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Characterization of the Raman background of optical fiber probes towards multimodal optical monitoring of neural activity

ABSTRACT

Brain functioning is linked to blood oxygenation levels, as localized neural activation triggers an increase in oxygen supply. This coupling enables the reconstruction of cerebral activity by monitoring fluctuations in blood oxygen levels, for example via functional near-infrared spectroscopy (fNIRS), a label-free optical method that measures the differential absorption of near-infrared light by oxygenated and deoxygenated haemoglobin and has found increasing clinical applications[1][2]. Interestingly, label-free optical monitoring via Raman spectroscopy has also emerged as a promising approach for in situ biochemical sensing under physiologically relevant conditions[3].

This master thesis focuses on merging Raman spectroscopy with fNIRS through optical fiber probes, aiming for a multimodal optical analysis of hemodynamic and biomolecular signatures.

A primary challenge in this integration is the presence of a strong fiber background signal, which can easily mask the metabolic signals of the biological sample. This work will report on the first research phase dedicated to a characterization of the background signal produced by various fibers.

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BIOGRAPHY

Giorgia Caccaro is a Physics Master student at the university of Padova, Department of Physics and Astronomy "G. Galilei", enrolled in the curriculum of interdisciplinary physics, with a focus on biological physics. She earned her bachelor's degree at the same university, with a thesis on the application of label-free endoscopic spectroscopy to study brain tumors with minimally invasive optical probes. She's currently working at her master thesis, which concerns multimodal label-free hemodynamic monitoring using fiber-based fNIRS and Raman spectroscopy.

Author: CACCARO, GIORGIA (Department of Physics and Astronomy "G. Galilei", University of Padua, Padua, Italy)

Co-authors: GUIDOLIN, Chiara (Department of Physics and Astronomy "G. Galilei", University of Padua, Padua, Italy); GERVAIN, Judit (Department of Developmental Psychology and Socialisation; Padova Neuroscience Centre, University of Padua, Padua, Italy); PISANO, Filippo (Department of Physics and Astronomy "G. Galilei", University of Padua, Padua, Italy; Padova Neuroscience Centre, University of Padua, Padua, Italy)

Presenter: CACCARO, GIORGIA (Department of Physics and Astronomy "G. Galilei", University of Padua, Padua, Italy)

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