New NIST Method Improves Accuracy of Spectrometers

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Measurements of the intensity of light at different wavelengths can be made more accurately now, thanks to a new, simple method for correcting common instrument errors. The new method, developed by researchers at the National Institute of Standards and Technology (NIST), will benefit fields such as color measurement, lighting development, remote sensing, biotechnology and astronomy.

The NIST method improves the measurement accuracy of spectrometers, devices that measure optical radiation at different wavelengths. Spectrometers are used widely in industrial settings and academic research to analyze the emissions from lamps or other light sources, as well as to analyze optical properties of materials. The NIST method corrects errors arising from the presence of stray light, unwanted scattered radiation within an instrument.

Stray light is often the major source of measurement uncertainty for commonly used spectrometers. It can cause unexpectedly large systematic errors, even as much as 100 percent depending upon the application, when an instrument tries to measure a very low level of radiation at some wavelength while there are relatively high levels in other wavelength regions. The new NIST method nearly eliminates stray light errors, to a level less than 0.001 percent of the total signal, a desirable level for most industrial and scientific applications. This allows very accurate measurement of low-power components of radiation and accurate measurements across a large dynamic range of intensities.

NIST researchers implemented and validated the method using a commercial CCD-array spectrograph, which measures light in the visible region instantly. They characterized the response to monochromatic emissions from tunable lasers that covered the instrument's full spectral range. Calculations were made using the measured data to produce a matrix that quantified the magnitude of the stray-light signal for every element (or pixel) of the detector array for every wavelength of light. The matrix then was used to correct the instrument's output signals for stray light. The method is simple and fast enough to be incorporated into an instrument's software to perform real-time stray-light corrections without much reduction in the instrument's speed.

NIST recently began offering a special calibration service to characterize spectrometers for stray light using the new method. Plans are being made to transfer the technique to industry, and a technical paper is in preparation. For further information about the calibration service, contact Yuqin Zong at yzong {at} nist.gov, or (301) 975-2332.

Source: NIST