

Safety And Effectiveness Evaluation Of Medical Therapeutic And Diagnostic Devices Using EM Field

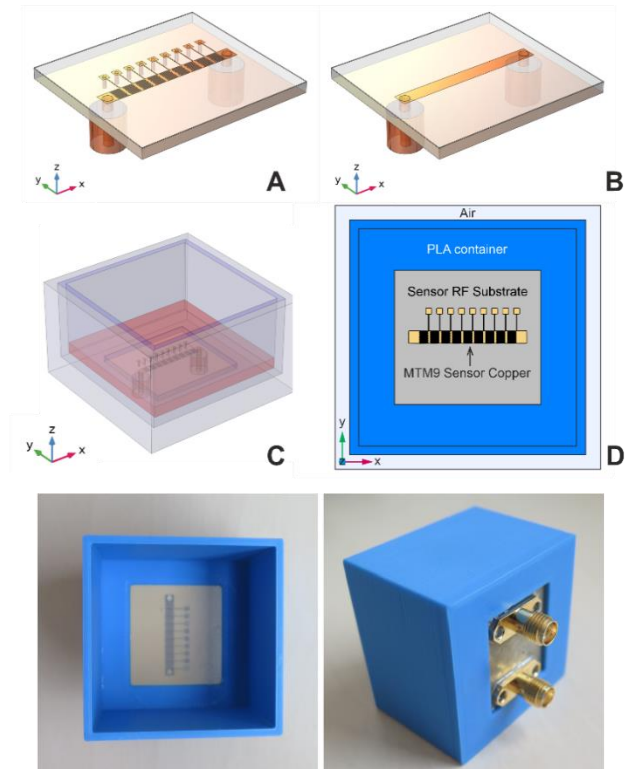
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V³ Consulting

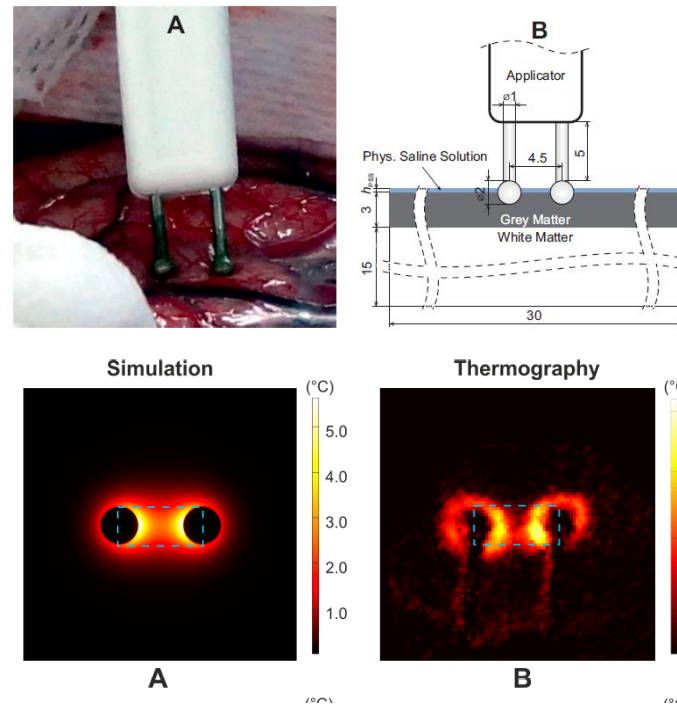
Bio-Electromagnetics Research Group, CTU in Prague

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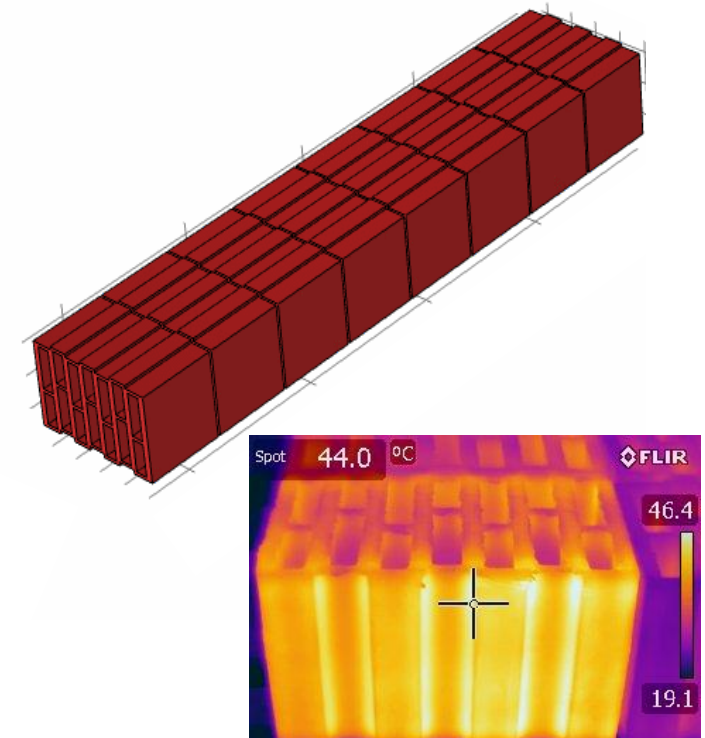
Non-Invasive Glucose Measurement



