Smart Medical Instruments
Design and Fabrication of a Printable Actuated SMA-Instrument — 14th April 2021 —

Context

Flexible medical instruments in minimally invasive surgery might be of great help to surgeons while operating next to or within critical structures and organs of the human body (e.g., blood vessels). The design and control of such instruments is challenging. “Smart materials”, such as so called "Shape Memory Alloys" (SMAs) are promising when facing these challenges due to their ability to memorise an arbitrary shape when heated. While the handling of SMAs regarding their fabrication and application (e.g., heat transfer, shape restoration) is quite demanding, their potential for innovative new approaches in steering and actuation are of great interest for ongoing research in the field of medical robotics.

Figure 1: Team of surgeons in the operation theatre. Source: © Solvay 2020.

Figure 2: Schematic for a printed flexible instrument for neurosurgery.

Objective


Task Summary

- Learn about additive manufacturing (µ-LPBF) and heat-induced actuation of SMA materials and analyse related constraints for the design process.
- Design a printable demonstrator comparable to preexisting instrument designs with conventional SMA wire actuators.
- Manufacture the demonstrator at Fraunhofer ILT (in Aachen)
- Evaluate the demonstrators accuracy regarding tip positioning and its shape in comparison to conventional SMA instrument designs or their simulation respectively.

Figure 3: µ-LPBF device at Fraunhofer ILT (Aachen) and schematic demonstration of fabricated actuatable sample. Source: Fraunhofer ILT

Requirements

Qualified candidates (engineering, physics, material science) shall be interested in:
- Smart materials
- Mechanics
- CAD design
- Additive Manufacturing

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