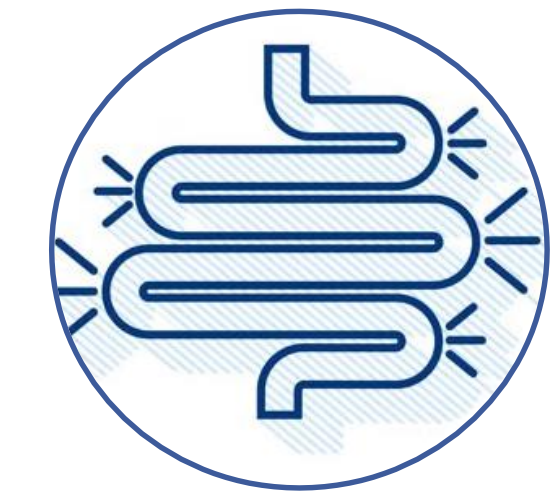


Motivation and Clinical Need



Irritable bowel disease
Inflammatory bowel disease
Parkinson's disease

↓
Impaired
gastrointestinal motility

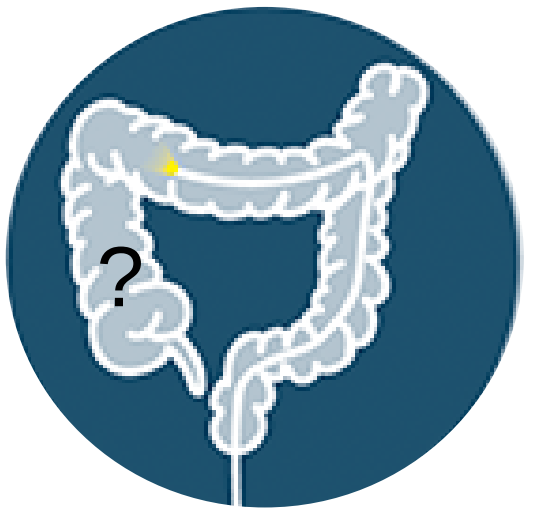
Precise diagnosis for individualized therapy

Problems of available motility diagnostics

Poor sensitivity

Contraindications (strictures vs. diameter of capsules)
Impossibility / uneasiness of swallowing
Long, unphysiological examination time

↓
Exact quantification of gastrointestinal motility (mm/s)
Anatomic localization of pathologies within the GI-tract

