FUSIMO: A prototype for patient-specific prediction of focused ultrasound surgery in moving organs

High Intensity Focused Ultrasound

- Only about 30-35% of the patients with liver cancer and liver metastases are suitable for surgical resection

- An alternative treatment is thermal ablation of the tumor by focused ultrasound (FUS)

- FUS therapy is non-invasive. In the liver, however, the location of the tumor is difficult to reach due to the rib cage, lungs and intestines.

- Another major challenge is the motion of the abdominal organs as the patient breathes.
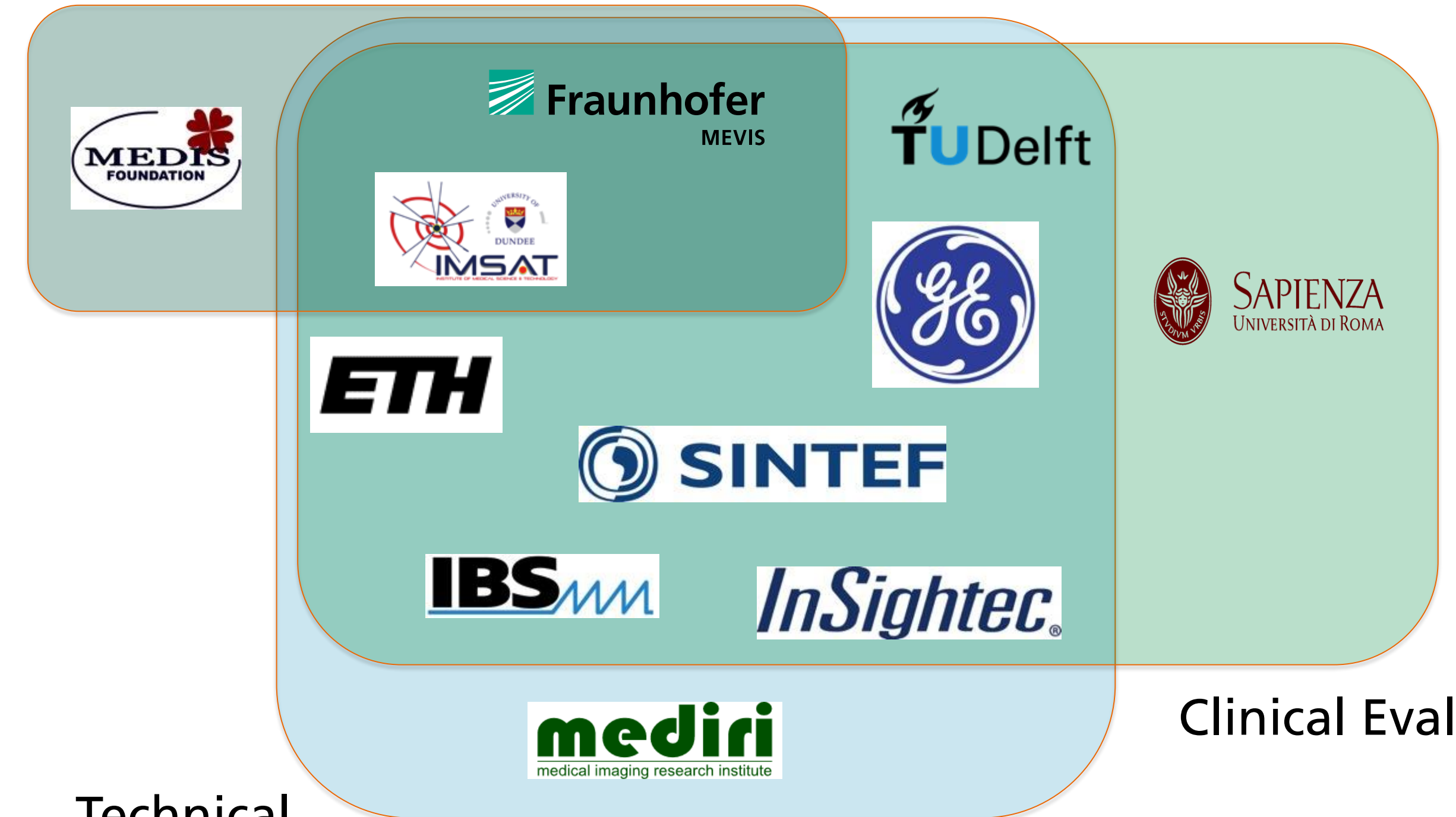
The FUSIMO system supports the attending physician in assessing the feasibility of a procedure by simulating it beforehand. The physician is enabled to judge how a procedure can be conducted safely and successfully.

