An Overview of the BTS - Technology (BiTec)

Content

1. Brief Description

This article discusses the physical background and technical implementation of the BTS technology in more detail and also looks at the advantages of the BTS technology over conventional spectroradiometers. This technology makes it possible to use spectroradiometers for additional measurements/new applications with an even higher level of precision.

2. BTS Technology Overview

The **BTS technology** uses a so-called **BiTec Sensor** that basically consists of an integral photodiode and a spectral-array spectrometer. Both sensors are independent detectors that can be used individually. The technical specifications of the two sensors largely surpass those of other detectors on the market since they were developed based on Gigahertz-Optik's high-quality standards and many years of experience in photometry (wavelength accuracy, stray light suppression, linearization, filter design, etc.). In addition, the two sensors are also set to benefit from each other (mutual correction) thus making them superior in different technological aspects.

Gigahertz-Optik applies the so-called "*mutual correction principle*". Here, the spectral data of the spectroradiometer are used to calculate the spectral mismatch coefficient of the integral detector (see Gigahertz-Optik's article on a* correction [1]). This allows for online correction of the values measured by the integral detector since both sensors perform the measurement in the same field of view of the same light source. The measured and corrected integral value of the photodiode is then used to readjust the linearity of the spectroradiometer. The photodiodes have better linearity and stability levels than CCD or CMOS detectors of the array spectroradiometer.

In order to enable good linearity levels for these detectors, quality manufacturers linearize their CCD and CMOS detectors. In addition to the BTS technology, Gigahertz-Optik also performs the linearization for all detectors that are used in its devices. Nonetheless, the integral diodes still have a much better linearity across the entire dynamic range. For instance interseting in long term stability in SSL testing, see **BTS2048 Series**.

Integral diodes also have additional advantages in terms of long-term stability and noise performance. For instance, photometric or radiometric parameters calculated from the spectrum always contain a certain noise level (depending on the signal level and noise performance of the spectroradiometer). Integral detectors have a very low noise amplitude, particularly for very low measurement signals.

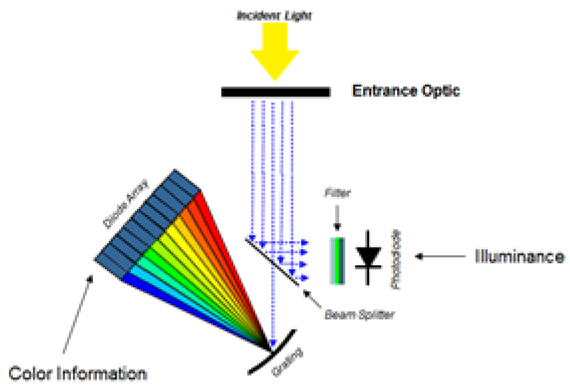
Hand-held spectroradiometers are often used in outdoor applications. Here, they are exposed to a wide temperature range that can affect the responsivity of the device. With the integral detector, this can easily be compensated for online thanks to the high linearity of the photodiode over a wide temperature range (e.g., the **BTS256-EF**). Conventional spectroradiometers do not have an online correction feature for such effects and often provide unsatisfactory measurement results in such cases.

The integral photodiode makes it possible to perform measurements that could never have been possible with conventional spectroradiometers e.g., fast CW measurements. For instance, a BTS device can be used to measure fast intensity fluxes. The **BTS256-EF** makes it possible to measure flicker parameters (see article on **Flicker** [3]). This is not possible with conventional spectroradiometers.

Using both sensors independently also has the advantage that both can serve as mutual reference detectors.

