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CALIBRATION METHODS AND SPECTRAL RETRIEVAL OF A SLAB WAVEGUIDE SPATIAL HETERODYNE SPECTROMETER

Abstract

Calibration methods and experimental results of the Slab Waveguide Interferometric Spatial Heterodyne (SWISH) spectrometer [1] is presented. The SWISH spectrometer has a high spectral resolution of 0.05 nm, is an infrared Fourier Transform Spectrometer (FTS) operating at the SHOW wavelength of 1364.5 nm [2] with a 2.5 nm bandwidth. The spectrometer is implemented using a slab waveguide with 100 Mach-Zehnder interferometers and measures only 2 by 3 cm. The spectrometers objective is to demonstrate the robustness and compatibility of slab waveguide technology with a nanosatellite platform.

Traditional approaches for calibrating spatial heterodyne spectrometers that rely on laboratory-based radiance are explored. Phase distortions resulting from fabrication errors and thermal properties will degrade the performance of the spectrometer. Therefore, emphasis will be given to phase distortion calibration algorithms as well as data processing algorithms developed to mitigate this [3]. The waveguide-detector alignment is of critical importance to the functioning of the spectrometer. A monochromatic signal will be used to conduct an analysis of cross-talk, Fresnel reflections and flatfielding of the interferometer array and will make evident the quality of the alignment [4]. The output from the slab waveguide comes in the form of a power interferogram which is Fourier Transformed in order to perform spectral retrieval. This indicates that the photo-response non-uniformity and the dark signal of the detector will be characterized. Defects, such as a non-ideal Y coupler, have only a localized effect on the interferogram, which allows for their isolation and characterization in the data processing algorithms. The majority of the explored defects are inherent in the spatial heterodyning concept and are characteristic of the individual spectrometer so they can be calibrated out of the retrieved spectrum. An initial attempt at a spectral retrieval will conclude the main section of this report.

References

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