

Motivation and Clinical Need

Clinical relevance

Localization of pathologies within the GI-tract of utmost importance

Precise diagnosis

Individualized therapy

Problem and Clinical Need

No tracking device with correlation to gastrointestinal anatomy available on the market

Clinical Application

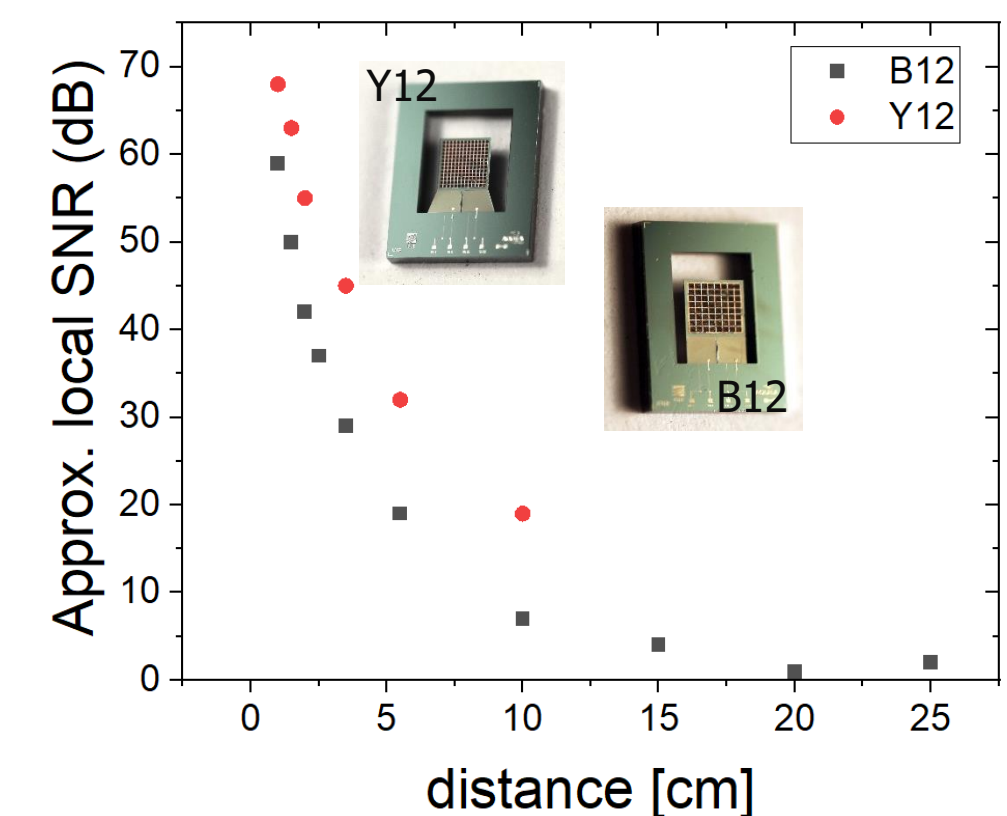
3D mapping in vivo correlation to GI anatomy of

