-like adhesives.

Keywords: Gecko-like adhesion, SMA wire, linear actuator, robotic gripper

1. Introduction

Microstructured, or gecko-like, dry adhesives have been used in conjunction with robotic grippers to manipulate flat objects [1] and as appendages in climbing robots [2], among other applications. The adhesives have several advantages, including lower power consumption and applicability to a wider range of materials, over traditional gripping methods such as suction and magnets. Furthermore, the microstructured adhesives can be used in unique environments, such as space, where suction and pressure sensitive adhesives are rendered useless due to space's vacuum and subsequent out-gassing concerns [3]. Most notably, there is a class of gecko-like dry adhesives, termed directional, that are controllable—as the adhesives are loaded in shear, the amount of normal adhesion increases from zero up to some limit [4]. These types of adhesives follow the same frictional-adhesion model as geckos [5].

Directional gecko-like adhesives are beneficial for robotic grippers because of their ability to turn adhesion on and off. There have been several examples of such grippers, many of which utilize a steering gear or Schunk parallel gripper for generating the shear force to engage directional dry adhesives [6, 7]. Although such electromagnetic drives are readily available and reliable, they are heavy, expensive, and occupy a relatively large volume.

*corresponding author
Email addresses: m-modabberifar@araku.ac.ir (Mehdi Modabberifar), mspenko@iit.edu (Matthew Spenko)