

Flexible Medical-Robotic Instruments

Shape-Sensing by Self-Sensing of SMA Actuators

— 19th July 2022 —

Master's Thesis

Context

Flexible medical instruments in minimally invasive surgery might be of great help to surgeons while operating next to or within critical structures of the human body (e.g., crucial blood vessels). The design and control of such instruments is challenging. "Smart materials", e.g. "**Shape Memory Alloys**" (**SMAs**) could be very useful to face these challenges due to their shape memory and **self-sensing** ability. The latter allows to estimate the actor's shape from measuring its resistance. This approach might be able to replace visual support and additional sensors (Figure 3) by intrinsic sensing.



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

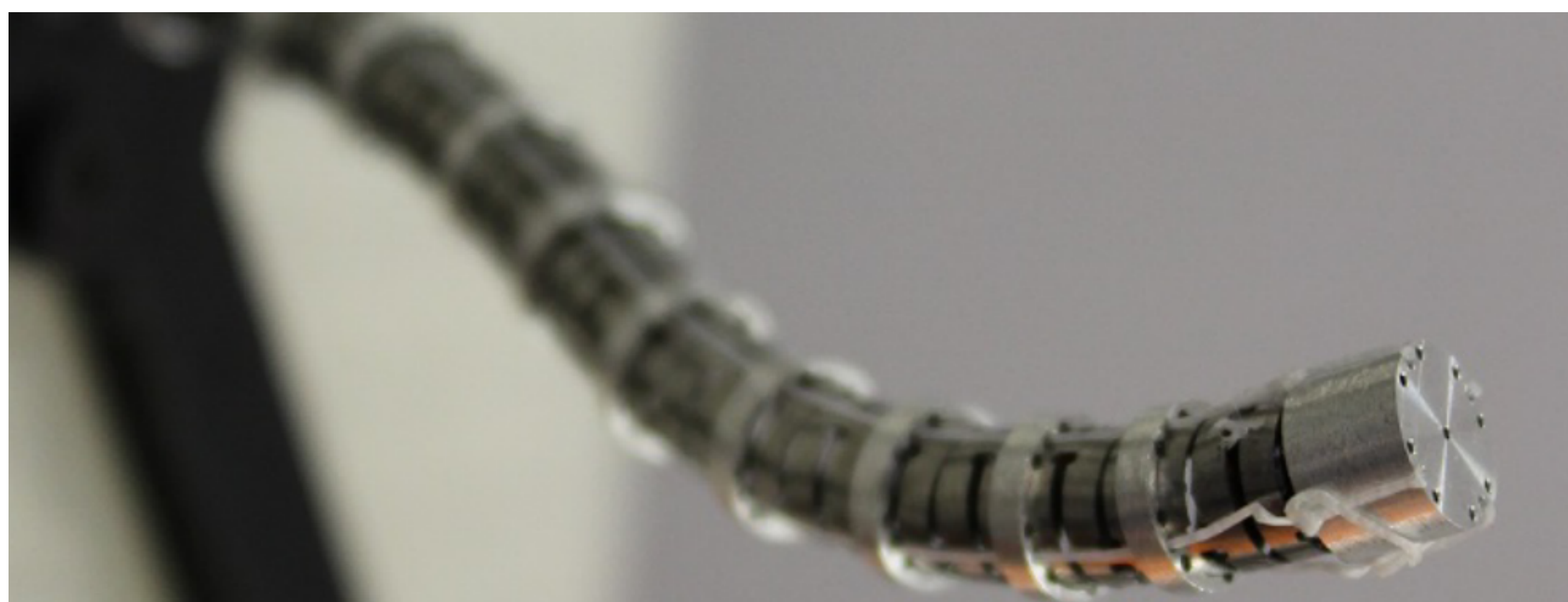


Figure 2: Hybrid continuum robot proposed by Amanov et al. (2017).

Objective

Investigate the self-sensing ability of various SMA actuators.

Task Summary

- **Read** about SMA actuation and self-sensing.
- **Modify** an existing experimental setup for automatic data acquisition.
- **Model** the resistance characteristic using non-linear approaches (e.g. Preisach model) and machine learning techniques (optional).
- **Evaluate** the models of different actuators for different loads.