1. Wireless motility capsule
2. Distal tip of flexible endoscope

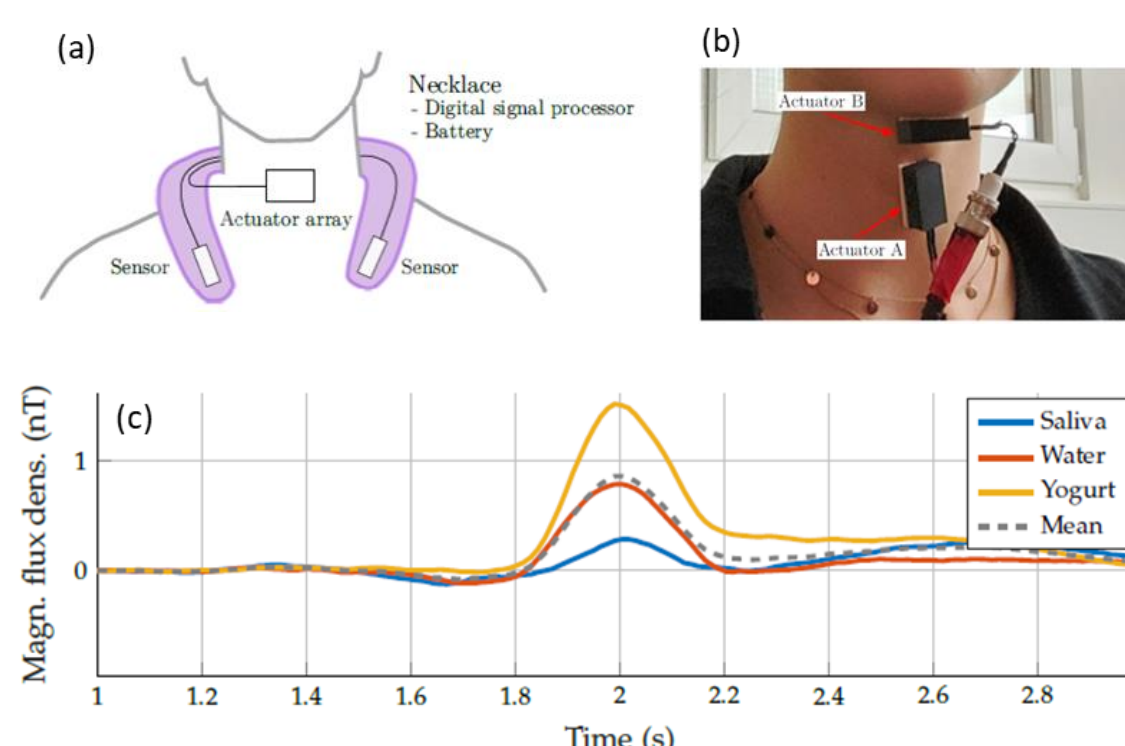
Preliminary Work

MEMS actuators for signal generation to analyze position and motions with ME sensors

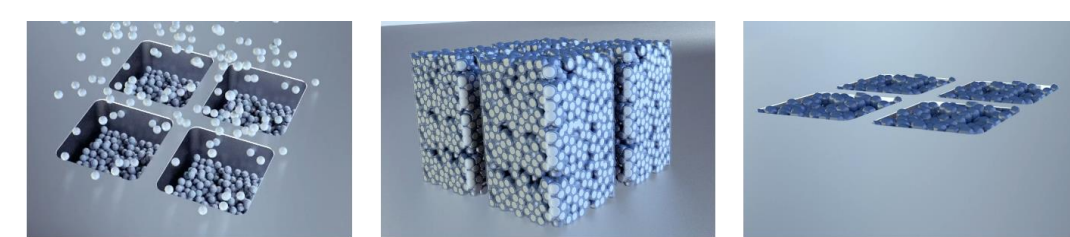
[B13-1, B13-2, B13-6, B13-7, B13-P1, B13-P2]

Approximated SNR at different distances to actuators excited in resonance (sine wave, 450 mV_{pp})

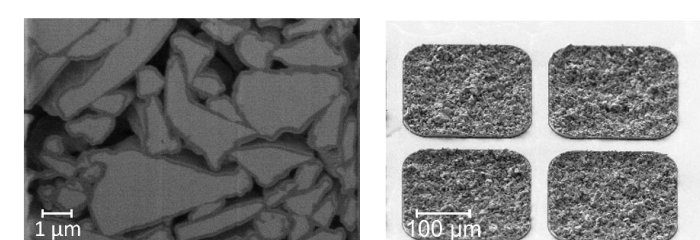
Swallow detection using MEMS cantilever [Hof23].



