Quasi-spectral measurement with Q-Spec™ - Multistimulus Colourimetry Systems

Optical multistimulus colourimetry system based on multichannel colour sensors

Absolute spectral measurements in quasi-spectral measuring mode

Scalable multichannel concept for measurement value processing

Numerous applications for colour monitoring, selection and reproduction

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Quasi-spectral measurements with a multicolor approach

A multistimulus approach results from expanding the tristimulus principle to include further spectrally selective channels, which do not have to be configured according to colourimetric requirements. The additional sensor information acquired through the use of a multistimulus sensor can then be used for a new measuring mode: **the quasi-spectral measurement**. Typical of a multistimulus or a so called multispectral sensory configuration is the significantly reduced number of measurement channels compared to a spectral measuring system, which enables the detection of colour stimuli within larger wavelength bands. Therefore, quasi-spectral measurement takes its place between the previously mentioned colourimetry principles.

The basis of the quasi-spectral measuring mode is formed by an application-specific calculation procedure, which is used to associate the measurement values from the multistimulus sensor with absolute spectral information acquired from the specimen properties.

Near-spectral measurement can be achieved through the application-specific adaptation of the calculation procedure despite the fact that the limited number of channels reduces the vast quantity of possible spectral stimuli to a still metamerised amount within the multidimensional sensor "colour" space. This is possible through the fact that most practical measurement implementations and applications can be assumed to cause stimuli of limited complexity or the spectra tend to possess a similar, multiplicative structure.

The advantages of a multistimulus system using quasi-spectral measuring mode are:

- Multistimulus measuring systems based around miniaturised multistimulus sensors are compact, easily integrable and manageable in the industrial environment. Measurement processing is quick and efficient similar to a colourimetric measuring system.
- The principle of quasi-spectral measurement processing is applicable to virtually any multistimulus sensor.
- There is a vast array of practically solvable problems with spectral object parameters, such as remission, transmission and even emission.
- Near-spectral measurement results form the basis for any desired colourimetric analyses.
- Application-specific, scalable measurement quality is achieved through the specialisation of the calculation procedure to the measurement task.

Examples for applications & references

- Spectral characterisation of reflection and transmission samples (Q-Spec™ - Device)
- Spectral colour monitoring in the area of colour reproduction for printing products and within the framework of "colour management"
- Spectral control of additive light sources
- Detection and correction of light source fluctuations in industrial camera-based inspection systems

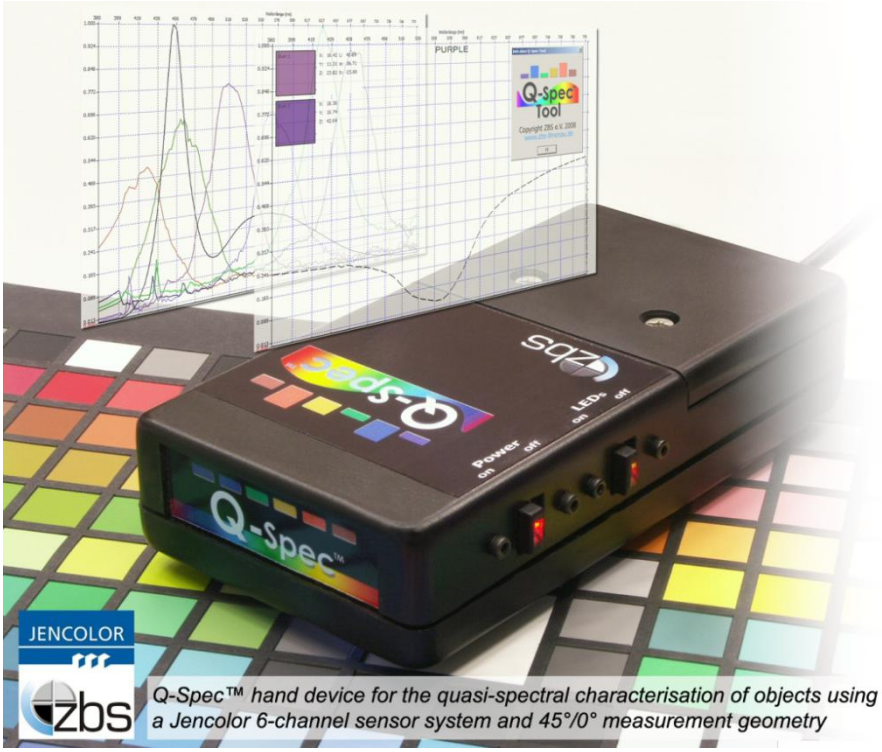
Offering

You can profit from our experience and know-how in the areas of colour, colour sensors and colour signal processing!

