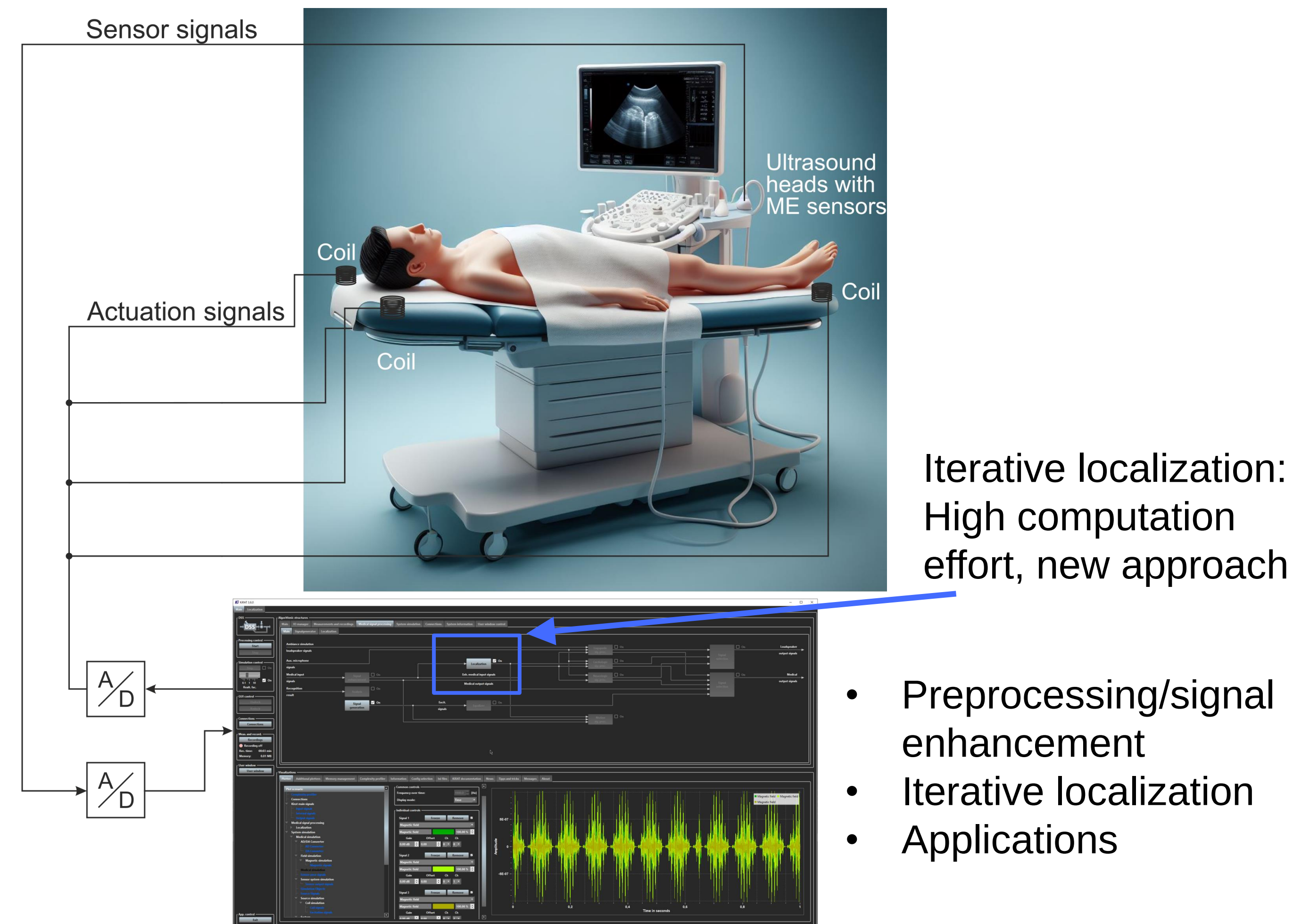


Motivation and Objectives

Medical device localization has high computational complexity and improvable accuracy



New localization approach:

Gradient descent/particle swarm optimization method, added imaging-based localization

