X-ray Tumor Mimic

Project Management and Software Development
for Medical Applications

General Info
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Project Abstract
Students develop a semi automatic segmentation GUI for Barium Sulfate based markers in CT and X-ray. Then they develop a fully automatic reconstruction based on their segmentation and tracking information for multiple tracked X-rays. Finally, using their reconstructions, they compute an error between the different 3D shapes.

Background and Motivation

![Figure 1. Multiple X-ray images of an ex-vivo liver with Barium Sulfate injected](image)

The background of this project is that we are performing animal trials for an augmented reality system for surgery. This augmented reality system requires a registration. In order to analyze our system, we need to understand the registration error, which will change during surgery (due to deformation of the tissue). The project is about how to measure this error. To this end, we inject Barium Sulfate into some organs of the animal that we are interested in. The Barium Sulfate acts like a marker in CT or X-ray. Now before the surgery we take a CT of the animal (with the Barium Sulfate). Then, the Barium Sulfate (the “Tumor”) should be segmented in the CT. Afterwards, an X-ray to CT registration is done. During the surgery, after multiple steps, we will take multiple X-rays, where the C-Arm is being tracked using an Optical Tracking System. From these X-rays, the Barium Sulfate should be segmented and then reconstructed. Then, all the Barium Sulphates (in CT and X-ray) need to be brought into the same coordinate system (using Tracking System and Registration Information) and then the error can be measured by analyzing the movement of the Barium Sulfate.

Student’s Tasks Description
The student should program a GUI that allows for easy semi-automatic segmentation of the Barium Sulfate in both CT and X-ray. Furthermore, the student should develop software that can perform a reconstruction of the Barium Sulfate from multiple (ca 5) tracked X-rays, using the segmentation obtained previously. The code should be able to handle multiple “Tumors”.

The semi-automatic segmentation should be as automatic as possible (but it can require e.g. the input of a seed point) and have a good user interface.

Students need to be able to install their code on the workstation used during the animal experiment. Ideally the students can join a few experiments.

Technical Prerequisites
Basic knowledge of OpenCV in either C++ or Python
Some prior experience in working with Ubuntu
Basic knowledge of Image Registration, Hand eye Calibration, Image Transformations, Optical Tracking Systems and GUI programming
Willingness to partake in animal experiments (in person).

References
Just read a bit about target registration error, CT reconstruction, hand eye calibration, semi-automatic segmentation methods and similar.

Please send the completed proposal to ardit.ramadani@tum.de, zl.jiang@tum.de, lennart.bastian@tum.de and tianyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.