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Classification of Brain tumour tissues in Human Patients using Machine Learning

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Delineating brain tumor margins as accurately as possible is a challenge faced by the neurosurgeon during tumor resections. The extent of resection is correlated with the survival rate of the patient while preserving healthy surrounding tissues is necessary. Real-time analysis of the endogenous fluorescence signal of brain tissues is a promising technique to answer this problem. For this purpose, a miniaturized multimodal non-linear endomicroscope is currently under development. The development of this tool requires in parallel the construction of a tissue database that includes the different imaging modalities that will be integrated into the endomicroscope. The database contains optical signatures from different samples of brain tissues, either healthy or tumoral, excited at different wavelengths. The collected data include spectroscopy measurements, fluorescence lifetime and auto-fluorescence images.
We will present two different studies carried out on these data.
The first one is based on spectroscopy data. We used Decision Tree based models and relative models to discriminate healthy from tumor tissues using different quantitative parameters computed from each spectrum. Two analogous studies will be presented, one in the visible excitation domain using 375 and 405 nm and the other in the Deep Ultra-Violet using 275 nm.
The second study is based on auto-fluorescence images. These images represent the response of endogenous fluorescence under two-photon excitation and the generation of the second harmonic in the near infrared excitation domain. In this study, we present the classification of those images into 6 classes (5 different pathologies and 1 control) using a convolution network. We show that the use of transfer learning and data augmentation methods significantly improve the results of the classification.

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