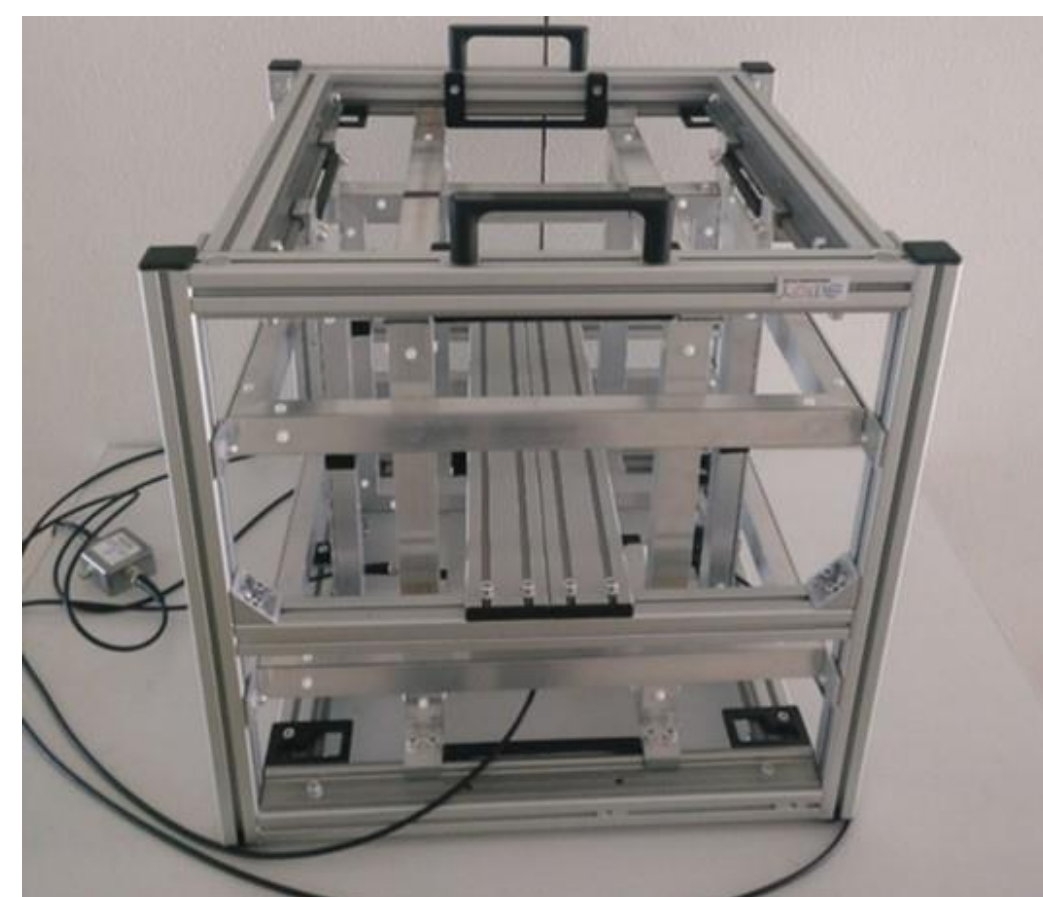
Objectives: Higher localization accuracy at lower computational complexity, for WMCs/ultrasound/endoscope

