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Période de stage / *Internship period* : 31/01/2024 – 31/08/2024

Titre / *Title* : Exploiting the time-domain in compressive Raman microspectroscopy

Projet scientifique (1 page maximum) / *Scientific Project (maximum 1 page):*

Even though the technological developments in Raman microspectroscopy are impressive in terms of speed, there is still the issue of overwhelmingly large data set generated, an aspect that precludes video rate microspectroscopy.

Recently, compressive Raman imaging has emerged as a paradigm shift concept: exploiting advanced signal processing concepts (single-pixel imaging) [1] with Raman spectroscopy in order to achieve high chemical selectivity imaging with high speed. This paradigm shift is conceptually presented in the figure below. The basic
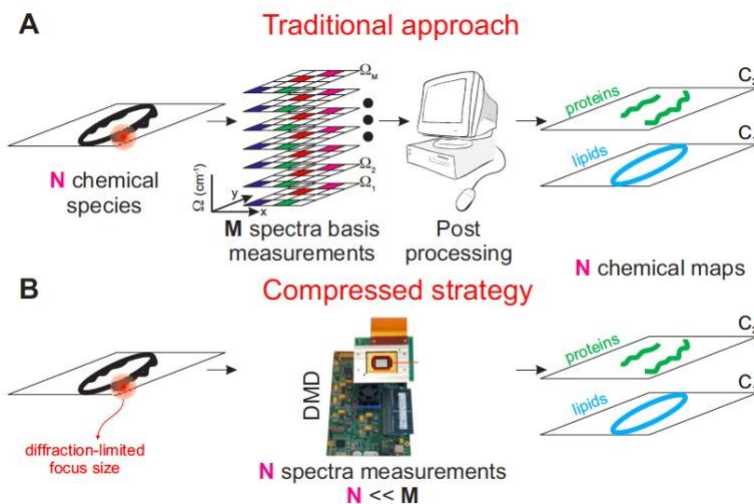
idea in compressive Raman is to design an experiment which can retrieve the same outcome as traditional Raman, however performing fewer measurements. For that purpose, a new design of the experiment is developed, which typically exploit programmable spectral filters using fast digital micromirror device (DMD). We have recently developed novel methodologies for compressive Raman imaging leading to the fastest spectral imaging acquisition to date of biological specimens [2].

Still, applications are constraint to surface imaging and to non-fluorescent samples. Both of these issues can be addressed by exploiting the temporal domain of Raman signals. In this project, we will upgrade the compressive Raman setup to add time domain analysis, which will be implemented both in hardware and in the computational treatment. Therefore, the development of the project will be experimental (optical imaging, signal processing, hardware synchronization, …), however there will be various computational tasks, therefore, basic experience with programming languages are needed. Depending on the outcome of the project, it could potentially follow up as a PhD project, that will be based on the recent activities of the group on computational microscopy. Informal queries are welcome.

[1] Edgar et al. Nat. Photonics 13, 13 (2019).
[2] Soldevila et al., Optica 6, 341 (2019). Sturm et al., ACS Photonics 6, 1409 (2019)