

# Delay Line for Polarization Sensitive Optical Coherence Tomography

Degree programme : BSc in Micro- and Medical Technology | Specialisation : Optics and Photonics  
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Optical coherence tomography (OCT) is a non-invasive, high resolution measurement technique. The images obtained with this technique will represent a measured sample in cross-sectional view. A polarization sensitive OCT allows to visualize the polarization changes of the light traveling through the sample. Such a system is developed in the present work.

## Introduction

Polarization-sensitive optical coherence tomography (PS-OCT) is used to analyze a sample with its cross sectional structure and its polarization properties. PS-OCT is frequently used in the medical field. For example in ophthalmology to prevent glaucoma, but also to follow the healing of skin burns or to delineate tumors during breast conservation surgery.

## How it works

The OCT works on the basic principle of the Michelson interferometer. The laser is divided into two parts. One is reflected on a mirror and the other on the sample. The superposition of the two reflected waves creates interferences that allow to obtain an image. In order to obtain a polarization-sensitive OCT, a polarization delay unit (PDU) is added to the system. This component creates an optical path difference between the two polarizations P and S. This shift will allow to obtain two final images recorded with different polarization states represented in red and blue, respectively. In order to reconstruct the sample polarization properties, the balanced detector unit (BDU) must also be polarization sensitive.

## Goals

The objective of the thesis is to build a polarization sensitive swept source OCT (PS-SS-OCT). To do this, the PDU must be developed, manufactured and aligned. Then the existing BDU must be adapted to the 1310nm laser wavelength, assembled and aligned. The PS-SS-OCT must be built by integrating these components and the system must be characterized to decide on further improvements of the BDU. Data processing must be performed to image the results. The final objective of the work is to measure the degeneration of partially coagulated samples.

## Achievements

One of the main goals of the work was to realize the PDU. The final design can be seen in Figure 1. The blue and red beams indicate the paths of the two different polarizations through the assembly. The PS-SS-OCT was mounted and the characterization of the assembly showed that the BDU gives a satisfactory result. A first measurement of a scar on the skin of the hand, visible in Figure 2, has been performed where we can see the two different polarization shifted in height. The data processing will allow to visualize the polarization properties of the sample.



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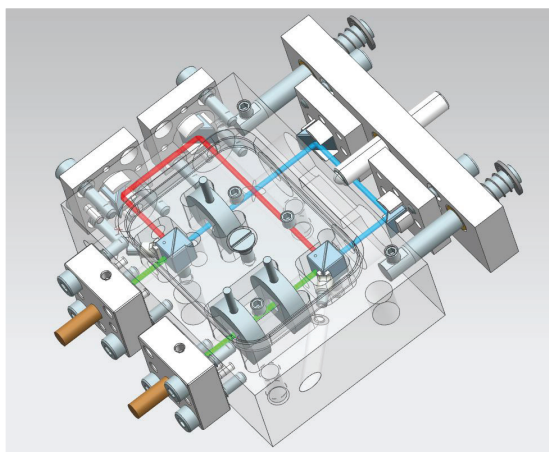


Fig1: Design of the polarization delay unit (PDU)

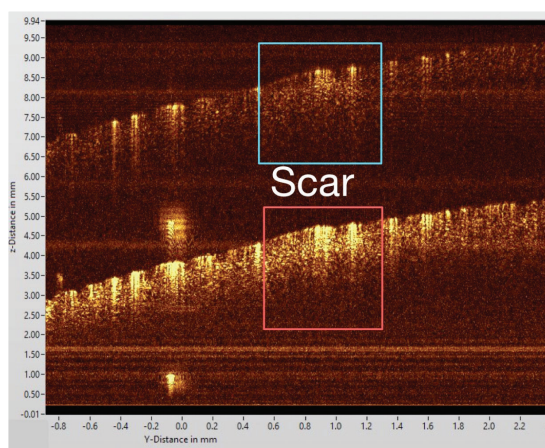


Fig2: Scar measurement performed with the PS-SS-OCT