

# Smart Grippers : Conception of a Novel Type of Actuator Powered by Shape Memory Alloys

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Integrated Actuators Laboratory  
Programme Doctoral en Robotics, Control, and Intelligent Systems  
École polytechnique fédérale de Lausanne  
pour l'obtention du grade de Docteur ès Sciences  
par

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acceptée sur proposition du jury :

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Prof Name Surname, rapporteur

Lausanne, EPFL, 2021





Wings are a constraint that makes  
it possible to fly.  
— Robert Bringhurst

To my parents...



# Acknowledgements

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*Lausanne, May 8, 2021*

D. K.



# Preface

A preface is not mandatory. It would typically be written by some other person (eg your thesis director).

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*Lausanne, 12 Mars 2011*

T. D.





# Abstract

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# Zusammenfassung

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## Résumé

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# Introduction

A non-numbered chapter...

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# **1 Fundamentals of Shape Memory Alloys**

In this chapter, a state of the art of shape memory alloys, their properties and their applications, are presented.

## **1.1 Introduction**

## **1.2 Conclusion**



## **2 Creating Artificial Muscles**

In this chapter, a basic simplified control strategy is investigated for characterization of SMAs. Furthermore, a basic analysis of sensorless SMA control is presented.

### **2.1 Introduction**

### **2.2 Conclusion**



## **3 Predicting the Shape Memory Effect**

In this chapter, different modelling strategies, such as finite element modelling and analytical modelling, are presented. Furthermore, the bias spring actuator model and a simplified model are presented.

### **3.1 Introduction**

### **3.2 Conclusion**





## **4 Mechanically Oscillating Actuator**

Here, in this chapter, a novel control mechanical control strategy and SMA actuator is showcased and studied.

### **4.1 Introduction**

### **4.2 Conclusion**



## **5 Biasing Compliant Mechanisms for SMA Actuators**

Using a compliant mechanism as a biasing element is a novel way to create an SMA actuator.

### **5.1 Introduction**

### **5.2 Conclusion**



## **6 Bistability in SMA Actuators**

In this chapter, a bistable mechanism is presented along with its implementation into an SMA actuator.

### **6.1 Introduction**

### **6.2 Conclusion**



## **7 Designing Compliant SMA Actuators**

Using topology optimization to create a compliant SMA actuator can be used to develop novel compact multi-output actuators.

### **7.1 Introduction**

### **7.2 Heating Strategies**

After a brief state of the art for heating strategies, the principle of wireless heating is extended to actuate the novel SMA actuators with complex shapes.

### **7.3 Conclusion**





## **8 Actuators Inspired by the Art of Kirigami**

By extending the use of novel shapes to create SMA actuators, a kirigami pattern can be used to create SMA actuators with higher force output while still showcasing high strokes.

### **8.1 Introduction**

### **8.2 Conclusion**





## **Conclusion**



## A An appendix

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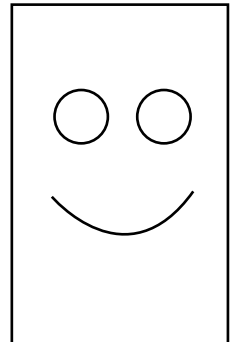
## **Bibliography**





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Children : none  
  
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Special experience : Europe work experience  
  
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## Personal profile:

As a Bachelor of Business Administration and after obtaining first relevant international work experience within the hospitality industry, I am now ready to take on new responsibilities to further my professional career. My key strengths include strong analytical and logical skills, an eye for detail, communication and interpersonal skills.  
I enjoy working in a team and help others progress. At the same time I work well independently.  
As a highly motivated and driven individual I strive on taking up challenges.

## Interests:

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Foreign Cultures  
Photography  
Sports

## Educational qualifications:

Oct 99 - Feb 02                      Higher Diploma (Hotel Management)  
Swiss Hotelmanagement School, SHL

## Employment history:

Mar 04 - Ongoing	<p>Assistant Manager (Rooms Division/Food &amp; Beverage)</p> <p>Hotel Atlantic Kempinski Hamburg <a href="http://www.kempinski.com">www.kempinski.com</a> 5 star business hotel, part of Leading Hotels of the World 412 guest rooms, large function facilities, 3 food &amp; beverage outlets</p> <p>Optimization of bar procedures, reinforcing SOPs</p> <p>Developing &amp; implementing promotions</p> <p>Responsible for day-to-day operations</p> <p>Optimization and streamlining of housekeeping and laundry procedures</p> <p>Implementation of new SOPs</p> <p>Analyzing monthly reports for rooms division performance and sub departments</p>
Mar 03 - Mar 04	<p>Management Trainee</p> <p>Hospitality Graduate Recruitment <a href="http://www.h-g-r.com">www.h-g-r.com</a> Leading company for placements within the Hospitality industry.</p> <p>Traineeship covering all aspects of an online recruitment agency.</p>
Mar 02 - Mar 03	<p>Management Trainee (Rooms Division)</p> <p>Hyatt Regency Xian, China <a href="http://www.hyatt.com">www.hyatt.com</a> 5 star business hotel 404 guest rooms, 4 food &amp; beverage outlets</p> <p>Traineeship covering all rooms division departments on operational as well as supervisory level.</p>

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