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A static Fourier Transform Raman spectrometer as novel planetary exploration technology

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Raman spectrometers are widely recognized as powerful analytical tools for unambiguous chemical and structural identification of materials in the gaseous, liquid or solid state. In recent years, considerable multidisciplinary effort has been made to prove the maturity of this technology for deployment in challenging environments, from the analysis of counterfeit drugs to planetary exploration [1].
We present the preliminary assessment of a near-infrared Raman spectrometer featuring an innovative design based on static Fourier Transform (FT) interferometry, as opposed to the conventional spectrograph using a diffraction grating. The proposed design relies on a modified Sagnac configuration to create a two-beam interference pattern across a detector array which is subsequently Fourier transformed from the spatial into the spectral domain [2].
In addition to the larger throughput that FT spectrometers are known to offer when compared to the diffractive counterparts, this system provides high spectral resolution (<10 cm-1) by implementing the concept of spatial heterodyning. Finally, the absence of moving parts lays the basis for a compact and rugged system that can withstand external vibrations. As such, this system lends itself to the deployment in planetary exploration as part of rover or lander instrumentation, where high levels of detection sensitivity and resolving power are paramount.
A brief introduction to the mathematical framework and optical design behind the heterodyned Static Imaging FT spectrometer will be followed by preliminary results on near-infrared Raman spectra of control samples.

References:
[1] F. Rull et al., Astrobiology, “The Raman Laser Spectrometer for the ExoMars Rover Mission to Mars”, July 2017, 17(6-7), 627-654
[2] H. Mortimer, “Compact interferometer spectrometer”, US patent 9046412 B2, issued June 2, 2015