An arterial phantom for continuous optical glucose monitoring

Background
Type 1 diabetes is an autoimmune disease that results in the destruction of insulin-producing beta cells in the pancreas, leading to insufficient insulin production. People with diabetes need to adjust their insulin dosage based on their blood glucose (BG) measurements, which can be done through self-monitoring with capillary blood samples and glucose meters. While this method provides limited BG values per day, it can be uncomfortable and inconvenient for patients. Continuous glucose monitoring (CGM) devices offer a more convenient solution, as they continuously measure glucose in the interstitial fluid (ISF) and significantly improve the quality of life of people with type 1 diabetes. However, current CGM systems, which use sensors based on an enzymatic reaction and are placed in the abdomen or upper arm, have a delay of approximately 10-15 minutes between the glucose concentration in the ISF and true blood glucose. This delay hinders the development of an artificial pancreas. Our research group is working to develop a new optical glucose sensing technology that can provide delay-free, real-time glucose sensing.

Aim
In this project, the student will design and build an artery phantom with controlled optical and mechanical properties.

Materials and Methods
The aim of this project is to develop an arterial phantom that mimics the optical and mechanical properties of a real artery. The student will first conduct a literature review and use Monte Carlo simulations to devise a strategy for producing the phantom. The phantom will then be produced through the successive deposition and curing of polymer layers on a rotating shaft or using 3D printing techniques. To tune the optical properties of the layers, scattering and absorbing agents will be added. Finally, the optical properties of the phantom will be tested using various measurement technologies such as spectroscopy, polarimetry, and imaging.

Nature of the Thesis:
Literature research: 10%Experimental: 70%
Programming: 10%
Documentation: 10%

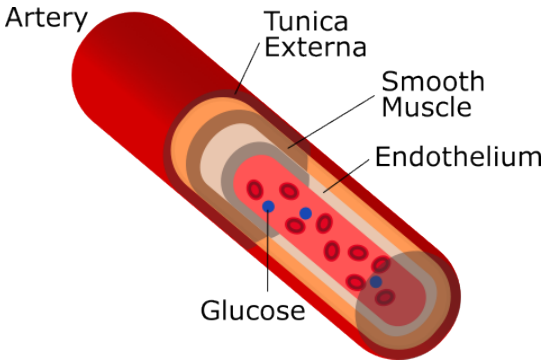

Figure 1: Artery and its layers

Requirements:
Motivation to work in a multidisciplinary team
Familiarity with optics
Interest in experimental work
Programming skills (Python or similar)

Supervisors:
Prof. Dr. Lilian Witthauer
Prof. Dr. Dominik Obrist
Dr. Ehsan Hassanpour

Institute:
Sensing and Monitoring Lab, UDEM, University of Bern and Bern University Hospital

Contact:
Prof. Dr. Lilian Witthauer, lilian.witthauer@med.unibe.ch, Sensing and Monitoring Lab, UDEM, University of Bern and University Hospital of Bern, Diabetes Center Berne, Freiburgstrasse 3, CH-3010 Bern, Tel. +41 31 664 22 77