

**Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)**

SUBJECT:

Encapsulated ICG-enhanced spectral time-resolved near-infrared spectroscopy for brain hemodynamic studies

SUPERVISOR:

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DESCRIPTION:

Goal: To develop a new brain perfusion assessment technique based on monitoring of the inflow of an encapsulated indocyanine green by multiwavelength time-resolved NIRS.

Near-infrared spectroscopy (NIRS) is a technique with a good potential of the application at the bedside for assessment of cerebral perfusion and brain oxygenation. Cerebral blood flow (CBF) and cerebral blood volume (CBV) could be assessed by NIRS when a bolus of an optical contrast agent - Indocyanine green (ICG) which reveals high absorption in the near-infrared wavelengths is administrated intravenously. Application of this dye is limited due to its numerous disadvantageous properties in aqueous solution, including its concentration-dependent aggregation, poor stability and low quantum yield. In plasma, ICG binds almost completely (98%) to non-specific plasma proteins leading to rapid elimination from the body with a blood half-life of 3 - 4 min. In order to overcome these limitations, encapsulation of ICG which resulted in positive effects on the optical properties and stability of the dye, could be used. Moreover, it was reported that encapsulated ICG improves signal-to-noise ratio of multiphoton imaging as well as in photoacoustic imaging.

The superimposing of multi-wavelength time-resolved diffuse reflectance measurements and high contrast optical dye agent could be a powerful tool for assessment of hemodynamic parameters of the brain in adult humans with elimination of the contamination of the extracerebral layers.

Work description: This work regards basic research on development and validation of the encapsulated ICG-enhanced, multiwavelength time-resolved NIRS method. This will require a multi-disciplinary effort including theory, software and hardware research finalized with in-vivo tests on animals.

You can expect to learn biomedical optics and biomedical engineering basics; develop and construct new optoelectronic hardware, methods, algorithms, software, etc.; carry out measurements in-vivo on animals; write peer-reviewed research publications; write PhD thesis based on the research.