Near-Infra-Red Suppressed "Blue" Calibration Source

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Abstract

Laboratory calibration and characterization methods using incandescent sources have been notoriously blue deficient. A homogenous spectral radiance source which better matches terrestrial targets has been developed. Standard industry practices and the issues encountered are discussed. How our solution addresses the problem and details of our approach are presented. This effort is part of an overall goal of developing cost-effective techniques for accommodating and determining the spatial/spectral transfer function of imaging spectrometers.

For spectral imaging systems with isolated spectral channels, or systems that are not sufficiently sensitive to systematic spectral response, the techniques of using distinct spectral levels for each channel helps mitigate these issues somewhat (Brueggemann, et al.).

However, since the latest spectral images use one optical train that handles the entire 0.38 to 2.5 micron range, and detector electronics noise characteristics and effective dynamic range have been improved, subtle optical spectral scanning effects have become more visible. An excess of stimulation in one part of the spectral range (i.e., NR) can noticeably clutter noise and prevent achievable accuracy in the spectral region of interest (VIS/Blue).

There are other considerations: it is also understood that in particular for images with relatively narrow spectral channels, that spectral homogeneity is complicated by the convolution of five spectral (Monroocks, Green, & Chrien). This means that an overall smooth spectral function is required. These considerations constrain the possible approaches to achieving solar-like calibration sources.

The absorptive filter approach showed promise in producing a more solar-like shape compared to incandescent. Preferred filter types (KOH, KG, BG) were defined. In the case of a large plate of filter glass placed over the exit aperture of an integrating sphere, the measured output 0.06 of an improved overall shape. Warming of the filter due to absorption was not found to be an issue. However, the beneficial Lambertian property of the integrating sphere was lost. Front-surface reflection, stray light, and varying filter path length issues were found to be spatially and radiometrically significant and nearly impossible to characterize.

Some way of advantageous filtering the light input into an integrating sphere was needed. Our first useful effort was on modifying a commercial source which had four light projectors spectrally normalized to completely illuminate the sphere.

The preferred absorptive filter type was incorporated into one of the projectors and an identical filter-outside of the sphere. Upon illumination, the filter immediately melted, leaving just a hole. Because the integrating sphere would make a crafted filter melt, a manner to capture and contain a pre-crafted filter was included.

This approach worked well, but greater radiance in the blue & UV was needed. As well, a more compact and convenient design (it was found that the screen deteriorated,里程的 sphere with filter dust) was desired. The next development path came from searching available laboratory instrumentation.

In conclusion, a method of spectrally shaping incandescent sources to produce a smooth spectrum of realistic radiance has been shown to be practical. There is still a lack of deep blue and UV light in this incarnation of the approach. In the future, more incandescent light can be added and draped, with the great majority of its total power going to heat. Other development paths that may hold promise include (i) with white lasers, custom lasers, laser pumped plasmas, closely-stacked LEDs.

This development effort is the result of an understanding at JPL, of increased need to strategically develop cost-effective practical techniques to more accurately characterize the (spectral & spatial) transfer function of the latest generation of compact imaging spectrometers. An added motivation is to calibrate the instrument with scene-radiance sources.

References