Fibroid / Focused Ultrasound
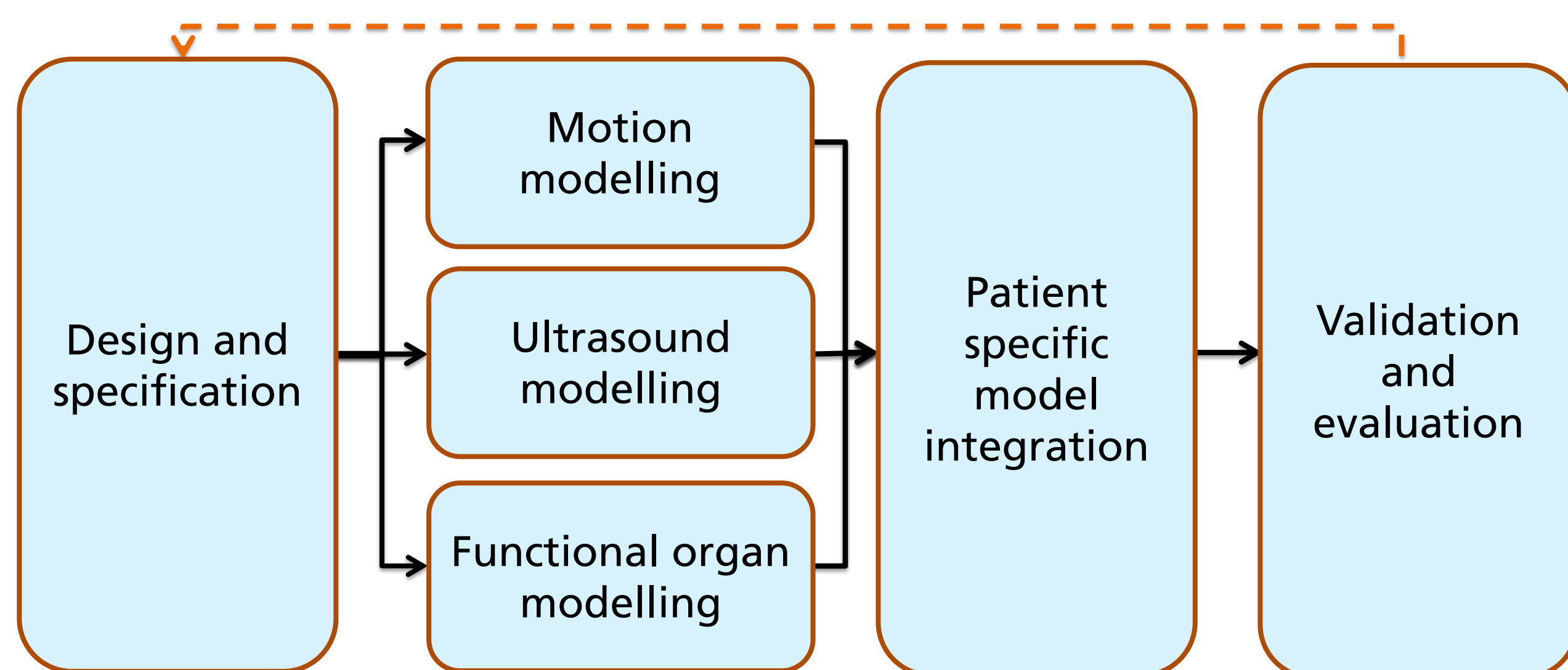© Insightec Ltd.

