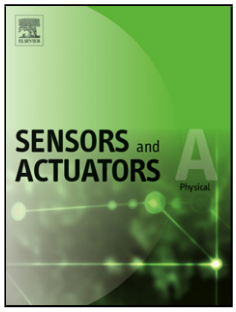

Title: Micro-Tweezers: Design, Fabrication, Simulation and Testing of a Pneumatically Actuated Micro-Gripper for Micromanipulation and Microtactile Sensing

Author: A.F. Alogla F. Amalou C. Balmer P. Scanlan W. Shu R.L. Reuben

PII: S0924-4247(15)30053-4
DOI: http://dx.doi.org/doi:10.1016/j.sna.2015.06.032
Reference: SNA 9237

To appear in: *Sensors and Actuators A*

Received date: 1-11-2014
Revised date: 25-6-2015
Accepted date: 25-6-2015

Please cite this article as: A.F. Alogla, F. Amalou, C. Balmer, P. Scanlan, W. Shu, R.L. Reuben, Micro-Tweezers: Design, Fabrication, Simulation and Testing of a Pneumatically Actuated Micro-Gripper for Micromanipulation and Microtactile Sensing, *Sensors and Actuators: A Physical* (2015), http://dx.doi.org/10.1016/j.sna.2015.06.032

Micro-Tweezers: Design, Fabrication, Simulation and Testing of a Pneumatically Actuated Micro-Gripper for Micromanipulation and Microtactile Sensing

A. F. Alogla, F. Amalou, C. Balmer, P. Scanlan, W. Shu and R. L. Reuben*

School of Engineering and Physical Sciences, Heriot-Watt University

Edinburgh, United Kingdom

*Email: w.shu@hw.ac.uk

Abstract

This paper presents a novel micro-gripper design with the dual functions of manipulation and force sensing. The device consists of two parallel plates, each mounted on torsion bars, which can be made to rotate towards or away from each other by use of a pneumatically- or hydraulically- actuated elastic membrane. The plates can be conveniently fabricated using photo-etching and the design allows for a range of ratios between actuation pressure and tip opening displacement and force. The elastic gripping tips can be designed to provide sufficient compliance that their strain can be used to monitor and control the gripping force. An exemplar device has been fabricated and its behaviour characterised by a series of mechanical measurements of force and displacement. These measurements have been rationalised using a simple analytical model, backed up with finite element analysis to emphasise the design variables and scalability. This exemplar device, with a maximum tip opening amplitude of 1mm and maximum force output of 50 mN, has also been demonstrated to perform pick-and-place operations with 200 µm micro beads.

1. Introduction

The rapid evolution in the biological sciences has led to an increased requirement for manipulating entities at the micro and nano- scale. In general, manipulating biological objects such as single cells, microbeads or even embryos can be classified into contact and non-contact techniques. The non-contact techniques are mainly optically-based [1-4], where a highly focused laser beam is used to trap and move a biological micro-object. Although the performance of such techniques is satisfactory, sophisticated and expensive optical setups are required [5] and the exposure to optical radiation may have long term negative effects on the manipulated micro-objects [6].