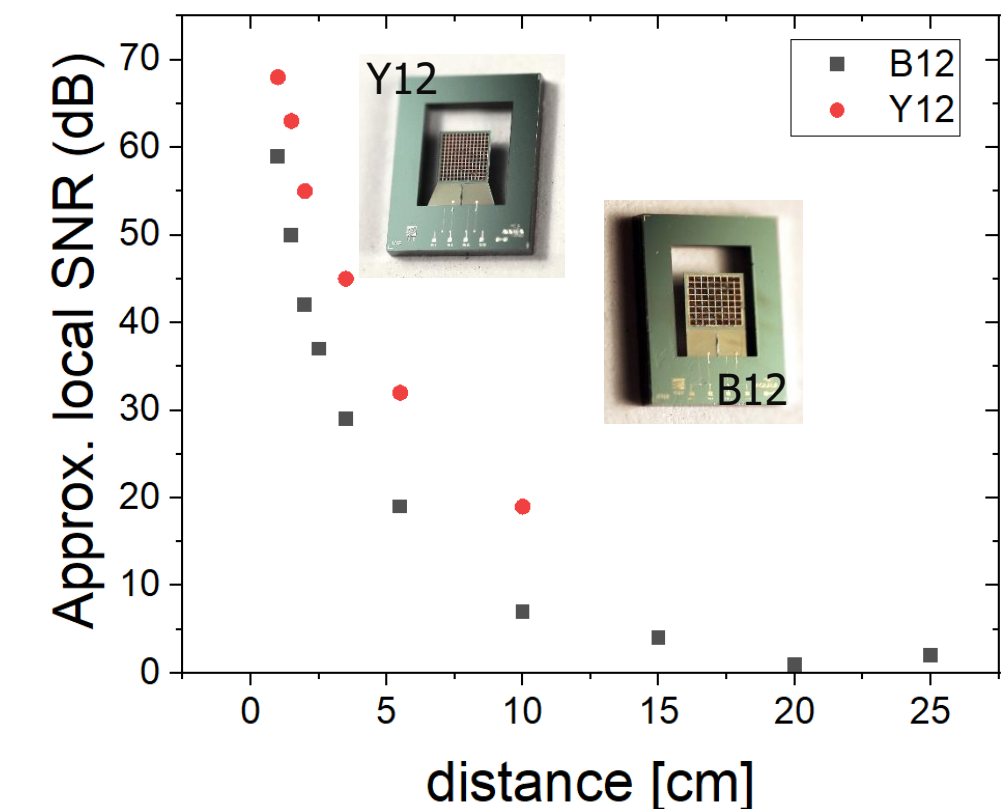


Preliminary Work

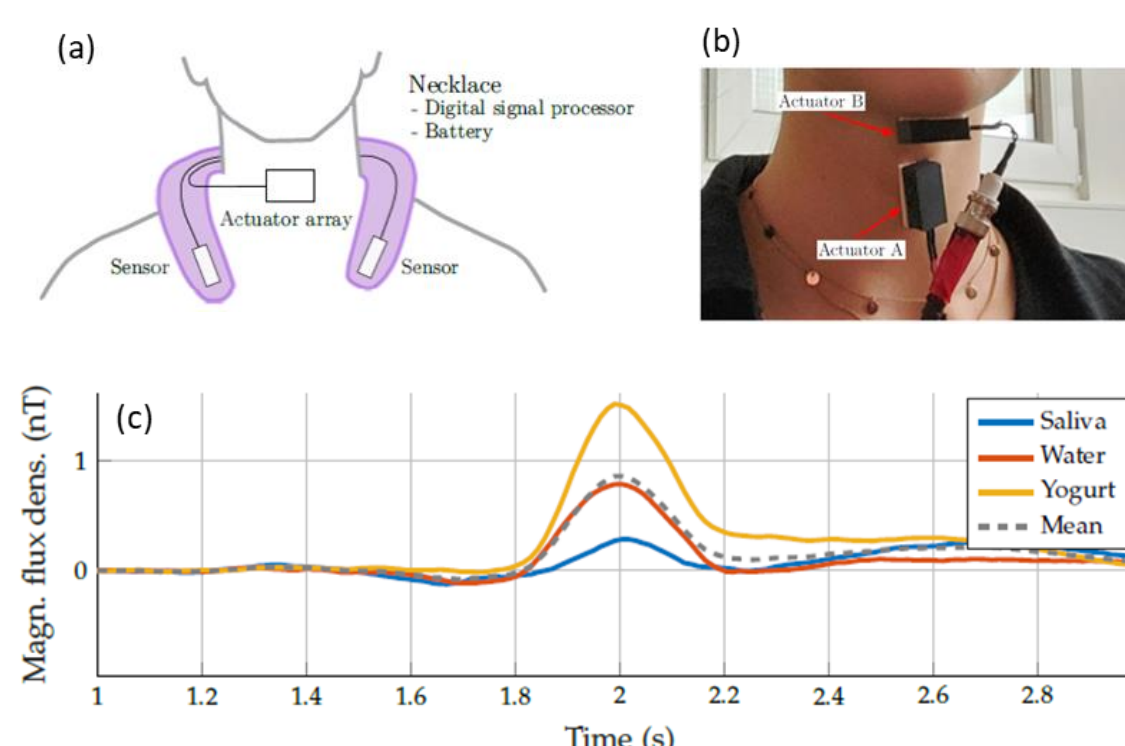
MEMS actuators for signal generation to analyze position and motions with ME sensors

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

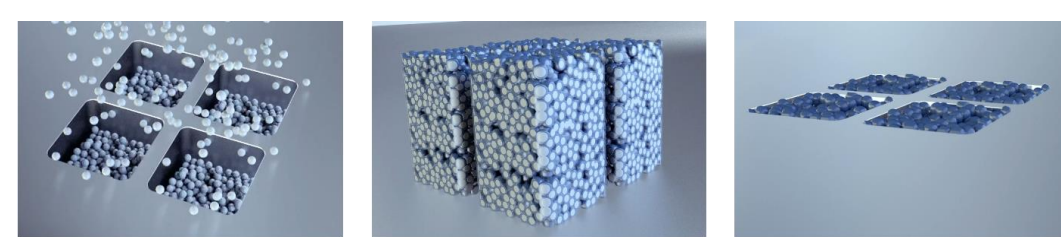
Approximated SNR at different
distances to actuators excited in
resonance (sine wave, 450 mV_{pp})



