Radiometer Specification Guide

Application Note 113

Overview

Following is general guide to the parameters used in selecting a radiometer to fit the application.

Dynamic Range

Dynamic range plays a major part in radiometry. A dynamic range in excess of 10^{10} is a natural outdoor occurrence from hazy moonlight to direct sunlight. A radiometer's dynamic range should be appropriate for the intended use of the instrument. For instance, if measurement outdoors are only going to be taken during the day, a dynamic range of 10^5 is adequate. One method of increasing dynamic range is to use ranges which are switched in as the applied signal strength increases. This method is sometimes called autoranging when the switching is done automatically. The concept of switching gain in the radiometer does increase the dynamic range, however, it does introduce errors at the switching points. Each switching level must be calibrated separately, and any errors will be evident at the moment the switch occurs. Gain switching or autoranging should be avoided if possible.

Dynamic range is important to radiometry because it defines the instruments full scale and resolution. Dynamic range can be calculated by dividing the full scale by the resolution. For instance, the PMA2201 UVB Detector has a full scale of 200MED/Hr and a resolution of 0.001MED/Hr. Therefore, the dynamic range is 200/0.001 = 2×10^5.

Wavelengths

The wavelengths being measured are the true indication of which radiometry system to select. Two types of radiometers exist today. The first is a single purpose meter with dedicated wavelengths, and the second is a radiometer with detachable detectors and various wavelength availability. The dedicated meter tends to be less expensive for an application which requires only one type of measurement. However, if more than one measurement is made, the removable detector is more economical and less time consuming. If multiple measurements are required, simply pick the number of detectors needed and use the same meter. This saves time in obtaining the additional meters and also in learning how to use them.

Cosine response

As a source revolves around a detector, the intensity will be at maximum when the source is directly overhead, and will decrease as the source is moved away from this position. The intensity should follow a cosine response. The angle is defined as the angle between the axis of the source and the normal to the detector surface.

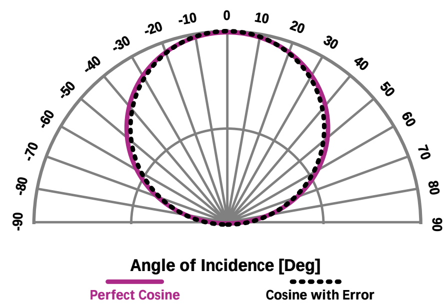

Figure 1 Polar Plot

At first, it would seem logical to plot a cosine response on a polar plot (Figure 1). However, the polar plot only shows the general shape of the response which is good for a quick visualization. It does not show details of the error to a perfect cosine response. Errors of a few percent are nearly impossible to see on a polar plot. Therefore a Cartesian system with the error curve shown is a better choice (Figure 2).

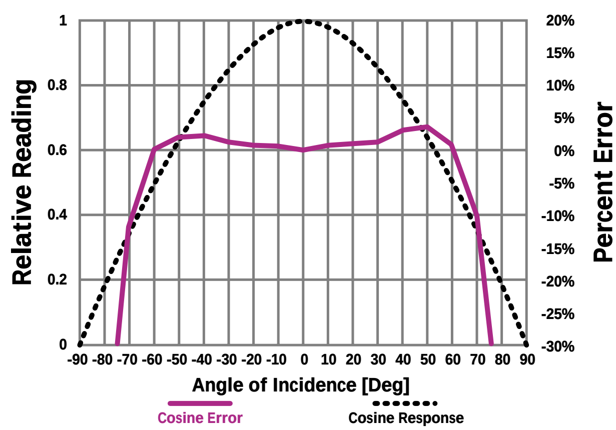

Figure 2 Cartesian Plot

Calibration

Any absolute measurement is only as good as the instruments calibration. Radiometers should be calibrated to a NIST (National Institute of Standards and Technology) traceable standard.

Unit Conversion

Conversion from one unit to the next may or may not be complex, but it is a potential source for error in measurements and data. The radiometer should always display the units, and save them if datalogging is available. This will at least make the units used for the measurement evident. Selectable units are also important in order for the user to change easily and without error to the units which are most comfortable for the measurement.

Environmental Conditions

The environment in which the radiometer is used also plays an important role in the selection of a radiometer. If the instrument is used in the field, portability may be a concern. If the radiometer is used outdoors or underwater, the detector must to be watertight. Power requirements may also be a concern in a given environment. If utility power is not conveniently available, the instrument should be battery operated. The battery capacity may be an issue if the instrument is used for extended periods of time under battery operation. Instruments used in a laboratory or permanent monitoring situation should be powered by utility power.

User Interface

The instrument's interface should be clearly labeled and intuitive. Important functions for a radiometer include: dose integration, a hold function, and unit conversion. Additional useful features include zeroing function, and some statistical information such as minimum, maximum and average readings.

Data handling

The radiometer should have a means of accurately and efficiently allowing the user to utilize the data. A PC connection such as RS232 is extremely useful for transferring data from the instrument to a PC for analysis. This connection eliminates the possibility of error due to manually recording the data on paper and typing it into a PC. If the radiometer will not have continuous access to a PC, datalogging may be preferable. Software packages which facilitate the data collection and storage are recommended.

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