Optical Coherence Tomography for Eye Length Imaging

Degree programme: BSc in Micro- and Medical Technology | Specialisation: Optics and Photonics
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Depth-resolved scans of specific samples can be acquired using a spatial domain optical coherence tomography system (SD-OCT). To obtaining high-resolution scans of the entire human eye, the measurement range of the SD-OCT system needs to be extended. In ophthalmology, this system allows preoperative diagnostic on the anatomy of the patient eye. In the present work, a possible solution is investigated.

Introduction

The following research project results from the request of an optical coherence tomography system (OCT) that allows rapid depth-resolved scanning of the entire human eye. This system would enable diagnosticians to examine the structure and dimensions of a patient's eye, for example, before cataract surgery. Since resolution and measurement range compete with each other in the SD-OCT system, the possibility of increasing its measurement range at a given resolution needs to be investigated.

Goal

The goals of this work can be divided into three main parts. It begins with an elaboration of the theoretical basis and research carried out in this field. Then a system that allows recording such measurements needs to be realized. This implies to setup the physically SD-OCT system and developing the required software. Finally, the reconstruction of the long-range A-Scan must be performed. A specific algorithm must be developed, and the measurements on the samples need to be reconstructed to show the entire scans with an image.

Methods

As a first approach to the problem, the research carried out in this field in recent years has been addressed. Different methods have been evaluated, and the approach of a moving reference arm has been chosen. Additionally, it will attempt to improve the signal quality by optimizing the focusing method. Therefore, before building the final system, simulations regarding the sample arm were made. Then, the focus was put on developing a program, able to process the data detected by the acquisition software. Finally, it must be tested on technical samples and pig's eyes.

Results

Different possibilities have been analyzed and evaluated, and the work is based on the idea of developing a variable reference arm allowing the operator to move it during the measurement and to make recordings over the entire length of the human eye. A corresponding OCT system has been built. A software able to control the movement of the reference arm and to synchronize the position measurement with the OCT system has been developed. The algorithm designed to provide discrimination of the recorded surfaces and to obtain the correct stitching of the scan series is in progress. Figure 1 shows how the scans should appear after the recomposition of the measures. To the end of the thesis, the first high-resolution long-range OCT scans of technical samples and pig eyes might be presented.

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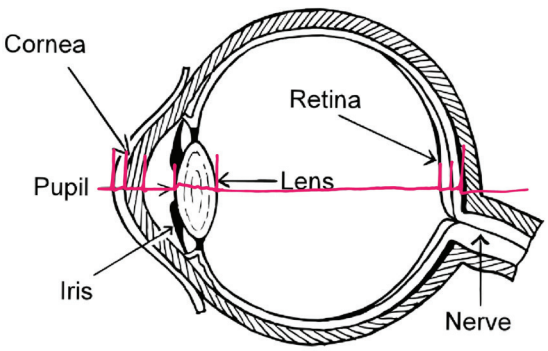

Figure 1: Long-range A-scans of an eye