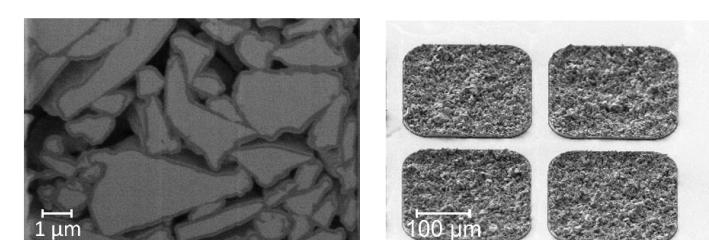
Swallow detection using
MEMS cantilever [Hof23].



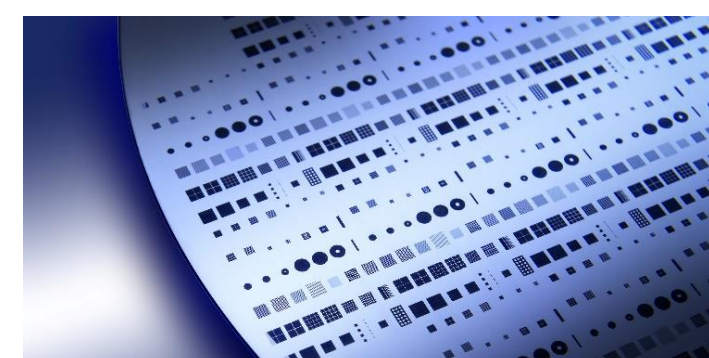
MEMS micromagnets for
powerful position signals



