A HYPERSPECTRAL CAMERA FOR SPACE APPLICATIONS

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Abstract (250 words):

Hyperspectral imaging (HSI) is a technique that acquires the continuous spectrum of light for each point of the image of a scene. One approach to HSI combines imaging with Fourier-transform (FT) spectrometry. Compared to dispersive optical systems, FT spectrometers have higher signal-to-noise ratio, higher throughput and flexible resolution. FT spectrometry is challenging as it is based on interferometers with delay accuracy at least of 1/100 of the optical cycle. However, the common amplitude-division interferometers like Michelson-type, are heavy, cumbersome and extremely sensitive to the external perturbations. An alternative approach is based on our common-path ultrastable birefringent interferometer, which has a delay accuracy better than 1/300 of the optical cycle from the UV to the infrared. By combining the interferometer with a monochromatic 2D sensor, we obtained a rugged and portable hyperspectral camera enabling ultrabroadband remote sensing. In this talk we present our recent results on extending the sensitivity of the hyperspectral camera to the thermal infrared, enabling HSI with continuous spectra ranging from 2 to 15 micrometers. This unique result is accomplished by three actions: the development of a novel spectrometer layout, which enhances the interferometric contrast in the thermal infrared; the use of calomel, an unrivaled birefringent crystal with transparency extending to 20-micron wavelength; the adoption of a microbolometer detector, whose signal-to-noise ratio is greatly improved by the FT approach. Since vibrational transitions associated with chemical bonds have their absorption and emission lines in the thermal infrared, the camera is a unique enabling technology for remote unambiguous chemical identification.