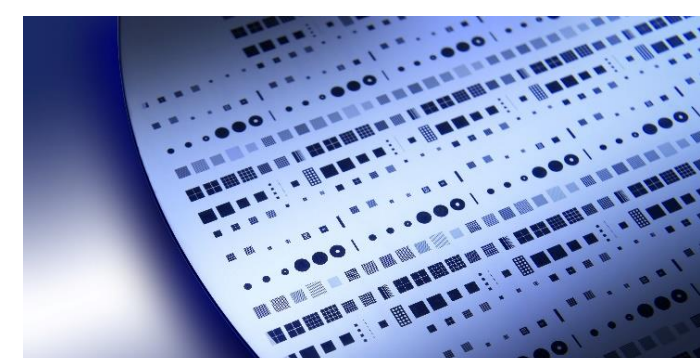
MEMS micromagnets for powerful position signals



1. Dry filling without organics
2. Agglomeration with atomic layer deposition (ALD)



SEM micrograph of agglomerated micromagnets

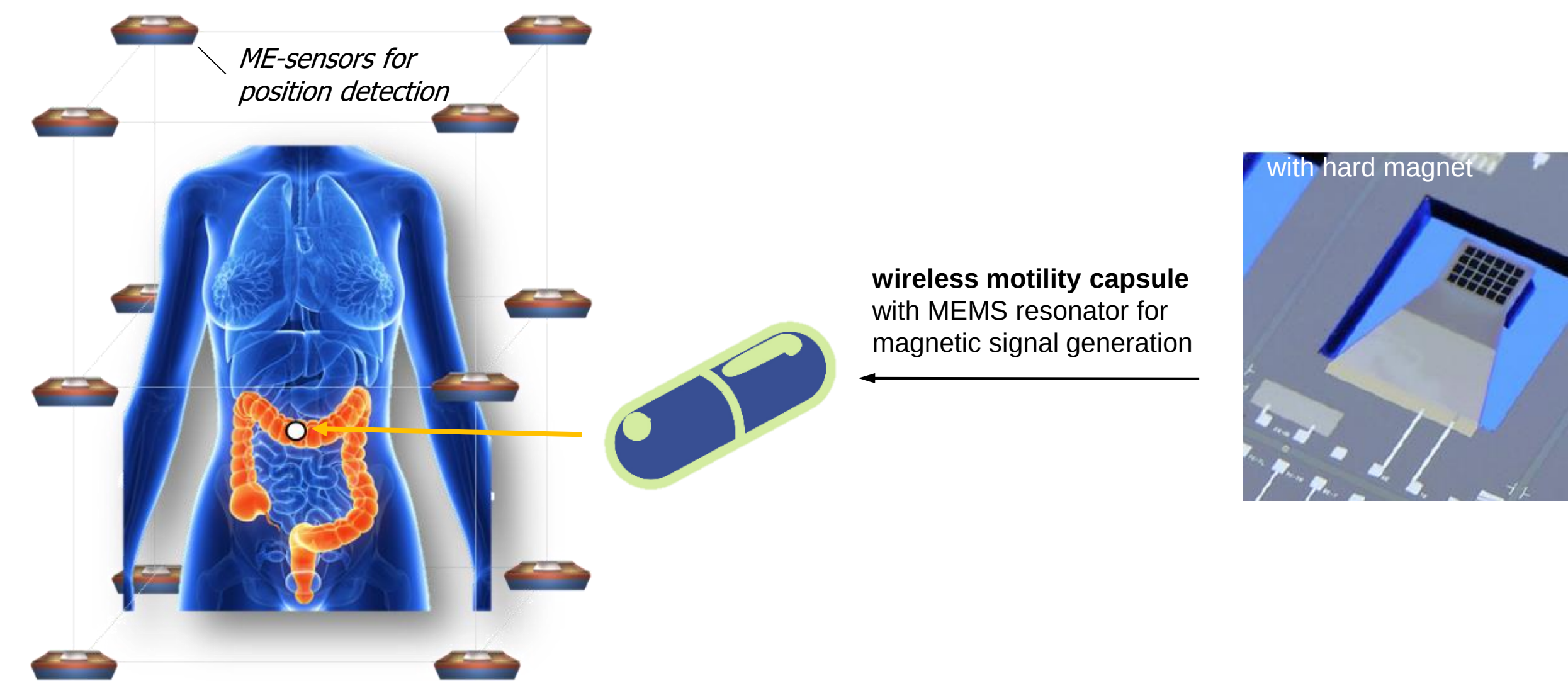


Wafer with integrated micromagnets

New Approach and Objectives

New Approach

MEMS actuator with micromagnets to generate strong and narrowband signal (in vivo) for precise magnetoelectric 3D mapping.



Main Objectives

3D mapping of capsule and endoscope in application studies

Work Plan for Third Funding Period

Main work done by:	2024		2025		2026		2027		2028	
	3	4	1	2	3	4	1	2	3	4
WP1 – MEMS magnetic probe (MMP)										