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



SEM micrograph of
agglomerated
micromagnets



Wafer with integrated
micromagnets

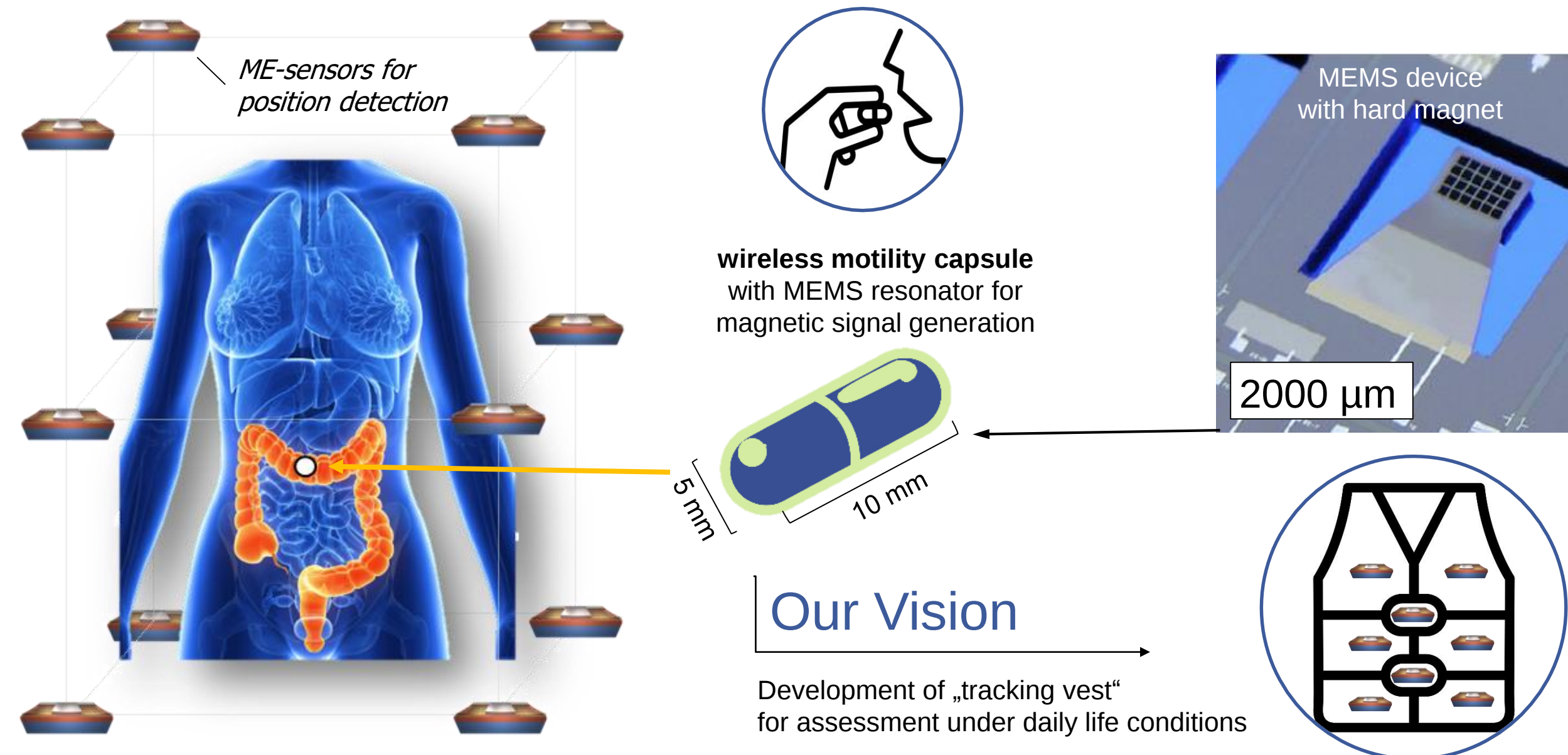
Main Objectives and New Approach

Main Objectives

Development of wireless motility capsule (WMC)
3D tracking of WMC in correlation to GI anatomy

New Approach

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



Work Plan for Third Funding Period

Main work done by: Blue – ISIT; Purple –CAU+HSIT	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										

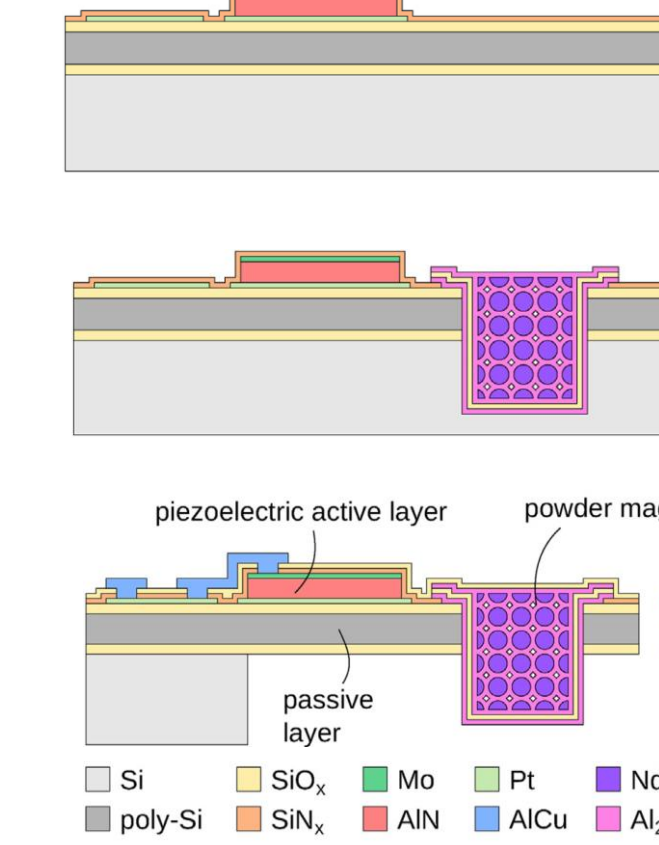
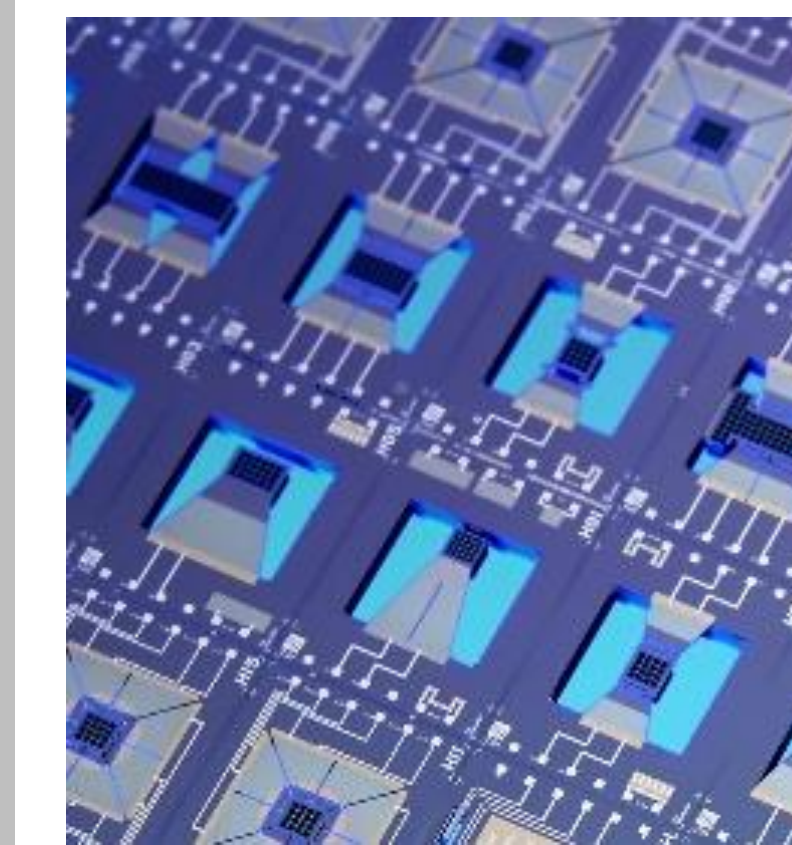
Research Methods

