Sujet de stage

1. Informations générales

Titre du sujet du Stage	Image processing for the enhancement of brain tumor biomarker visualization from images acquired by Stimulated Raman Scattering microscopy.
Laboratoire d'accueil	Institut Fresnel UMR 7249
Date début de stage	Entre Janvier et Avril 2026
Date de fin de stage	fin Juillet 2026

2. Tuteur du stage

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Unité de recherche	Institut Fresnel UMR 7249

3. Sujet

Scientific context:

Stimulated Raman Histology (SRH) is a novel imaging technique allowing the acquisition of histological images enabling the visualization of consistent brain tumor biomarkers from sampled tissues. The main benefit of SRH is that images are obtained within few minutes while the traditional histology technique (Hematoxilin/Eosin (H&E) staining) can take up to 24 hours. Images are acquired with a Stimulated Raman Scattering (SRS) microscope configured to detect two Raman shifts 2845 cm^{-1} and 2930 cm^{-1} corresponding to CH_2 et CH_3 chemical bonds. The resulting images are then a two-channel images : one channel associated with CH_2 chemical bonds (mainly located in cell bodies) and the other associated with CH_3 chemical bonds (predominantly located in cell nuclei). Currently, cell nuclei, a major feature for cancer diagnosis, are identified by performing by a simple subtraction between both image channels [1].

Missions:

The proposed internship aims to develop and implement algorithms to enhance the visualization of cell nuclei. More precisely, the idea is to estimate new representations by minimizing the statistical dependance and/or the correlation between image channels [2, 3] while preserving biological and physical information. Furthermore, a second challenge is to design efficient quantitative metrics to ensure the consistency between the learned representations and the acquired images.

Candidate profile:
Student in the final year of a master's degree or engineering school with skills in computer science, AI, signal/image processing, and mathematics.

Requiring skills:

- High programming python skills (numpy, Scikit-Learn, Pytorch libraries)
- Strong knowledge in data science and biomedical image processing
- Skills in physics and in microscopy would be appreciated

Bibliography:

[1] R. Appay, B. Sarri, S. Heuke, S. Boissonneau, C. Liu, E. Dougy, L. Daniel, D. Scavarda, H. Dufour, D. Figarella-Branger, and H. Rigneault, "Live Stimulated Raman Histology for the Near-Instant Assessment of Central Nervous System Samples," The Journal of Physical Chemistry B 127, 3624-3631 (2023).

[2] J. Shlens, A Tutorial on Independent Component Analysis - arXiv preprint arXiv:1404.2986, 2014.

[3] J. Shlens, A Tutorial on Principal Component Analysis- arXiv preprint arXiv:1404.1100, 2014.