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The Static Heterodyne Fourier Transform Spectrometer (SHIFTS) instrument: A high resolution imaging Fourier transform spectrometer for the remote sensing of land and atmospheric processes.

Hugh Mortimer, Elin McCormack, and Luca Ciaffoni
Rutherford Appleton Laboratory, RAL Space, Oxford, United Kingdom (hugh.mortimer@stfc.ac.uk)

The Static Imaging Fourier Transform Spectrometer (SIFTS) is a miniaturized Fourier Transform Spectrometer (FTS) that has no moving components. This new FTS design means that the instrument is highly miniaturized, lightweight and insensitive to vibration. However while this instrument has been used in a wide variety of Earth Observation based applications, the medium resolution (Vis$\sim$0.5nm IR$\sim$16cm-1) broadband hyperspectral measurements (Vis$\sim$200nm to 1100nm IR$\sim$2μm to 15μm) is a limitation to some applications that require the high spectral resolution in order to provide spectral discrimination or improved sensitivity.
In this paper we demonstrate the use of a novel optical technique to improve the spectral resolution of the original SIFTS instrument. This is accomplished by heterodyning the signal in order to increase the optical path difference of the generated interferogram. We have shown that through the use of a single transmission grating that we can achieve an order of magnitude improvement in spectral resolution while maintaining the inherent advantages of the original spectrometer design. This new heterodyne technique, Static Heterodyne Imaging Fourier Transform Spectrometer (SHIFTS), includes the advantages of the original instrument including high through-put (high etendue) in comparison to diffractive spectrometer counterpart. And unlike the Michelson FTS instruments, has high temporal resolution and can be used as effectively in the UV as it can in the infrared. This SHIFTS instrument technique, its performance is presented and its remote sensing applications in atmospheric and land surface applications is discussed.