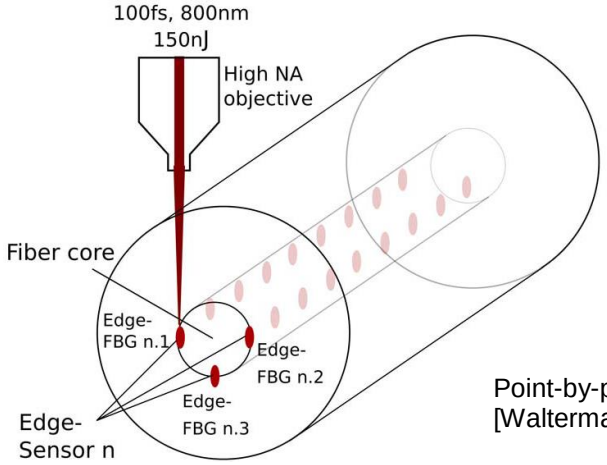
University of Basel
Department of Biomedical Engineering

Master Thesis Proposal

Effect of bending-related phenomena on the spectrum profile of the fundamental mode in an optical fiber

Context

In minimally invasive surgeries, it is often required to use non-rigid instruments in order to maximize accessible regions. However, the main drawback of using flexible tools is the higher risk of damaging non-target tissues as there is uncertainty about their shape. Consequently, an accurate tracking system is needed. Shape sensors based on Fiber Bragg Gratings (FBG) are suitable for this task, because they are small, biocompatible, immune to electromagnetic interference, and require no line of sight.
One of the most recent types of these sensors is based on edge-FBGs, where the Bragg gratings are inscribed on the edge of the core in a single-mode optical fiber using point-by-point femtosecond laser technology. The amplitude ratio of the edge-FBGs is sensitive not only to external perturbations but also to the spectral change of the propagated mode inside the fiber. Therefore, the main challenge is to estimate and correct the effect of spectral instability on the performance of these sensors.



Point-by-point inscription of three edge-FBGs [Waltermann, et al., 2018]

Task description

This master thesis aims to study the effects of bending loss oscillations and bending-induced birefringence on the performance of edge-FBG sensors. The following steps describe the work packages:

- Conducting a broad literature review on the existing theories that explain these two phenomena.
- Estimating the error caused by bending loss oscillations in the output signal of the sensor and testing the repeatability of the measurement.
- Evaluating tow different methods to reduce the sensitivity of the sensor to the bending loss oscillations and bending-induced birefringence.

Specific Requirements

Background in Optics and fibers, experience in working with optical fiber, and free-space optical elements.

Supervision

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