MIT Lincoln Laboratory, in collaboration with the NASA Earth Science Technology Office and NASA Goddard Space Flight Center, developed a compact imaging spectrometer that maintains state-of-the-art optical and signal-to-noise performance in a unit that has a volume more than an order of magnitude smaller than that of other spectrometer designs.

**KEY FEATURES**

- Compact optical form employs a doublet lens with a reflective back surface and a flat immersed grating to minimize volume and simplify optical alignment.
- Grating facets optimize the optical efficiency and signal-to-noise ratio.
- Optical form supports >3,000 spatial samples and the 380–2500 nm (VNIR/SWIR) spectral range.
- Modular design supports wide-field applications via multiple spectrometers coupled with a freeform telescope.
While high-performing, state-of-the-art imaging spectrometers have reached near-perfect aberration control and high signal-to-noise ratios (SNRs), the CCVIS maintains optimal performance in a package that has reduced size, weight, and power (SWaP).

Advantages of the Chrisp Compact VNIR/SWIR Imaging Spectrometer (CCVIS)

- The CCVIS can be readily deployed on airborne platforms, such as unmanned aircraft systems, and on small satellites.

- The CCVIS can be implemented as modules that, when coupled with a freeform telescope, may offer fields of view as large as 40 degrees or more.

- Local control of surfaces enables the optimization of complex surfaces with optical designs that have the high degree of aberration control necessary for a spectrometer capable of imaging over a wide optical field. This control is enabled by a freeform telescope design that uses the Lincoln Laboratory Fast Accurate NURBS Optimization code, which employs nonuniform rational basis-spline (NURBS) surfaces.

- The CCVIS flat grating is easier and faster to manufacture than the convex or concave gratings of other high-performing imaging spectrometers. The flat grating with dual-angle facets exploits grayscale lithography to produce 3D microstructures.

(a) The catadioptric lens is a combination of refractive optics with a reflective back surface. The CCVIS is 11 times smaller than the nearest compact optical form that covers the same spectral range. (b) The CCVIS modular design, when combined with a freeform telescope, enables a wide-field implementation. Available VNIR/SWIR focal plane arrays can have as many as 3,000 spatial samples. (c) Each dual-facet blazed diffraction grating has two planes, or blaze angles, designed to optimize the optical efficiency across the full spectral range.

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