Institute of Medical Technology and Intelligent Systems

Medical Technology Project in Summer 2025: How can a human respiratory system be realistically simulated?

Respiratory movement plays a crucial role in medicine, as it influences the position of organs and thus impacts the accuracy of needle placement to extract tissue biopsies or during radiotherapy. Several methods are available to compensate for respiratory motion, e.g., tracking the movement with a camera. However, to develop and test performance of novel motion compensation methods a phantom setup is necessary. In this interdisciplinary project, you will develop an actuated, controlled, 3D-printed phantom of the thorax.

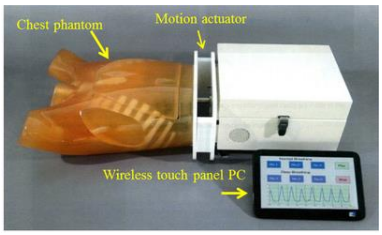
The focus of this project will depend on your previous experience and interests as well as on the group size. During the kick-off meeting on the **11th of April at 12:15 pm in room E 1.022** the project is presented and discussed. The work packages described below can be adapted to the interests of the group members. In the following weeks, you will organize your work as a team and plan your working hours individually. We will offer interim meetings to discuss the overall progress and solutions.

The project will be evaluated based on a final presentation in our lab and a written report. We encourage you to provide also a short video of your phantom explaining the design, functionality and its evaluation. This module being a team project we will grade both, the individual contributions but also the efficiency and cooperation when working in a team.

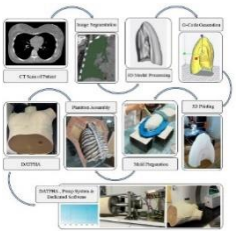
Possible work packages:

1) Image processing: test existing AI-based methods to segment features in CT images
2) 3D Printing: parameterization and design of a 3D printable rib cage considering joints for rib movements
3) Electrical + control engineering: development of an actuated model with adjustable breathing dynamics
4) Evaluation and characterization of the phantom functionality

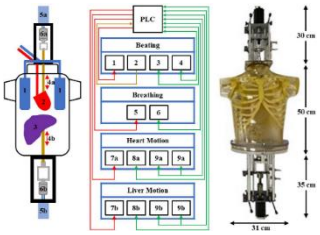
Examples from the literature:



Ching-Yi Hsieh, et al., ***Evaluation of a commercial cardiac motion phantom for dual-energy chest radiography,*** *Journal of Applied Clinical Medical Physics*



Abdollahi S, et al., ***Dynamic anthropomorphic thorax phantom for quality assurance of motion management in radiotherapy.*** *Phys Imaging Radiat Oncol.*



Panagi, S, et al. ***A moving liver phantom in an anthropomorphic thorax for SPECT MP imaging.*** *Phys Eng Sci Med 45, 63–72 (2022).*

Institute of Medical Technology and Intelligent Systems (MTEC, E-1)
Contact: Sarah Grube (sarah.grube@tuhh.de), Sarah Latus (s.latus@tuhh.de)