WP2 – MEMS probing system (capsule and endoscope)										
WP3 – Probe tracking										
WP4 – Application study with silicone phantom										
WP5 – Application study with body donor and animal										

Research Methods



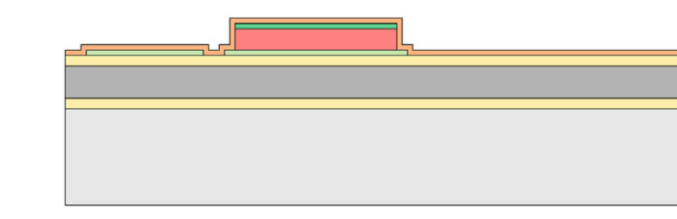
1000 qm ISIT cleanroom



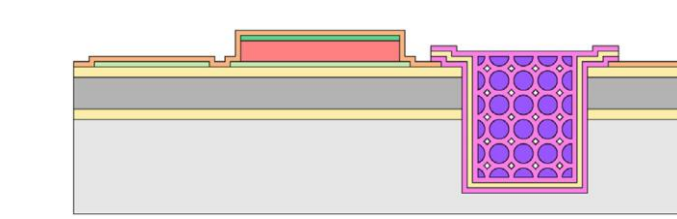
300 qm CAU cleanroom

- Fabrication of MEMS actuators
- Functional and structural characterization

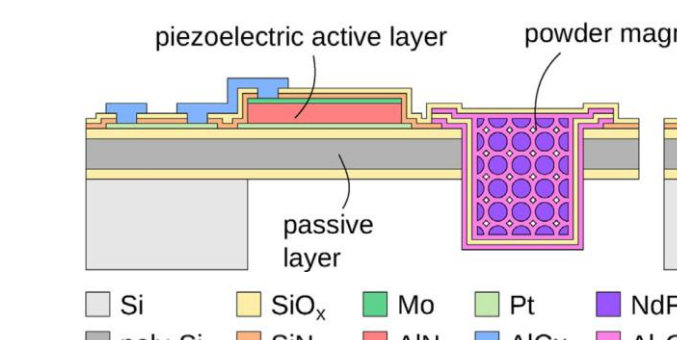
WP1 – MEMS magnetic probe (MMP)



Piezoelectric layer stack on passive poly-crystalline



Powder-based permanent magnets solidified by ALD



DRIE release of the cantilever (bulk micromachining)