FUSIMO Consortium

Management

Fraunhofer MEVIS, IMSAT, TU Delft, MEDIS FOUNDATION, GE, ETH, SINTEF, SAPIENZA Università di Roma, IBS, InSightec, mediri medical imaging research institute

Technical Development

Clinical Evaluation

FUSIMO Project

The FUSIMO project is divided into the following tasks:

Design and specification → Motion modelling / Ultrasound modelling / Functional organ modelling → Patient specific model integration → Validation and evaluation
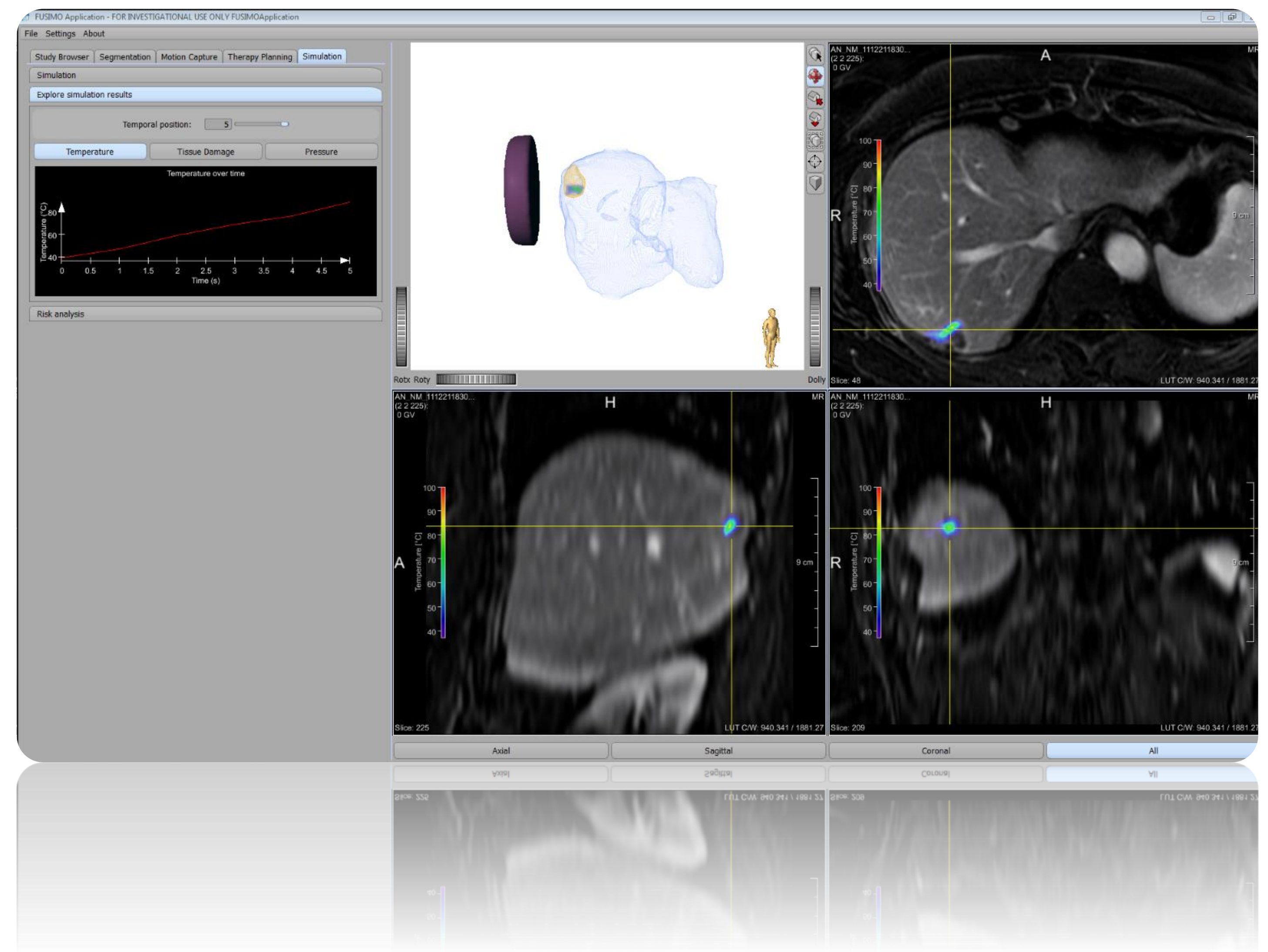
The main focus of the modelling tasks is

