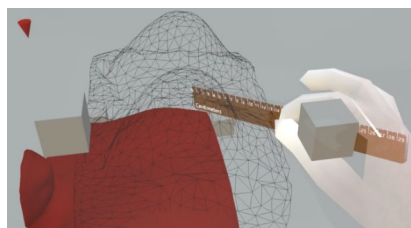# Augmented Reality for Breast Cancer Surgery

Master Projects

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During intervention in surgical oncology, localization of specific tissues (tumors, blood vessels,...) can be difficult. Generally, surgeons have to look at pre-operative images (such as CT, PET scan, MRI) acquired before the intervention in order to visualize the tissues of interest and make a 3d mental representation of their positions. Dye can be used as well to help seeing tumors. In this project we look at the possibility of using augmented reality during surgery to provide more visual information to the surgeon during the intervention. Such information would be extracted from pre-operative images and aligned with the patient during the intervention. Mixed reality glasses (optical see-through headset) is used to superimpose the 3d model (e.g. tumor 3d model) onto the reality. Different parts in this project have to be investigated: tumor visualization with Microsoft Hololens 2 glasses, registration (alignment) between pre-operative images (before intervention) and intra-operative images (depth map from Hololens), deformation model of tissue (e.g. breast deformation following landmarks). These projects will be done in close collaboration with involved surgeons.

Master Project 1: 3D Tissue and Tumor Visualization in Mixed Reality
Distance and depth perception can be difficult to estimate when wearing Hololens 2 glasses. The goal of this project is to develop methods to visualize 3D tissue and tumor on top of reality. Evaluation should be done to see which visualization would fit best to assist surgeons with tumor localization using Hololens 2.

Master Project 2: Deformable Breast Model using Landmarks
Different pre-operative images of breast tissue are available for augmented reality: different modalities (MRI, CT, PET scan), different positions (prove/belly vs supine/back, arms down/up). Before being used for augmented reality during the surgery, it is important to study and model breast/tumor deformation as soft tissue leads to large deformations following the position of the patient [1]. The goal here is to develop a deformable model for the breast and evaluate how accurate such a model could be to localize the tumors when aligned with landmarks (nipple, sternum, skin surface).

1. 2020 Wang, Breast tumor movements analysis using MRI scans in prone and supine positions

Master Project 3: Breast Imaging Alignment using Hololens 2 Depth Map
In order to align pre-operative images with the patient during the surgery, landmarks visible on both images and reality have to be used. Here we want to investigate if the depth map + camera of the Hololens 2 could be a solution to align the breast image with the patient using the shape of the breast.

Requirements:
- Best suited for students with a major in computer science, engineering, physics or related areas.
- C++, image processing (preferably in 3d, meshes).
- Experience in VR/AR is a plus.

If you want to know more about other Master projects at the Biomedical Imaging Group Rotterdam (BIGR), you can follow virtually the **BIGR Open Lab Day** on **May 12th 2021** starting at 14h. Contact me for more information on the event.