

# Smart Actuators for Exoskeletons

## 3D-Printed Continuous Carbon Fiber Reinforced Shape Memory Polymer Actuators

— 1st August 2022 —

Master's Thesis

### Context

**Shape memory polymers (SMP)** demonstrate the ability to remember a preset shape configuration when stimulated at specific elevated temperature. Actuators, which are entirely or partly **3D-printed** with **continuous carbon fiber reinforced SMP**, are promising alternatives to conventional bulky actuators and comparable shape memory materials such as shape memory alloys. Especially for applications in the context of lightweight robotic **exoskeletons**, large reversible strains and more compliance of SMP present an exciting new approach in the field of wearable robotics.

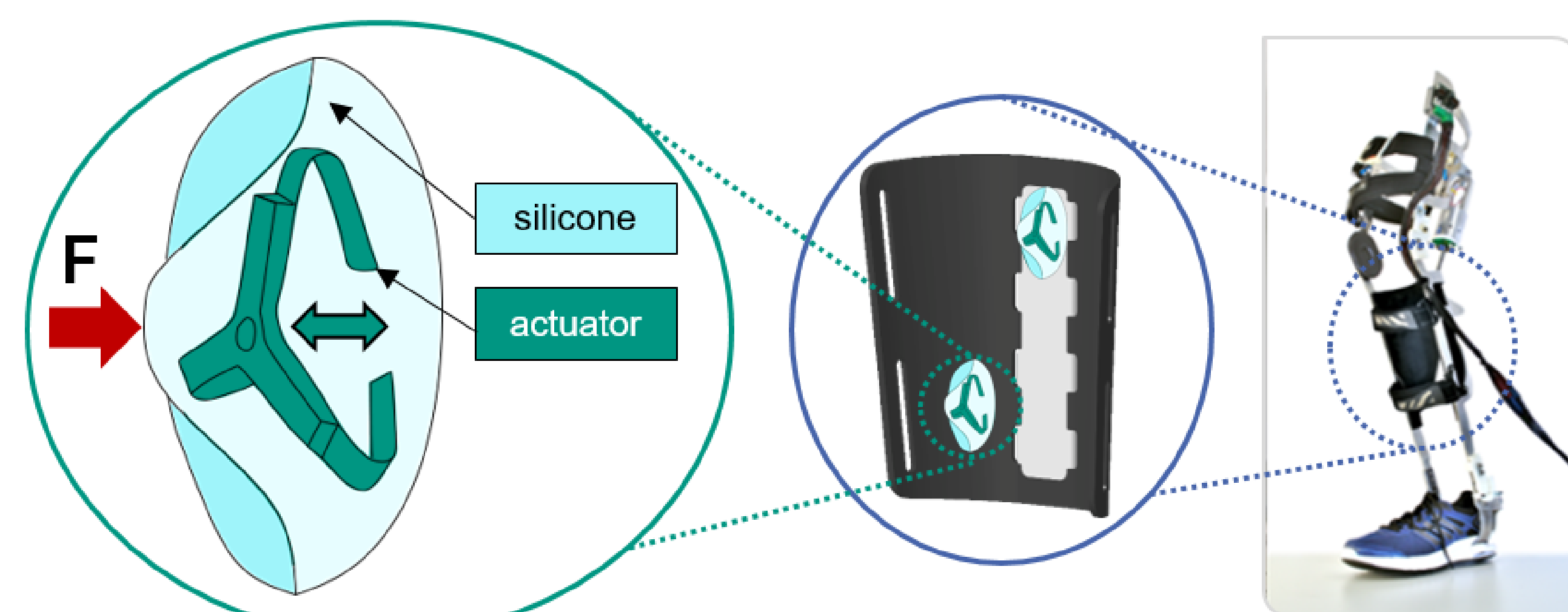


Figure 1: Schematic of smart actuator in the interface of a robotic exoskeleton application.