Online calibration

Signal processing/enhancement for application projects

Results of the Second Funding Period

Adaptive scheme for fast impulse response estimation



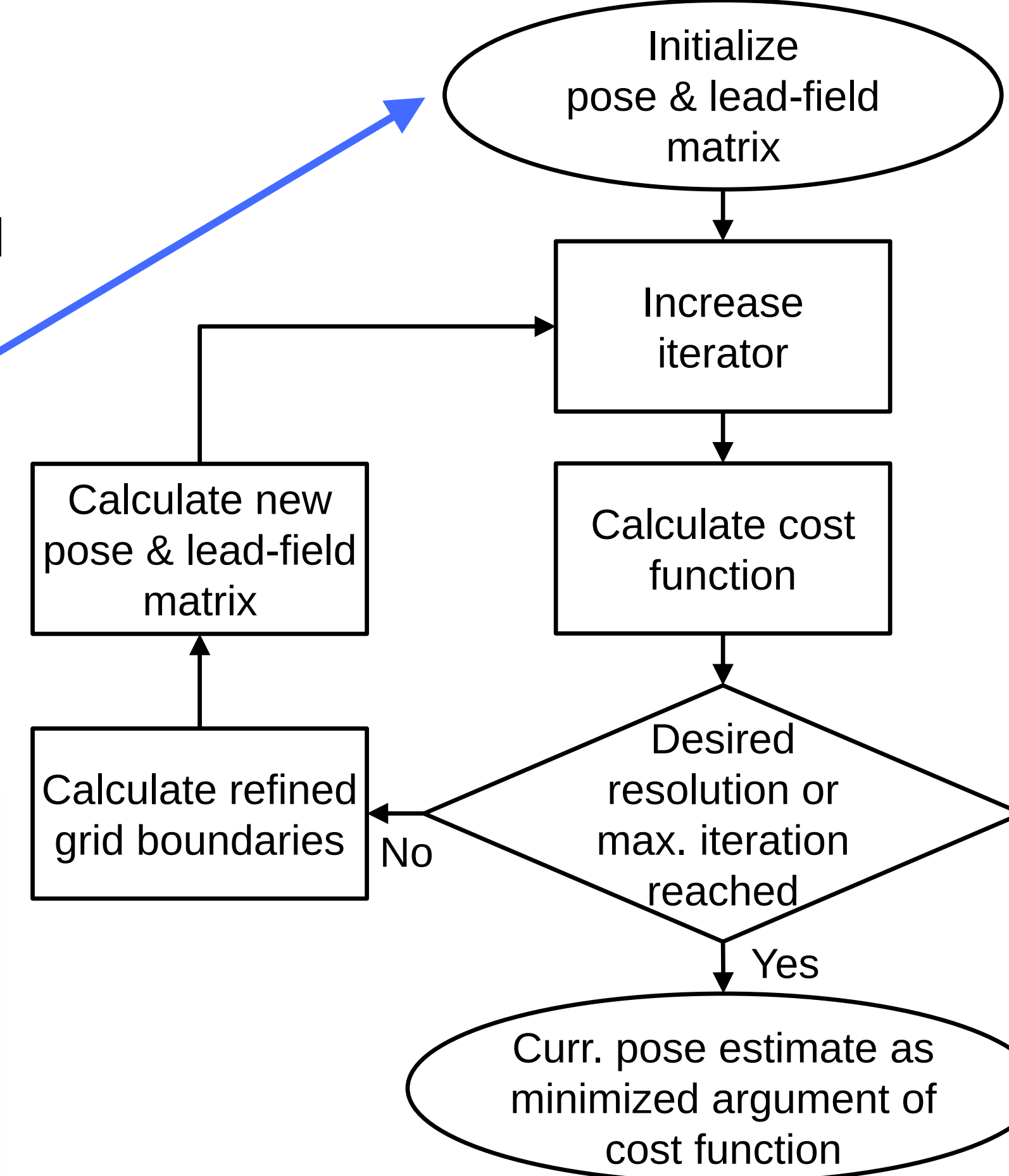
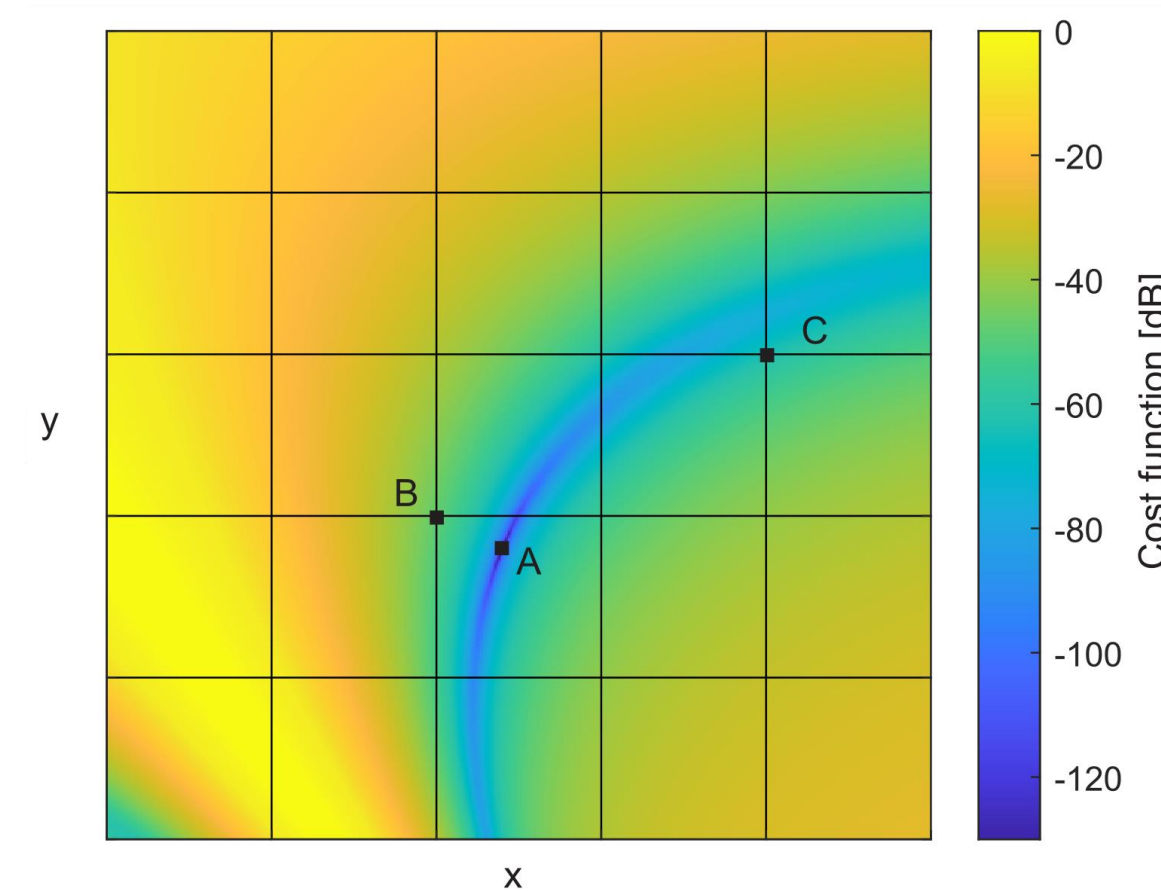
- Helmholtz coil arrangement
- Gradient descent estimation
- Up to 3D directivity and frequency response estimation
- Time and precision gain
- Factor ~ 30-50 faster