3. Technical Implementation

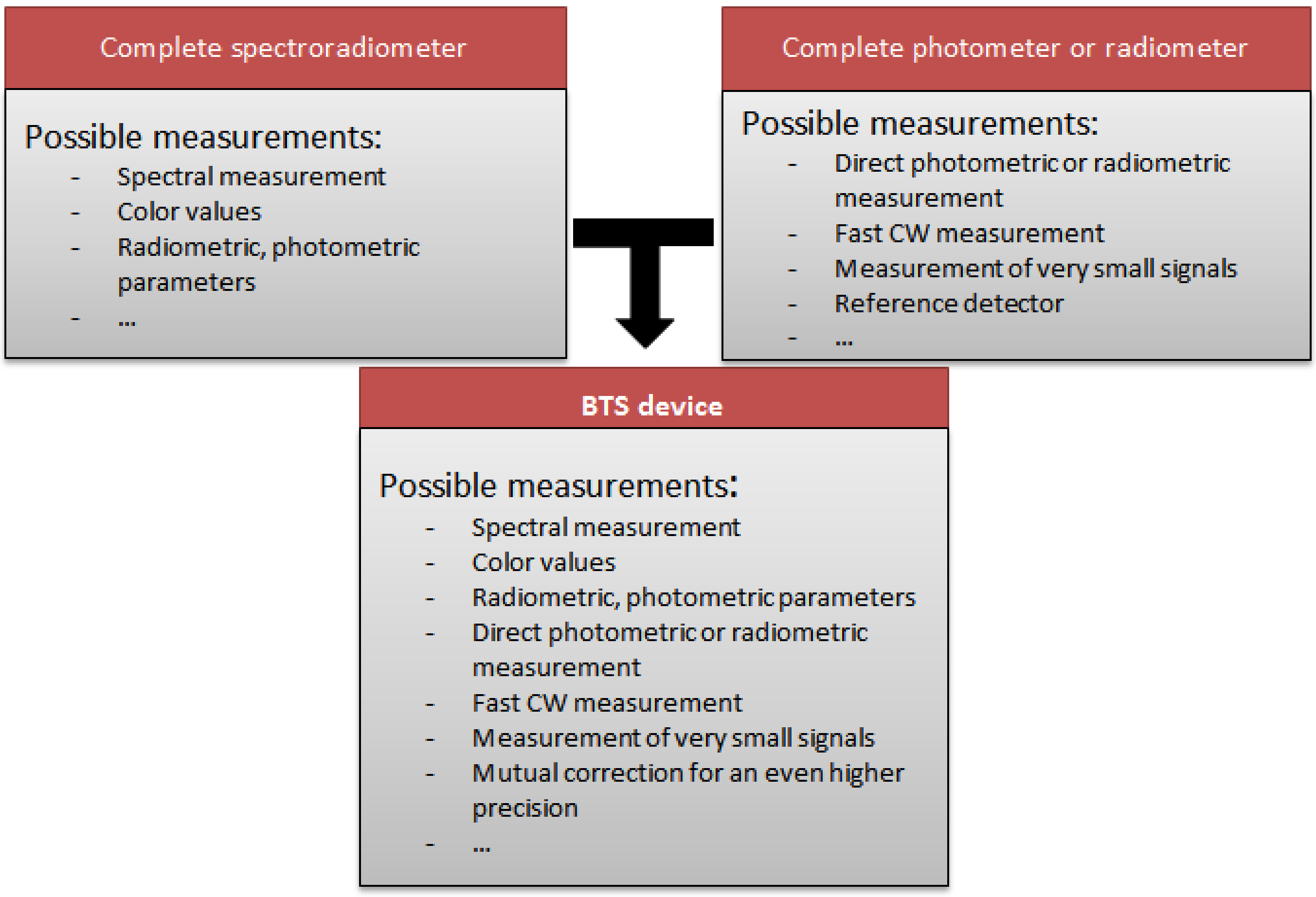
The BTS sensor consists of two separate detectors: a spectroradiometer and a detector that is based on an integral diode. In order to ensure a high quality of the BTS, it is essential for both sensors to have the same field of view i.e., similar input lenses (see figure 1). The signal that is guided to the respective sensors through a beam splitter depends largely on the input lens.



The array spectroradiometer can have different optical paths. More information on this can be found in the “Basics of Light Measurement” tutorial from Gigahertz-Optik [2]. The integral photodiode is equipped with a filter (e.g., photometric V(λ) filter) in order to guarantee the desired measurement function.

The precise mutual correction of the two sensors is a big challenge. Gigahertz-Optik’s extensive experience in photometry was the basis that made it possible for Gigahertz-Optik to integrate a fully-automated correction method in its user software and SDKs (software development kits) thus allowing for easy and intuitive operation.

Schematic illustration of the technology:



4. Advantages of the BTS Technology

✔	Complete spectroradiometer
✔	Complete photometer or radiometer (depending on the filter function of the photodiode)
CW	The benefits of both sensors can be exploited; e.g., for fast CW measurements using the integral photodiode (flicker measurement, PWM, etc.). This is not possible with conventional spectroradiometers
2 in 1	Both sensors can be used independently

✔	Correction of the spectral mismatch of the integral detector (photodiode) using spectral data from the spectroradiometer
✔	Correction of the spectroradiometer’s linearity using the highly-linear photodiode
SNR	Noise reduction of the parameters calculated from the spectral data thanks to the low-noise photodiode (especially for very small signals)
ΔT	Correction of temperature effects thanks to the diode’s linearity over a wide temperature range (particularly advantageous for hand-held devices that are used in outdoor applications)
REF	One of the sensors can be used as a reference to control the other

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5. Conclusion

The BTS technology allows for many measurement options that are not possible with conventional spectroradiometers This has been shown in chapter 4.

The BTS technology is a spectroradiometric advancement in photometry that is superior to conventional spectroradiometers in various aspects.

See devices like: **BTS256-EF**, **BTS256-LED Plus Concept**, **BTS2048 Series**

6. Literature

[1] Technical article – The spectral mismatch factor F* (or “Der spektrale Fehlanpassungskoeffizient a(Z)”), Gigahertz-Optik, 2014

[2] Tutorial - Basics of Light measurement, Gigahertz-Optik, 2014

[3] Technical article – ”Flickermessung mit dem BTS256-EF“, Gigahertz-Optik, 2014

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