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

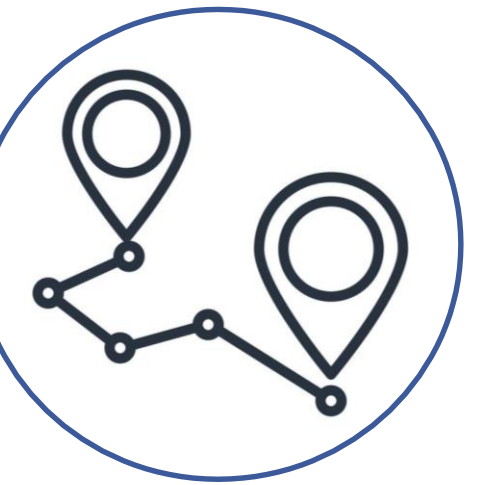
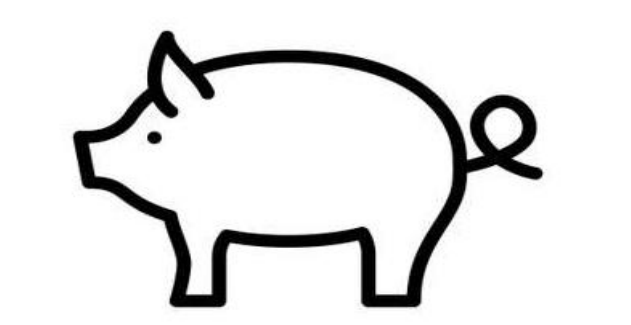
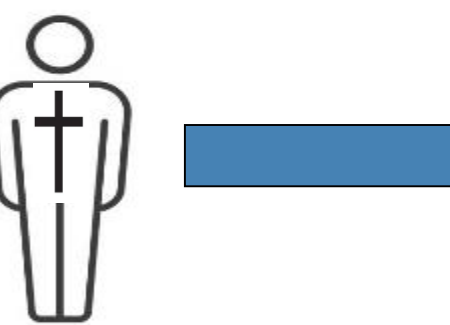
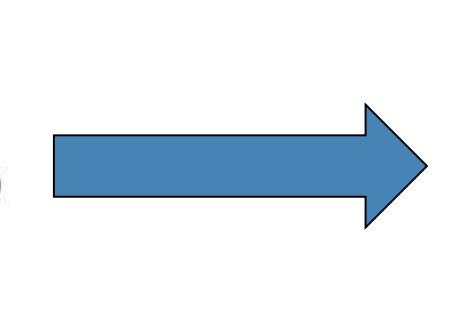
Wireless motility
capsule



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 phantomWP5 – 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€