Signal platform enhancement

Module based framework for multiple application projects

Determination of position and orientation of the sensor
[B2-1, B2-3, B2-5]

- Excitation with multiplexed, known signals
- Matched filter receive signal
- Trilateration for coarse localization
- Iterative procedure
- Discrete grid: Errors with cost function



Work Plan for Third Funding Period

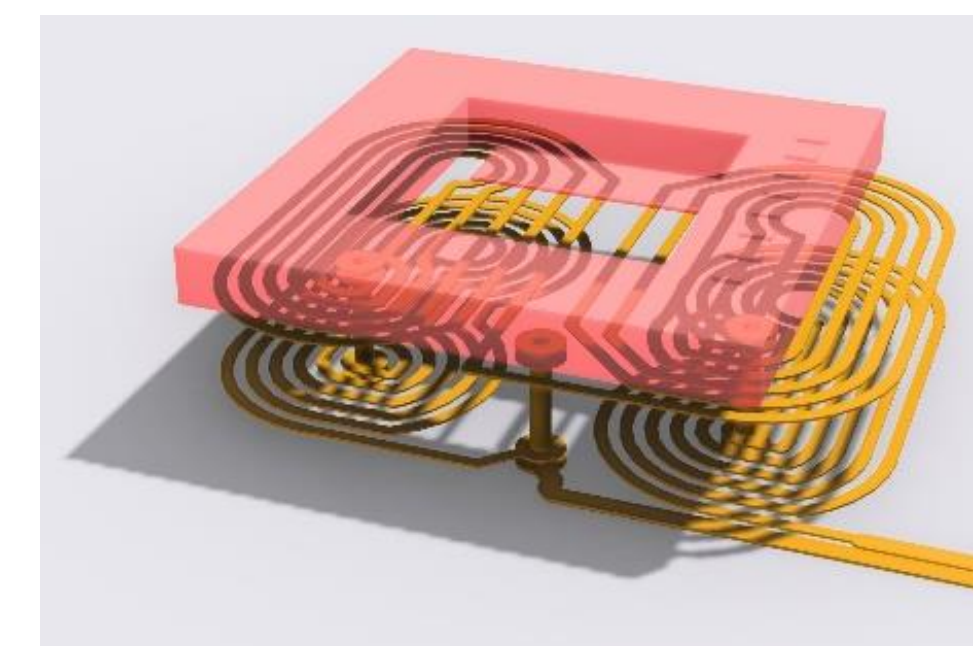
Research methods

- Adaptive signal processing and enhancement stages
- In situ real-time calibration system for ME sensors
- Collaborative research with other B-projects in localization algorithms (different objectives)
- Multimodal processing approaches (medical images + magnetic signals) for mutual improvement

Work plan

WP1 Adaptive signal enhancement and system development

- Nonlinear and adaptive signal enhancement stages
- Online calibration, e.g., with on-board PCB-coil [Wo23]
- Readout schemes over the course of the funding period