patient specificity

This is achieved by an
- individual adaption of the simulation model and
- patient individual breathing information.
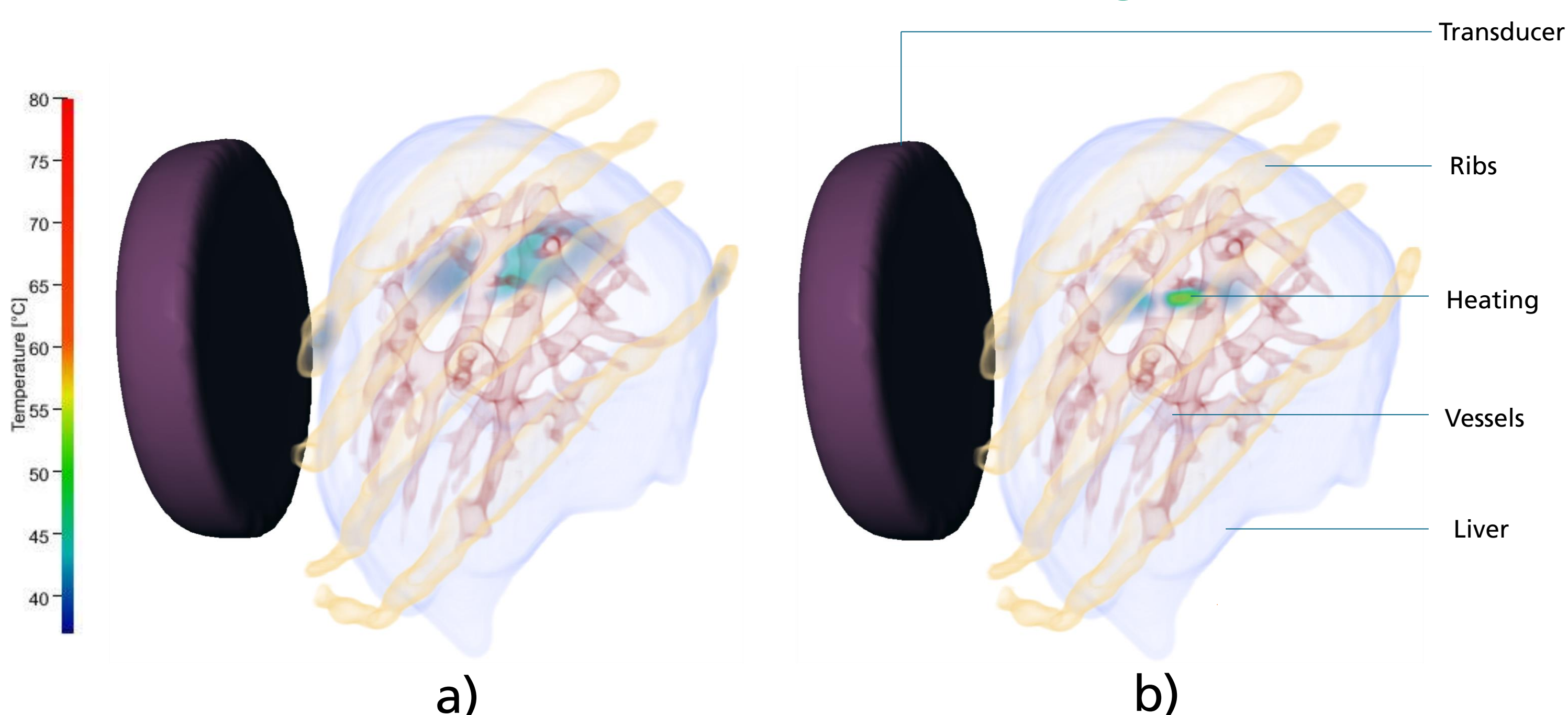
FUSIMO Demonstrator

The whole workflow is integrated in a software prototype, which covers the whole planning phase of a patient-specific FUS application in moving organs.

It provides:
- Flexible scalable patient specific data-model
- Segmentation tools organs and lesions
- Definition of the target area and visual treatment planning
- Motion estimation of the patient using a motion model based on 4D MRI and additional US tracking information
- Multi level patient-specific simulation of the ablation necrosis taking into account
    - Heterogeneous tissue
    - Breathing motion
    - Heat transfer
- 2D and 3D visualization of derived data and results especially of the results

Simulation Results Incorporating Motion

Transducer, Ribs, Heating, Vessels, Liver

a)   b)

Simulation of FUS heating in a moving organ a) with fixed focal spot and b) with auto tracked focal spot

www.fusimo.eu