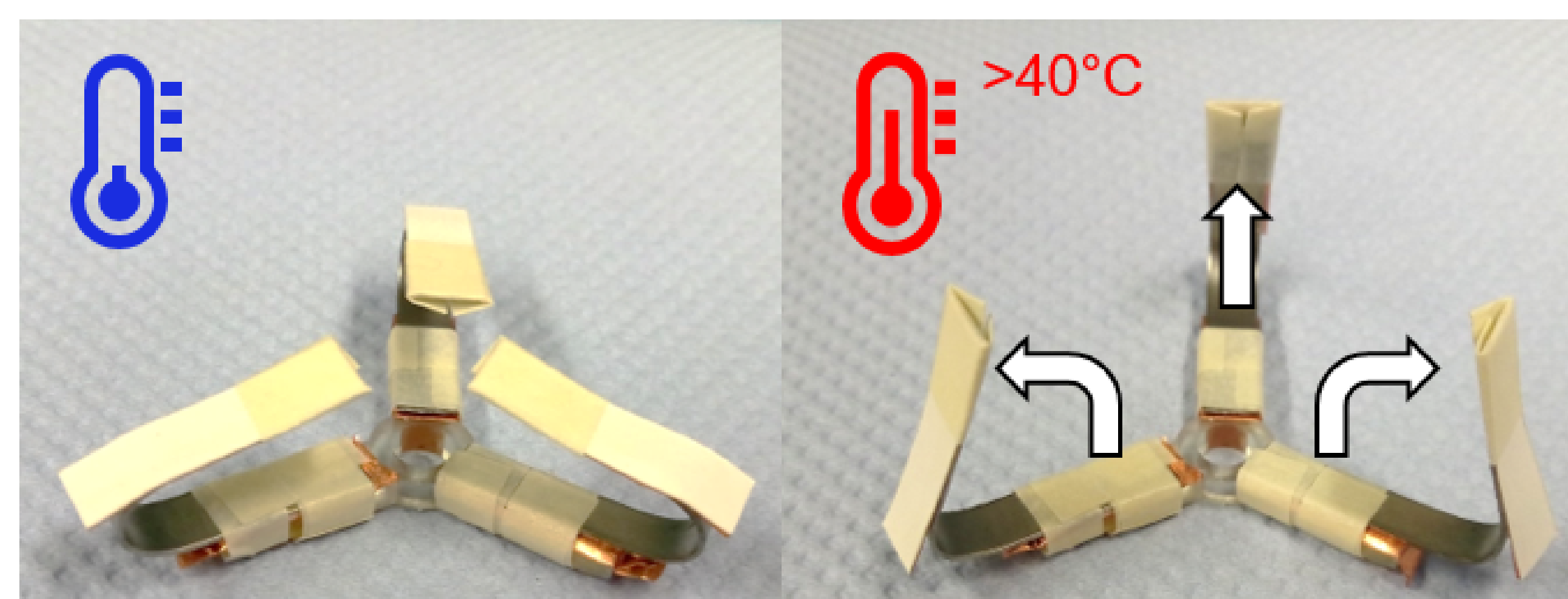


Figure 2: Working principle of existing actuator prototype based on shape memory alloys.

### Objective

Investigate the performance of SMP-based actuators as an alternative for an existing actuator unit made from shape memory alloys.

### Task Summary

- **Read** about SMP actuation and manufacturing.
- **Modify** an existing actuator design.
- **Fabricate** your design by 3D-printing.
- **Evaluate** the actuator's performance.

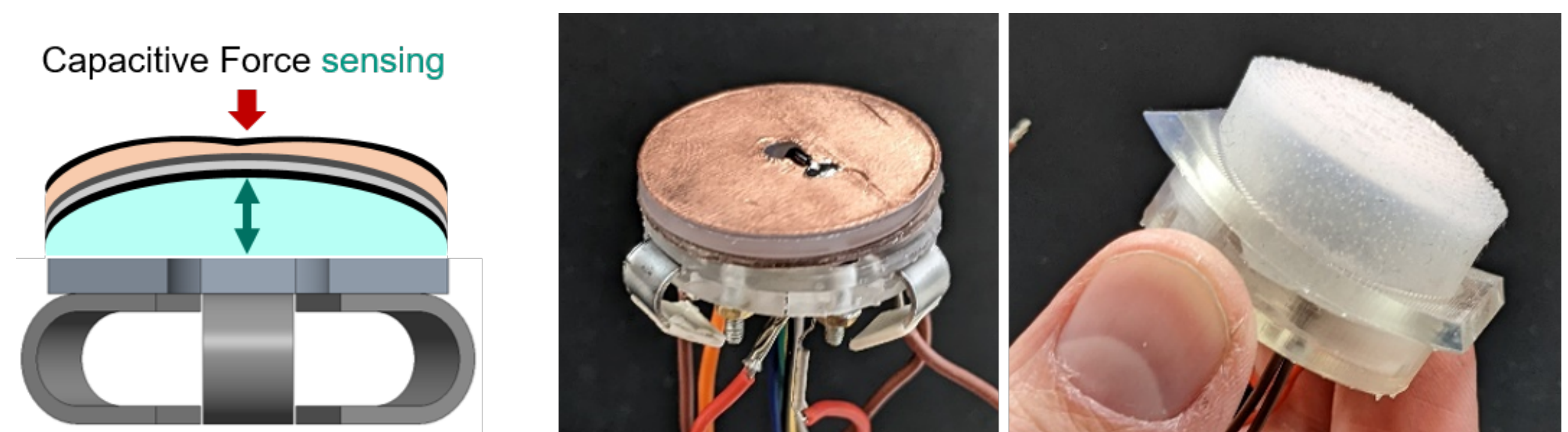


Figure 3: Deployment as sensor-actuator unit for embedded applications.

### Requirements

Qualified candidates from the fields of:  
**mechatronics, electronics, computer science**  
shall be interested in:

- Additive manufacturing
- Smart materials
- Design & Experimentation

### Contact

This thesis is offered in collaboration with the Institute for Pulsed Power and Microwave Technology (IHM):

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