Direct Cortical Stimulation

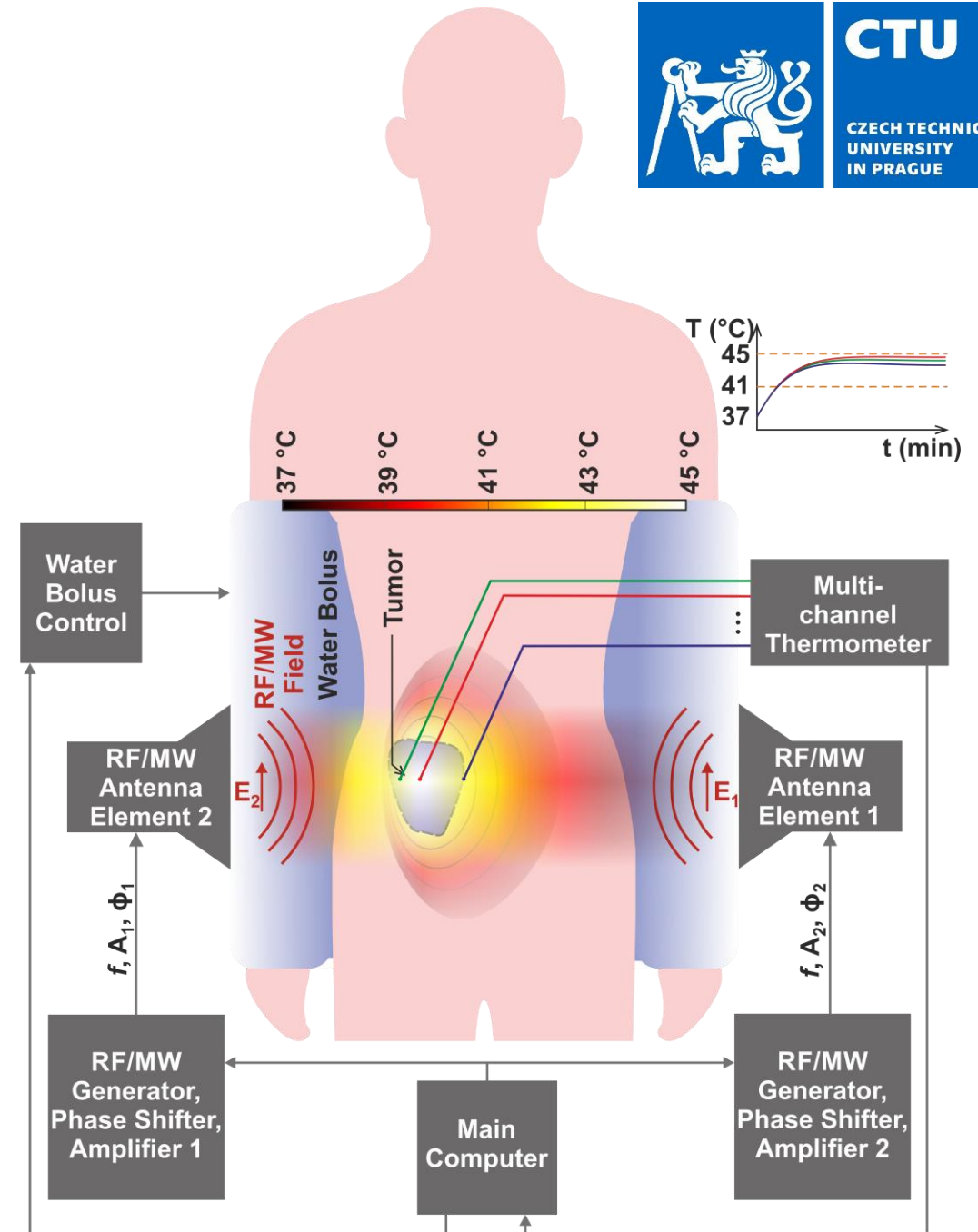


Industrial heating and drying



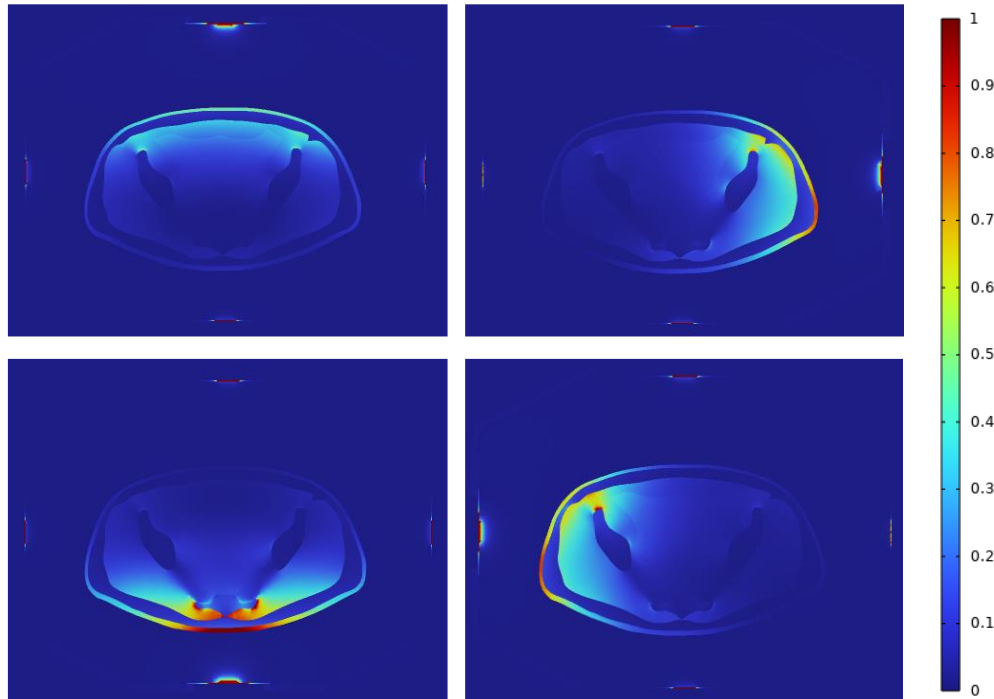
Regional microwave hyperthermia

- Hyperthermia - a targeted increase in the temperature of the tumor area to a temperature of 40-44 °C for 30 to 60 min.
- The goal is:
 - increased tumor sensitivity to radiotherapy or chemotherapy,
 - inducing a state of so-called apoptosis (i.e. tumor cells stop dividing).