WP2 – MEMS probing system – capsule and endoscope

Wireless motility capsule

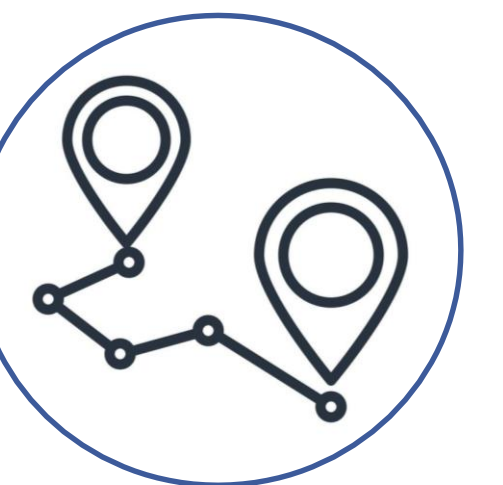


Distal tip of flexible endoscope



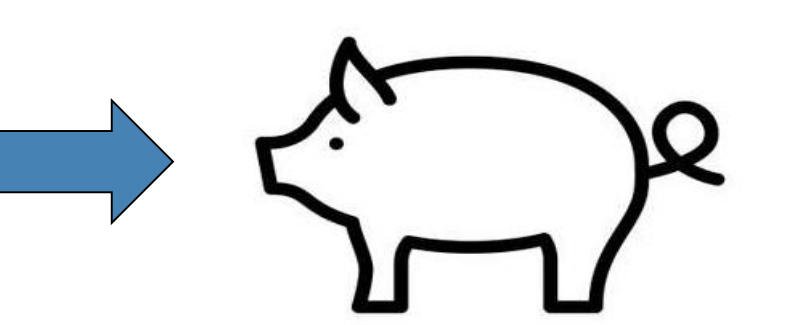
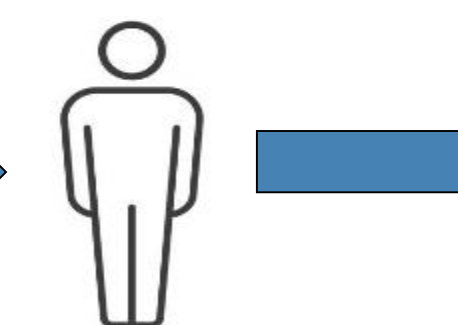
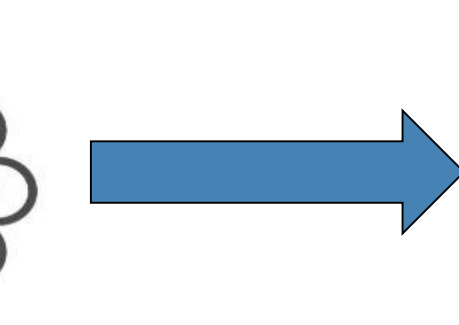
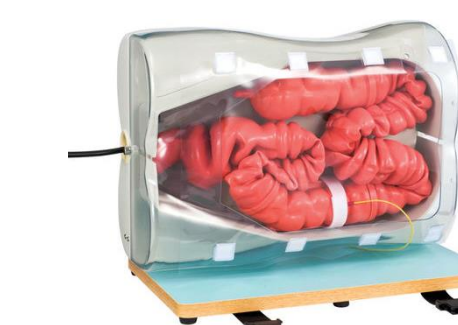
WP3 – Capsule tracking

Localization algorithms for digital signal processing and programs for data processing are developed in project B2 and then adapted to the measurement task in this project in joint work.



WP4 – Application study – tracking in silicone phantom

WP5 – Application study – tracking in post mortem model / in vivo animal



Collaborations

A1: Work on PowderMEMS magnets for the MMP
A4: Application of DE-Sensors for WMC localization
A7: Application of Electrically Modulated ME Sensors for WMC localization
A9: Application of SAW-Sensors for WMC localization
B1: Analog excitation electronics for the MMP
B2: Digital signal processing for WMC localization
B9: ME-sensor based localization techniques
B11(N): ME-sensor based localization techniques
Z1: Fabrication of MMP sensor chips; PowderMEMS process technology;
Supply of a sufficient number of similar ME sensors to build sensor-arrays for 3D Mapping in Gastrointestinal Diagnostics
Z2: Support with sensor characterization

Participation in focus groups

F4: Magnetoelectric Sensors

F6: Biomedical Applications

Funds Requested

1 Doctoral researcher, 0,5 Clinical Scientist, consumables: 52 k€