Real-time iOCT Volume Registration

1. General Info

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Outcome: The project result will potentially be published.

2. Project Abstract

This project aims to create a fast deep-learning model that can stitch together partial intraoperative optical coherence tomography (iOCT) volumes in real time. We will explore the best ways to register the images and the most realistic interpolation methods to create a complete retinal image. The main steps would be: investigating state-of-the-art models for real-time registration, stitching the registered volumes together into a complete image (perhaps using preoperative data), and implementing and optimising the chosen approach.

3. Background and Motivation

iOCT is a technology that allows ophthalmic surgeons to evaluate the effects of surgical manipulations in real-time. OCT can be built into microscopes

Just as OCT now commonly guides decisions in the clinic, iOCT may become a key asset in the surgical setting, and it has been used in various studies to provide visual guidance during ophthalmic interventions. To date, iOCT is the only imaging technology capable of detecting small retinal structures at micrometre resolution while providing live feedback during surgery. The cross-sectional B-scan images can be used to determine the position of the tool relative to the retina and estimate the needle insertion status during the subretinal injection. While in other vitreoretinal procedures, the microscopic field of view provides the surgeon with all essential information, and the OCT is used to integrate additional high-resolution information, in subretinal injection, the cross-sectional view offers information that is not apparent from the microscopic view, such as imaging of the anatomy and the insertion target located below the retina surface, as well as the current insertion status, which emphasizes the importance of OCT for targeted and reproducible injections. However, the field of view is limited in OCT imaging, sometimes restricted to a 3x3mm area. For the surgeon to use all available information, we would like to present a complete view by stitching together volumes, in real-time, that the OCT has already captured.

4. Technical Prerequisites

- Background in deep learning and some on computer vision
- Familiar with Pytorch
- “Sick” Python skills
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5. Benefits:

- Working on real-world clinical problems
- Possibility of finding novel findings and writing a scientific paper.

6. Work-packages and Time-plan:

	Description	From	To
WP1	Literature review		
WP2	Define the baseline method		intermediate presentation
WP3	Modeling and implementing the stitching		intermediate presentation
M1	Intermediate Presentation II		
WP4	Optimize code to run fast on GPU		
WP5	Test solution in lab		
WP6	Documentation		
M2	Final Presentation		