- Regional hyperthermia targets tumors located deep below the surface of the patient's body. Typically in the abdominal cavity or in the pelvic area.
- RF/microwave regional hyperthermia uses constructive interference of EM waves from multiple sources surrounding the treatment area
- Hyperthermia increases the effectiveness of radio- and chemotherapy by tens of percent



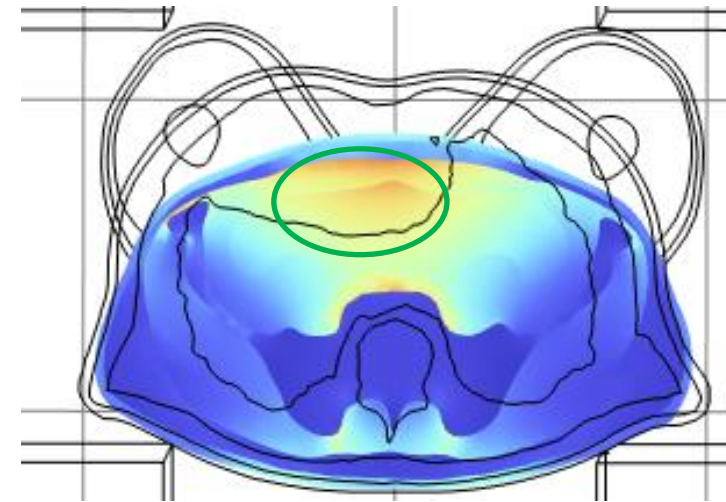
Regional microwave hyperthermia treatment planning