Our offering ranges from licensed software libraries through quasi-spectral measurement value calculation to the conception and realisation of multistimulus measuring systems adapted specifically for your measurement task.

Some background about colour and colour measurement

The colour of an object is the subjective sensation of an observer, which cannot be wholly represented by the



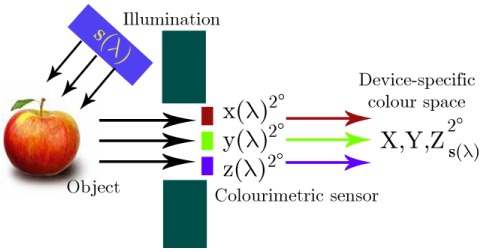
object's physically measurable properties.

An impression of colour requires the presence of an object, of light and of the act of observation. Only by specifying all of these elements a colour impression can be fully characterised. Additionally, several subjective and objective factors from both the observer and the observation influence the colour value. An array of standardised and device-specific colour spaces exists for the metric determination of colour.
Because the human eye is unsuitable for the exact measurement of colour perception, technical colour measuring systems must be employed in applications in which colours must be monitored quickly, objectively and with time-constant quality. The list of possible application areas extends from industrial quality management for high-value goods to the monitoring of colour reproduction processes (printing, colour management), to the food industry and in medicine. The demands of a concrete application determine the suitability of a colourimetric system, but particularly in the industrial sector, solutions are required which are compact, robust, reasonably priced and reliable.

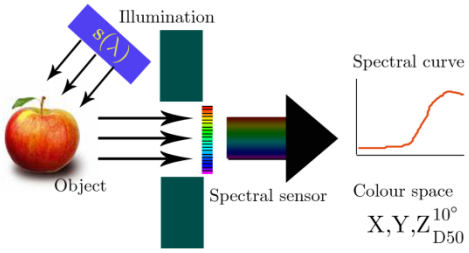
Up to now, the well-known methods of colourimetry can be classified into two groups: tristimulus methods and spectrophotometry.

Colourimetric, spectral or quasi-spectral measurement ?

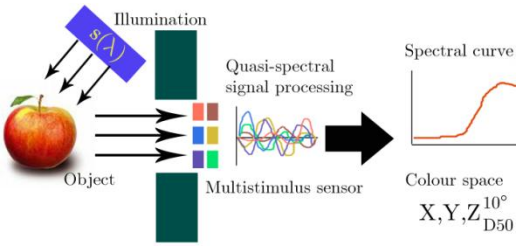
Tristimulus measuring systems are oriented toward the three-channel colour vision found in the human eye. Sensors using this method attempt to realise the response curves of the eyes of a "standard observer" (CIE-1931), so that, from the point of view of that observer, colour information can be directly derived from these curves. Because many of these devices employ light sources whose spectra substantially deviate from the standardised sources typically used for colour comparison, each of these systems carries out its measurements within its own device-specific colour space.



This means that a measurement is only useful and meaningful after being retroactively corrected according to the utilised colourimetric standard for comparison (observer, type of light etc.). This correction, or "colourimetric calibration", is usually possible at least approximately in most cases. On the other hand more complex issues, such as the so-called metamerism problem caused by changing light types or observers, are not solvable.



In spectrophotometry either a spectral colour stimulus or the spectral interaction with an object (reflection, transmission) is measured in absolute terms for different wavelengths or narrow wavelength bands. The principle of spectral analysis avoids the characterisation of light interaction on an object using weighted, integral wide-band and direct colourimetry; rather, it involves the acquisition of a very high number of independent sampling points. After compensating for effects from systematic device influences, a device-independent (absolute) measurement result can be realised, which can form the basis for purely computational, arbitrary retroactive colourimetric analyses.



A multistimulus colourimetric measuring system combines the advantanges of both of the above methods: the compactness, robustness, speed and price of a tristimulus device with the high-quality results and ease of further utilisation provided by the spectral measurement.

This system concept, united with the quasi-spectral measuring mode, allows near-spectral, absolute measurements in many applications in which only simple colour sensors could be used up to now.

Information & Downloads

More information on the topic of colour and on other interesting products and services from the Zentrum für Bild- und Signalverarbeitung e.V. can be found at:
www.zbs-ilmenau.de/farbe.html

and
www.zbs-ilmenau.de.