Miniaturized visible near-infrared hyperspectral imager for remote-sensing applications

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History: Received March 1, 2012; Revised July 20, 2012; Accepted July 24, 2012

Abstract

A new approach for the design and fabrication of a miniaturized hyperspectral imager is described. A unique and compact instrument has been developed by taking advantage of light propagation within bonded solid blocks of optically transmitting glass. The resulting series of micro-hyperspectral imaging (microHISI™) spectrometers have been developed, patented, and built as a visible near-infrared (VNIR) hyperspectral sensor capable of operating in the 400- to 1000-nm wavelength range. The spectrometer employs a blazed, convex diffraction grating in Offner configuration embedded within the optical blocks for ruggedized operation. This, in combination with fast spectrometer operation at $f/2.0$, results in high optical throughput. The resulting microHISI™ VNIR spectrometer weighs 0.54 kg, including foreoptics and camera, which results in a $2 \times$ decrease in spectrometer volume compared with current air-spaced Offner spectrometers. These instruments can accommodate custom, ruggedized foreoptics to adapt to a wide range of field-of-view requirements. These fast, telecentric foreoptics are chromatically corrected for wideband spectral applications. Results of field and laboratory testing of the microHISI™ spectrometers are presented and show that the sensor consistently meets technical performance predictions.
Citation: Christopher P. Warren; Detlev Even; William Pfister; Keith Nakanishi; Arleen Velasco, et al. 
http://dx.doi.org/10.1117/1.OE.51.11.111720