Calculation of EM fields in patient specific models



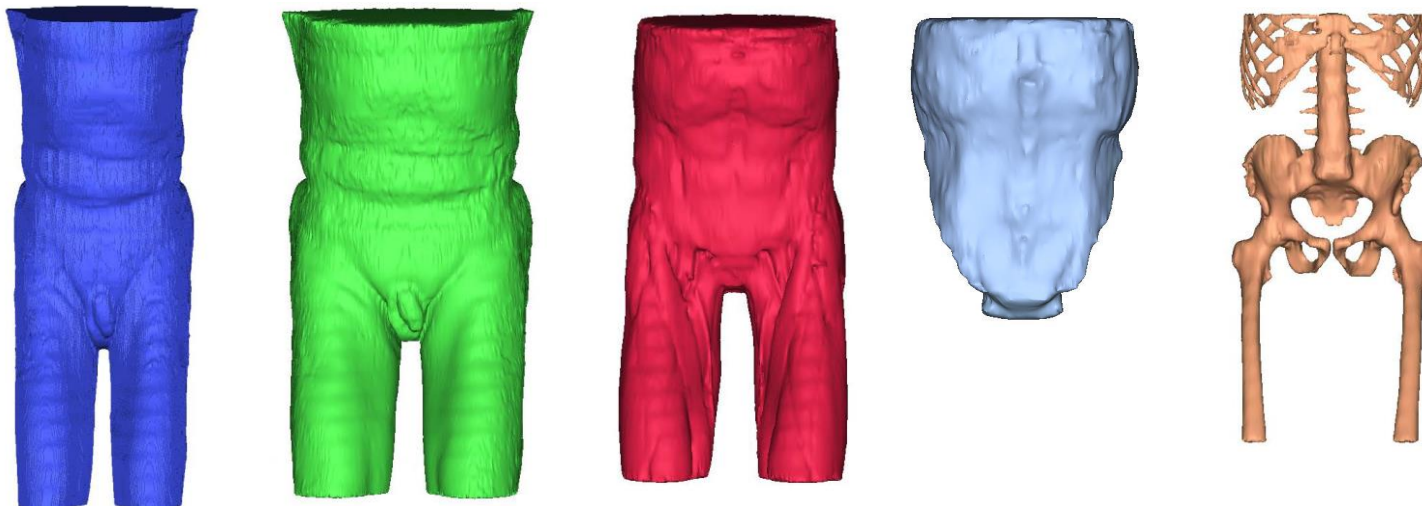
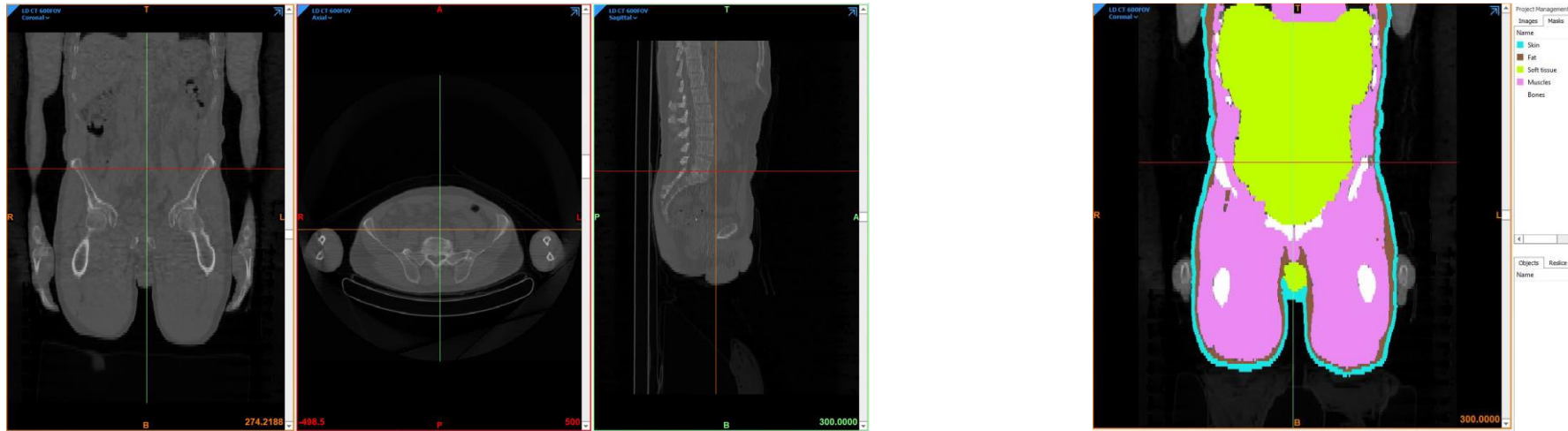
Normalized magnitude of E-field

SAR Optimization $THQ = \frac{\langle SAR_{target} \rangle}{\langle SAR_{1\%HS} \rangle}$