WP2 Hardware and interface development

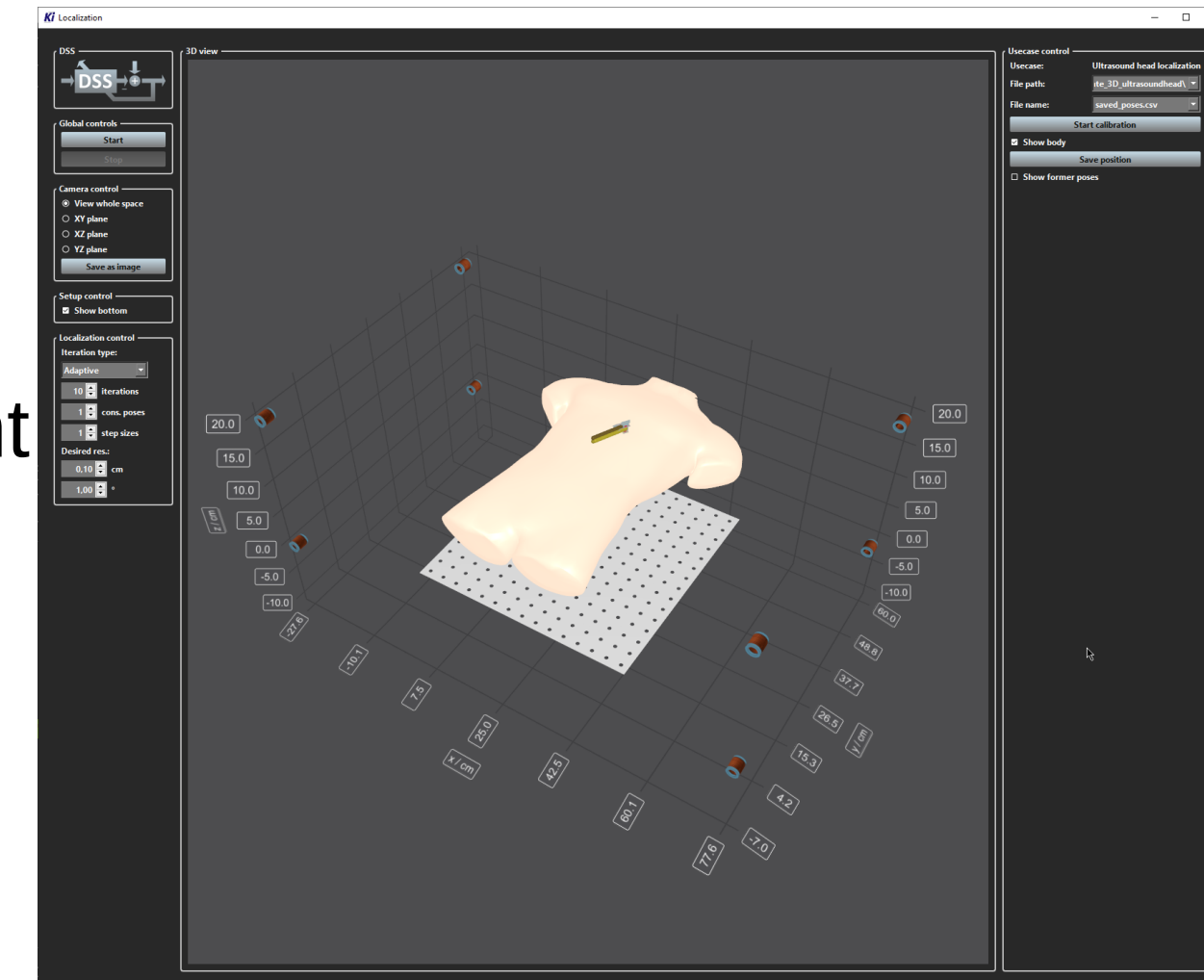
- Measurement system (bed) with actuators (coils, magnetic cantilevers)
- Sensors in medical devices
- Interface between medical imaging data (ultrasound, endoscope) and localization system

WP3 Magnetic localization algorithm development

- Magnetic localization based on gradient descent/particle swarm methods
- Adaption to multiple scenarios, including WMCs (B13(N))

WP4 Ultrasound and endoscopic image localization

- Localization based on med. images, fusion with magnetic localization



	24/2		2025				2026				2027				28/1	
	1	2	1	2	3	4	1	2	3	4	1	2	3	4	1	2
WP1 – Adaptive signal enhancement and system development																
WP2 – Hardware and interface development																
A – Hardware development																
B – Interface development																
WP3 – Magnetic localization algorithm development																
WP4 – Ultrasound and endoscopic image localization																
A – Localization based on images																
B – Fusion of the algorithms																

Collaborations

A8: Incorporation of modeling into localization algorithms

B1, Z2: Collaboration on sensor frontends and arrays, test measurements

B9, B10, B11(N): Collaborative development of closed-loop real-time framework

B12(N): Collaboration in the sensor system design and readout schemes

B13(N): Localization of endoscopes and wireless motility capsule

Z1: Production of micromagnetic sensors and actuators

Participation in focus groups

F3: Comparison of Sensor Concepts

F6: Biomedical Applications

Funds Requested

1 Doctoral researcher, consumables: 51.5 k€

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