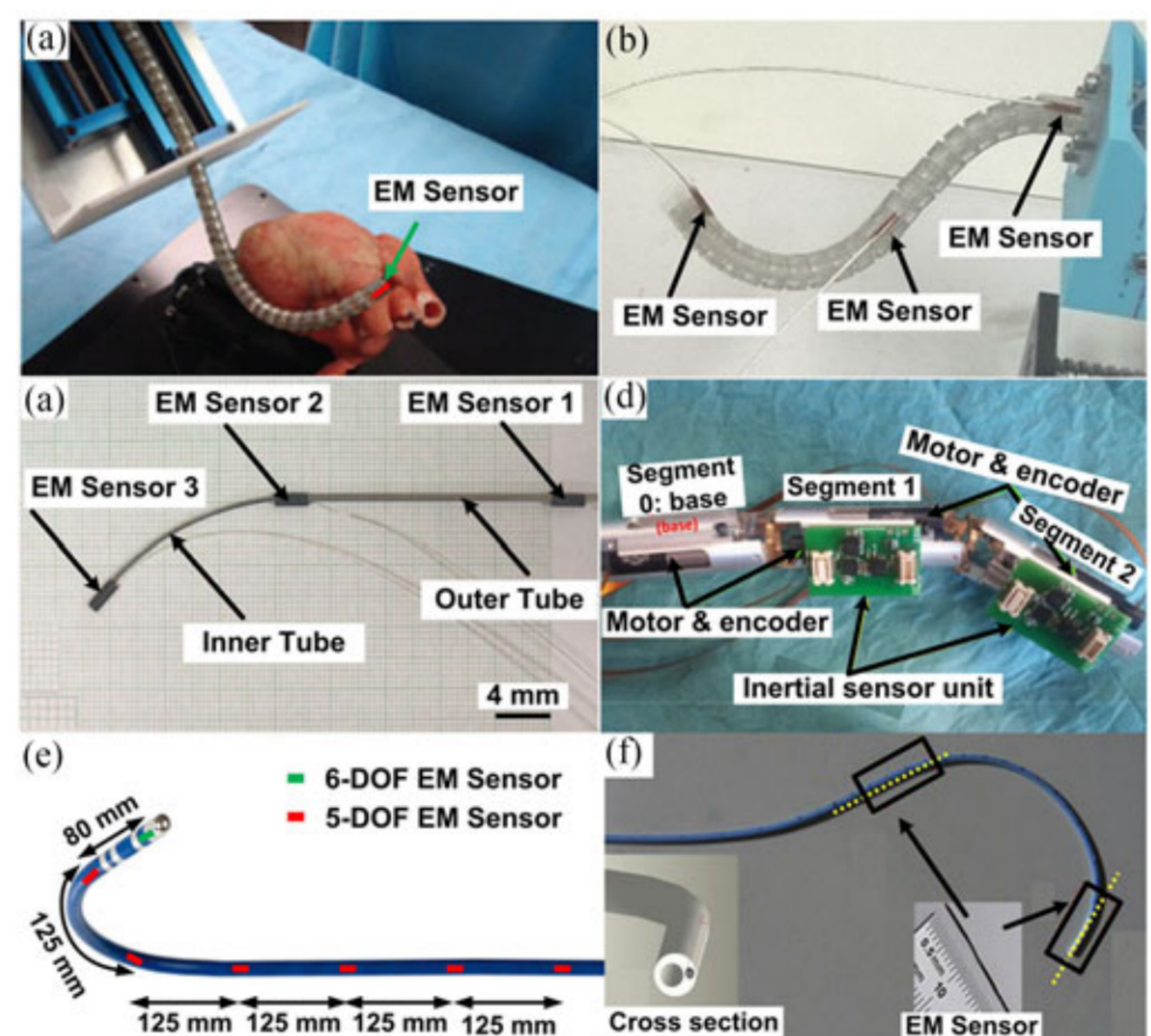


Figure 3: Shape sensing approaches (without self-sensing) as reviewed by Shi et al. (2017).

Requirements

Qualified candidates (computer science, engineering, physics, material science) shall be interested in:

- Electronics
- Sensing
- Material science

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