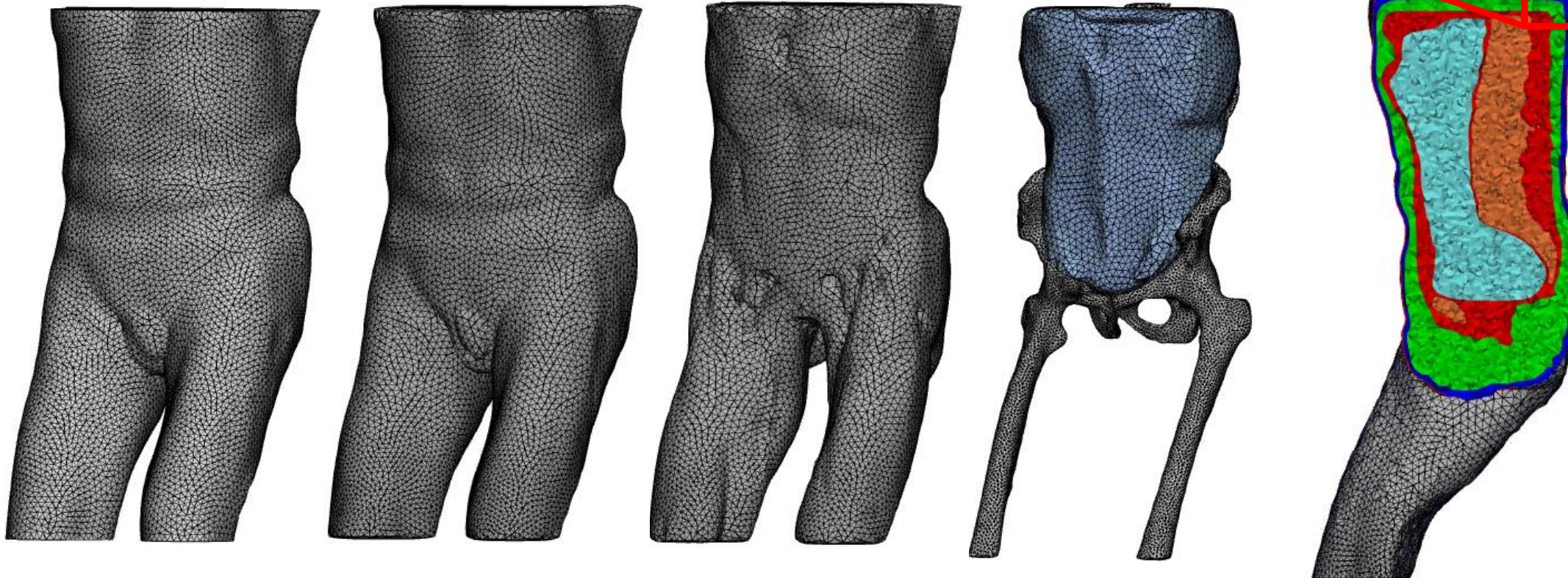


HTP quality evaluation $TC_{50} = \frac{V_{target} (SAR > 0.5 \cdot \{SAR\})}{V_{target}} [\%]$

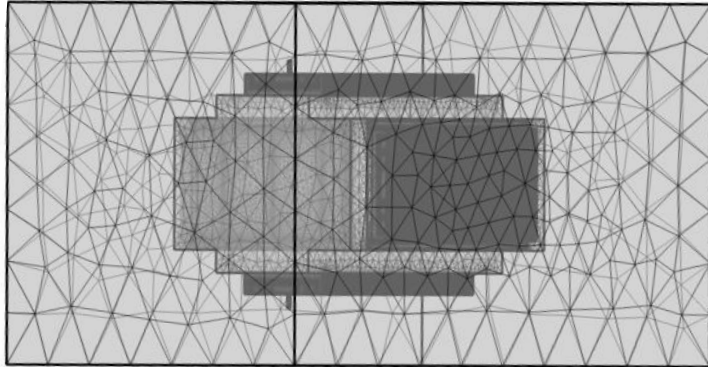
Preparation of anatomically accurate models



