



**IGMP** Institut für  
Gewebemedizin  
und Pathologie



INSTITUT  
POLYTECHNIQUE  
DE PARIS

**INSELSPITAL**  
UNIVERSITÄTSSPITAL BERN  
HÔPITAL UNIVERSITAIRE DE BERNE

## Master thesis proposal

### Polarimetric instrumentation for biomedical diagnosis of brain tissue

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**Background.** Proof of concept studies of polarimetric detection of brain white matter fiber tracts using a wide-field imaging Mueller polarimeter (IMP) have already been established in the framework of HORA O project for different brain tissue specimens (ex vivo formalin-fixed human tissue and fresh animal tissue). It has been shown that IMP enhances the contrast between white and gray matter zones on macroscopic images of the scalar retardance, the depolarization and the azimuth of the optical axis. This contrast enhancement is due to the densely packed and highly aligned fiber tracts of the white matter of healthy brain tissue, which exhibit uniaxial linear birefringence. The results from thick sections of formalin-fixed human brain tissue and fresh cadaveric calf brain tissue measured in backscattering geometry with the IMP prototype that was built in LPICM, IP Paris and installed in the premises of the HORA O lab, Inselspital are very encouraging.

An important goal of the HORA O project is designing and implementing an imaging polarimetric system for in vivo settings, which will have a considerable impact on the envisaged technology transfer. The main instrument requirements include an intra-operative, real-time, label-free, and non-contact identification of brain tumor borders and brain fiber tract orientation.

**Aim.** For this master thesis project we intend to address the important requirement for fast acquisition time by targeting a real-time system. For that, your main task will be to build a replica instrument based on an existing IMP system under the guidance of experts in polarimetry.

**Materials and Methods.** Your biggest challenge will be the optoelectronic optimization of the ferroelectric liquid crystals-based IMP system. After the optimized implementation of the IMP system, you will perform the validation of the instrument on different calibration samples and brain specimens.

You will acquire and increase the knowledge in polarimetric imaging, optoelectronic, brain sample preparation and Labview/Python programming. You will have the opportunity to work in the HORA O Lab on Inselspital campus, in close collaboration with the experts in Optical Instrumentation, Image Processing, Neurosurgeons and Neuropathologists.

**Proposed duration:** 6 months

**Applicant profile:** Master's student with focus in physics/photonics/biomedical engineering.

**Required skills and interests:** Interest in biomedical applications and hands-on knowledge in electronics, optics, and good programming skills are desirable.



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