

# Magnetic Sensing for Pose Detection

## Optimization and Evaluation of a Flexible Magnetic Sensor-Array for Real Time Pose Detection of Medical Instruments

— 10th October 2021 —

Master's Thesis

### Context

**Medical instruments** in minimally invasive surgery bring great benefits in terms of patients' medical outcome while monitoring the instrument's exact pose (position + orientation) within the human body remains challenging. As an alternative to limited optical tracking, **magnetic tracking** might be promising for medical applications of different kind. Simplified prototypes with rigid planar arrays of Hall sensors already provide pose information permanent magnets. When applied in a medical-robotic context, such sensor array shall be rather **flexible and compliant** to be used directly on a patients body surface. Thus, facile handling and better sensing performance can be achieved. However, further optimization on the provided flexible sensor array is needed such as enhanced solvers, filters and deformation models. Desired hardware improvements include a reduction of the array thickness and robust embedded wiring.

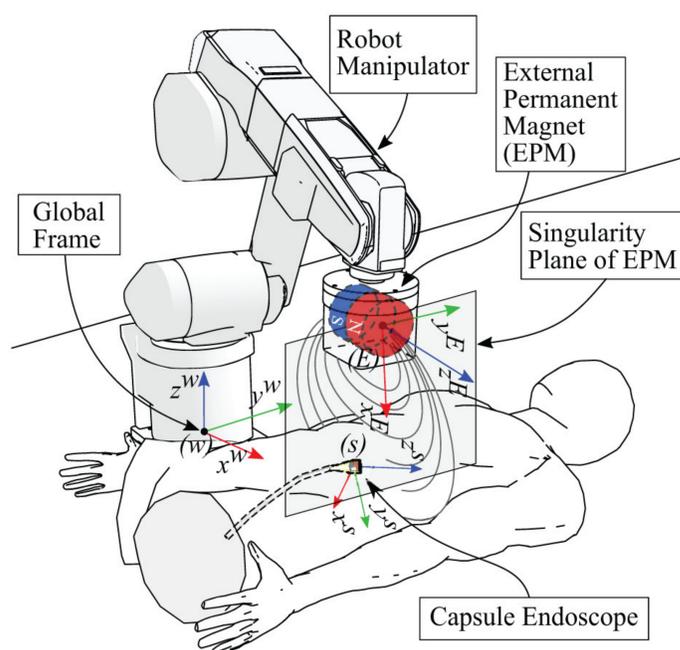


Figure 1: Utilization of permanent magnets for magnetic control and sensing in in-vivo medical applications. Source: DOI 10.1177/0278364918779132.

### Objective

Optimize the provided flexible sensor array design and evaluation setup to obtain relevant data and investigate its limitations for future scientific publications.

### Task Summary

- **Study** the provided documentation and relevant literature about intracorporeal (magnetic) tracking and pose estimation strategies.
- **Optimize** the design and evaluation setup based on provided findings and your own ideas.
- **Fabricate** the new design and setup.
- **Evaluate** and discuss the new design.
- **Optional:** Contribute your findings to the scientific community in the form of a conference paper.



Figure 2: Provided prototypes: Rigid planar sensor array (left) and flexible compliant sensor array (right).

### Requirements

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

- Magnetism
- Microcontroller
- Sensing
- Experimentation
- Robotics

### Contact

**Nikola Fischer, M.Sc.**  
Building 40.28, Room 102  
[nikola.fischer@kit.edu](mailto:nikola.fischer@kit.edu)  
+49 721 608 - 44263