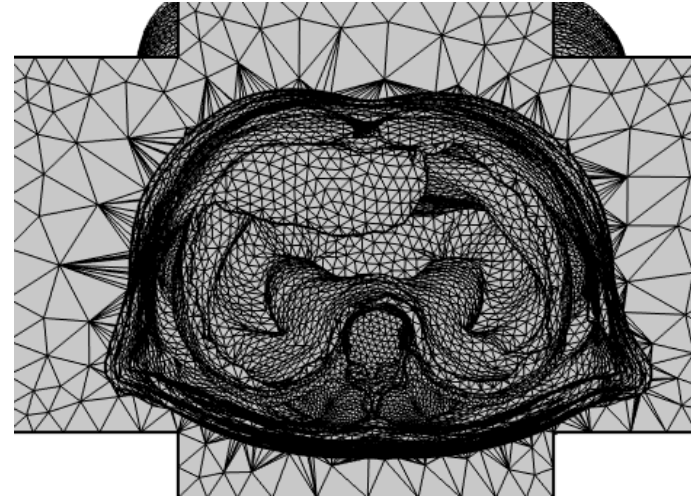
Mesh preparation in an anatomically accurate model



Merging COMSOL geometry with imported meshes



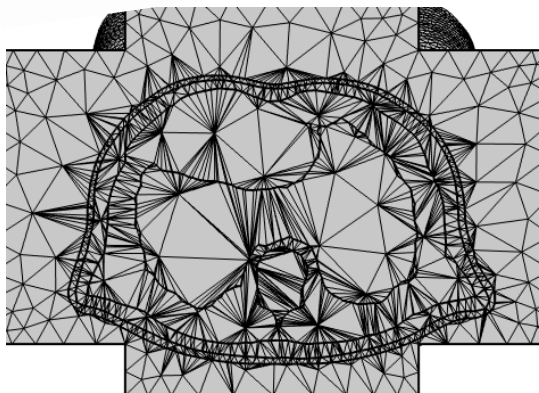
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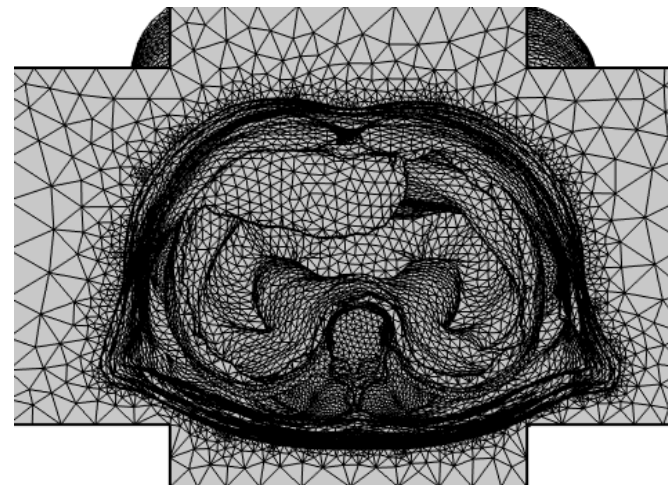
