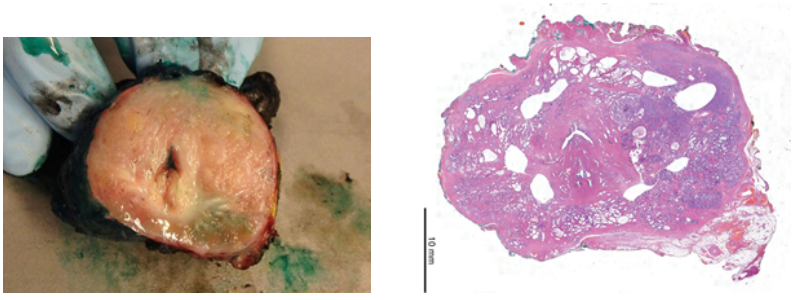
Multimodal Image Registration of Camera RGB to Histopathological HE

Project Description

Surgery is the preferred treatment for most types of localized cancer. However, in up to 40% of the cases the tumor resection is inadequate, because either some tumor tissue is left behind or too much healthy tissue is removed [1]. Inadequate tumor resection results in increased risk in tumor recurrence, poor functional outcome, and decreased survival rates [2]. Consequently, surgeons operate at a delicate balance between achieving complete tumor resection whilst preventing complications from removing too much healthy tissue. This clinical problem emphasizes the long lasting but still unmet need for a precise surgical tool that can provide guidance during surgery by informing the surgeon on the tissue type in the area of planned resection. At the Netherlands Cancer Institute (Antoni van Leeuwenhoek hospital) we are developing state-of-the-art and novel optical techniques to address the aforementioned issues of tissue type characterization during surgery.

However, when using a novel measurement technology to develop a classification algorithm with the aim of differentiating tumor tissue from healthy tissue, one requires a dataset in which the state of the tissue is known for each measurement. In other words, a dataset in which each measurement has a label: either tumor or healthy. With certain tissue specimen it is possible to discern by eye and palpation where the tumor is located, consequently at the time of measurement one can label the measurements. However, for the majority of specimen it is not known at the time of doing the measurement what the state of the tissue is. It is only after histopathological examination that a reliable description of tissue type and tissue state is obtained, usually in the form of a hematoxylin-eosin (HE) image that is labeled by an experienced pathologist. The



(a) (b)

Figure 1: (a) Camera image of a cleaved prostate specimen. The measurements have been done on this surface. (b) Corresponding hematoxylin-eosin (HE) image. This image can be annotated by a pathologist to discern which areas correspond to which tissue type.

downside is however, that producing such an HE image takes several days and the specimen is non-trivially deformed as a result of the histopathological examination. The question is therefore how to reliably correlate the positions at the time of measurement to the tissue type information from the HE. With the measurement locations known on an accompanying camera image, the task can be reduced to an image registration task between that camera image and the HE image, see figure 1.

In this project the student will work on developing and implementing an image registration algorithm capable of registering camera images to HE images. The student will have the possibility to work on a clinically relevant problem whilst being part of a research group with postdocs, PhDs, and other interns with varying backgrounds, including: physicians, engineers, and physicists. A background along the lines of: biomedical or medical engineering, biomedical sciences, imaging, medical physics, applied mathematics, computer science, or related topics are alleged well suited for this project. It is recommended for the student to have an interest or experience in programming, image registration, deep learning or algorithmic design, since the more auspicious methods will likely involve some of these skills. The student will furthermore be involved in data acquisition on tissue specimens in the clinic, pre-processing of data, validation of methods, and the evaluation of results.

Duration & Location

The project will be conducted at: Antoni van Leeuwenhoek - Netherlands Cancer Institute, Amsterdam. Depending on the coordinated objective, the duration can be established within the range of three to twelve months. Therefore, both externship and master end projects are appropriate.

Contact

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Additional Supervisors

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- Dr. Maureen van Eijnatten, Medical Image Analysis, Technical University of Eindhoven.

References

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