



Università di Pisa

SCUOLA DI INGEGNERIA

Corso di Laurea Magistrale in Ingegneria Biomedica

TESI DI LAUREA MAGISTRALE

Design and development of a Soft Robotic instrument for manipulation in Minimally Invasive Surgery

Relatori:

Prof. Cecilia Laschi
Dr. Matteo Cianchetti
Dr. Gastone Ciuti

Candidato:

Giovanni Rateni

Anno Accademico 2012-2013



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A Mamma e Papà

ABSTRACT

This work describes the concept design, fabrication and experimental characterization of a soft robotic gripper and discuss its utilization as a tool for grasping procedures in Minimally Invasive Surgery. The idea at the base of this proposal is to study the feasibility to grip soft tissues by using soft instruments. The advantages are all related to the intrinsically compliant property of the elastomeric material which allows safely getting closer to soft tissues inside the unstructured workspace of abdominal cavity, without the risk of damaging blood vessels or delicate organs during the manipulating procedures. This redefines the concept itself of open-loop control which can be based on the material property as a 'sensing element' of environmental stimuli. This allows to realize a powerful instrument equipped with a kind of low-level intelligence sufficient to ensure a safe and stable approach, without the need of a real force-feedback. Additionally, the scalable design allows its application to several different areas in which it is necessary to safely handle delicate parts, such as food industry, space sector and service robotics. In the first introductory chapter an overview of the areas in which the work fits into will be done, in the second and in the third chapters the concept design and fabrication process will be explained, in the fourth and fifth chapters the experimental validation of the prototype will be described and the results with relative discuss will be listed. Finally in the sixth chapter, conclusions and future work will be drawn.

This work has been carried on at the BioRobotics Institute of Scuola Superiore Sant'Anna and at the Artificial Intelligence Laboratory of the University of Zurich.

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ABBREVIATIONS

MIS.....*Minimally Invasive Surgery*

SPL.....*Single-Port Laparoscopy*

DOF.....*Degree Of Freedom*

SCG.....*Soft Claw Gripper*

CAD.....*Computer-Assisted Design*

CAM.....*Computer-Assisted Manufacture*

FDM.....*Fused Deposition Modeling*

MJM.....*Multi-Jet Modeling*