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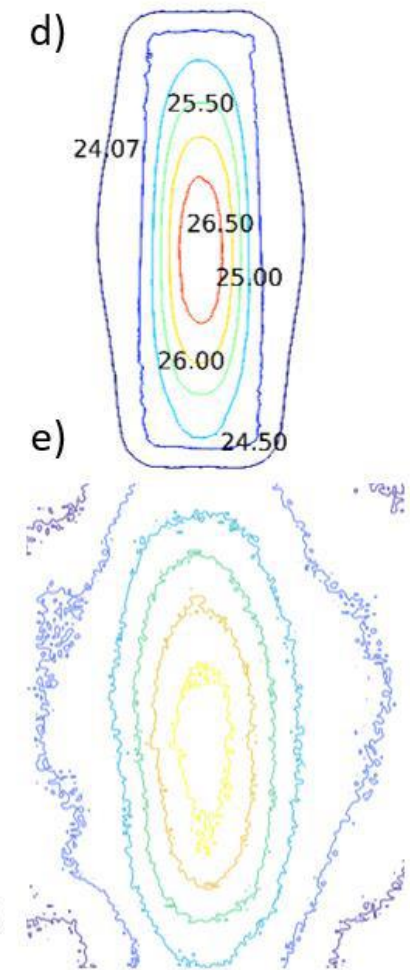
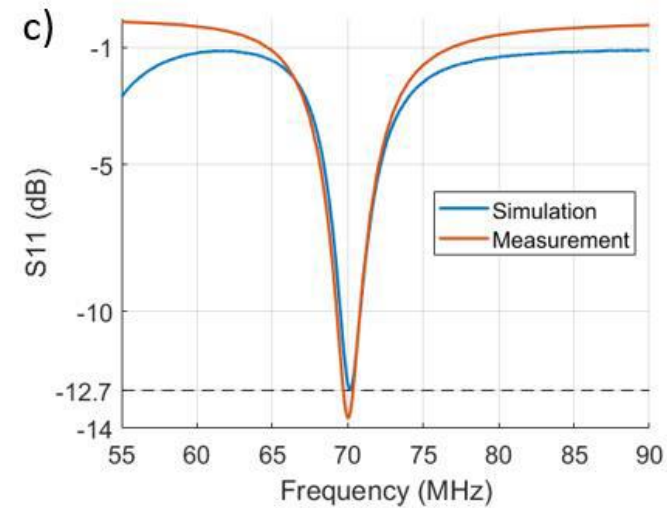
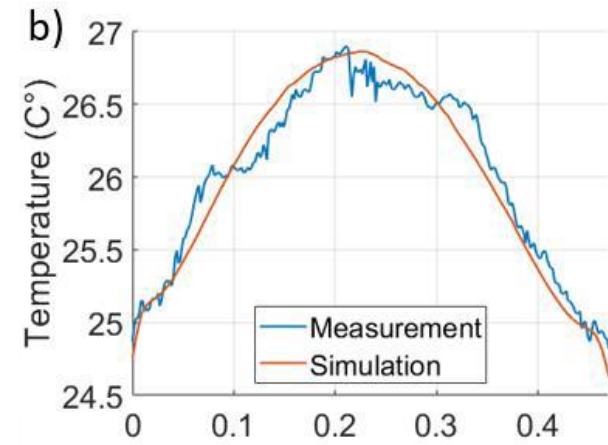
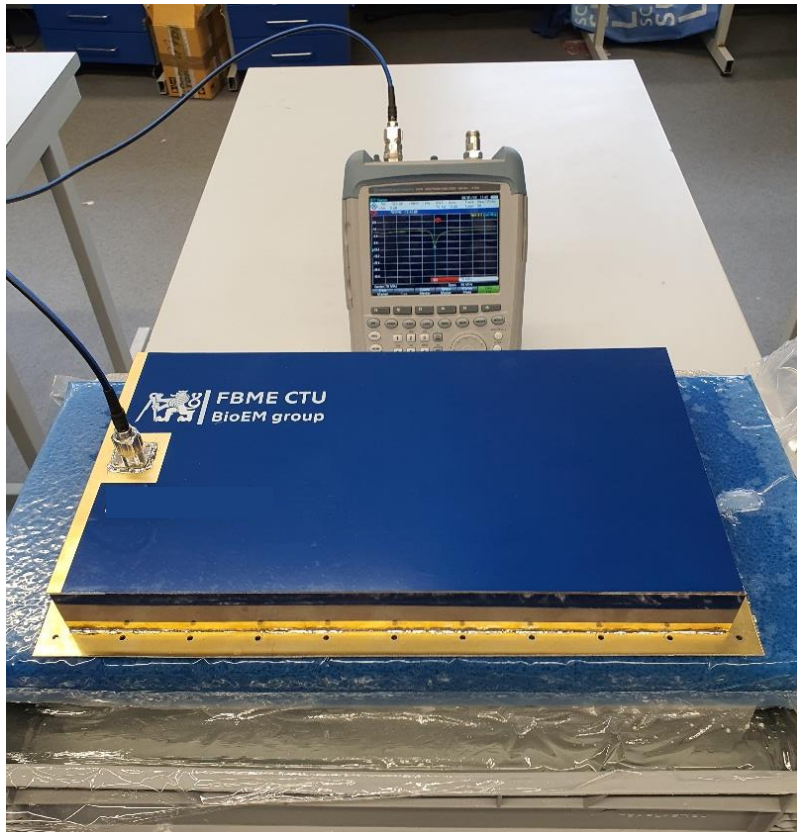


