University of Basel
Department of Biomedical Engineering

Project MIRACLE
Planning and Navigation
CIAN

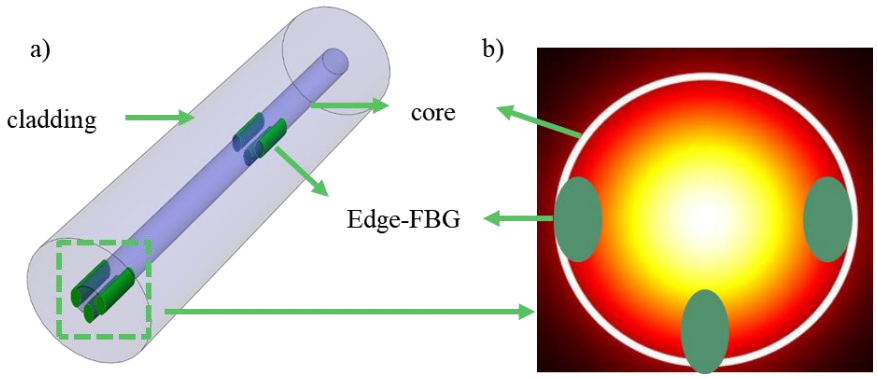
Master Thesis Proposal

**Designing a Deep Learning model for temperature sensing**

**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. External perturbations such as mechanical strain and temperature cause changes in the amplitude of the Bragg peaks. The main challenge in these sensors is to accurately model their behavior as the main signal is often affected by other undesired phenomena. Preliminary results show that the complicated relationship between the amplitude of the Edge-FBGs and the sensor's shape can be described using a basic deep learning algorithm.




**Task description**

This master thesis aims to design a deep learning model that describes the temperature sensitivity of an Edge-FBG shape sensor. The following steps describe the work packages:

- The student should Prepare a setup to record the sensor's signal at different temperatures.
- A fast spectrometer controlled by MATLAB collects the output signal of the sensor, which should be synchronized with the temperature variations.
- Different Deep learning architectures should be tested to find the most accurate model describing the sensor's behavior.

**Specific Requirements**

Experience with MATLAB, Python, Machine Learning Basics, and Optical Fibers.

**Supervision**

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