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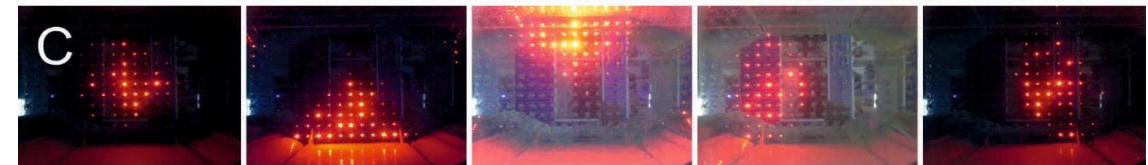
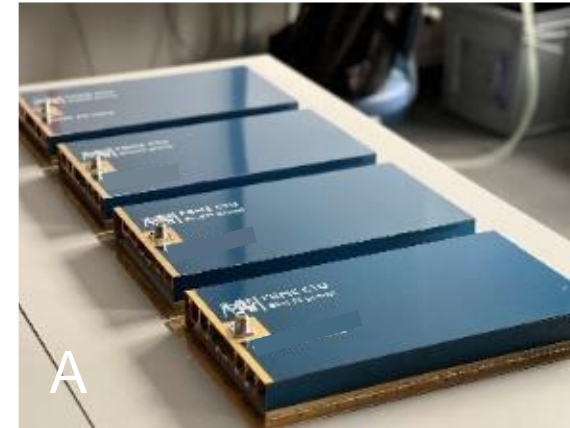
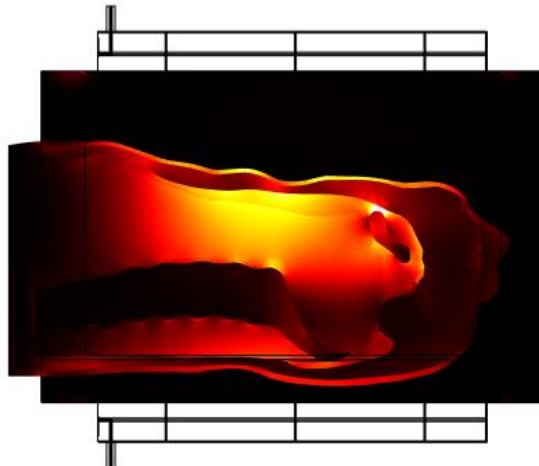
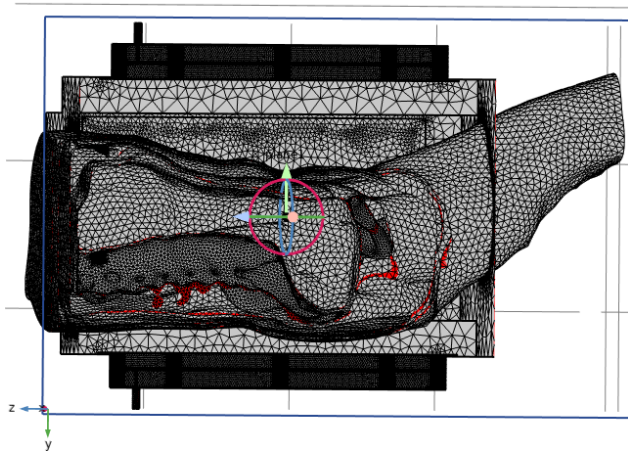
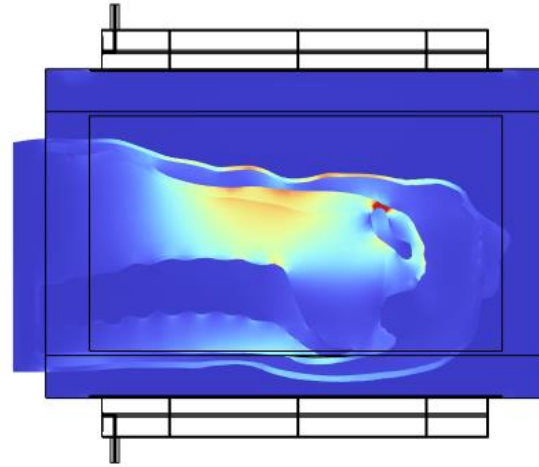
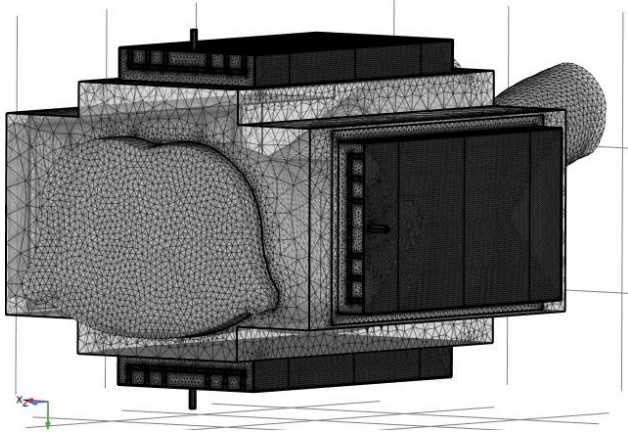


- Free Triangular
- Free Tetrahedral

Laboratory testing of the novel AE and comparison between measurement and simulations



Laboratory prototype of regional hyperthermic system with a noval AE



A) Realized regional hyperthermic system applicator consisting of a supporting part and antenna elements. (B) Applicator connected to a commercial generator and with an embedded pelvic phantom and LED array. (C) results of testing the ability of the system to focus the electromagnetic field to different parts of the pelvic area phantom.