

Miniaturized multispectral, hyperspectral or spectral measuring devices in tasks of production quality monitoring



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Outline

- **Introduction**
 - **Activities & Areas of research** in the fields of colour and spectral technologies
- **Multispectral, hyperspectral or spectral measurement** in tasks of production quality monitoring
 - **Q-Spec™ hyperspectral measuring principle** and OEM-devices
 - **SpecWorks™-MSM** miniaturized spectral measuring devices
- **Conclusions / Where do we stand**
- **Further informations**

Introduction



Historical roots in University of Technology Ilmenau with its former research group „Technische Erkennung“

Many years of experience in the field of signal and image processing since **1978**

Founding of the **Zentrum für Bild- und Signalverarbeitung e.V.** in **1994**

Founding of the GBS mbH as a subsidiary in **1997**



Long standing cooperations...

with national companies and establishments, e.g.

Jenoptik AG, ESW GmbH, Wincor Nixdorf Int. GmbH, Jena-Optronik GmbH, Carl-Zeiss AG, Osram GmbH, ELTEC GmbH, MAZeT GmbH, B.Braun Melsungen AG

with research institutions and universities,

among others Univ. of Tech. Ilmenau, FSU Jena, Bonn University, Hannover University, Fraunhofer Gesellschaft e.V., DLR e.V.

Introduction

Society's activities

- Pre-market research and development
- Transfer of academic research results into usable methods, prototypes and products for our customers
- Postgraduate education (www.visionexperts.de), e.g. autumnal seminar „**Elements of colour image processing**“
- Co-founder and member of the German Color Group (www.germancolorgroup.de),

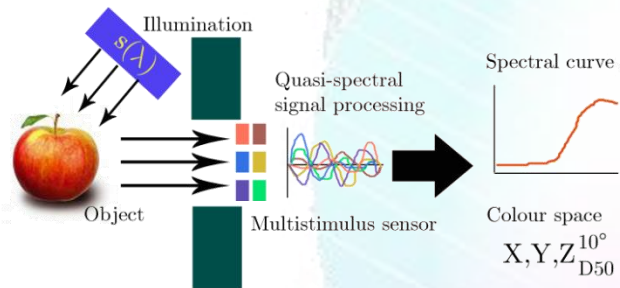
Host of the annual national workshop „**Farbbildverarbeitung**“



Introduction

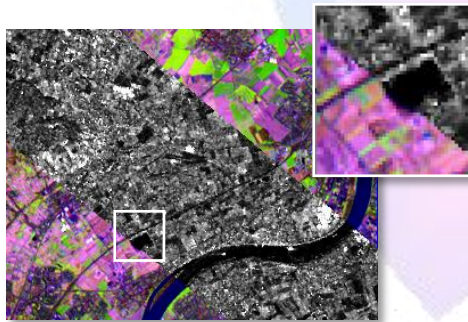
Areas of research in the fields of Colour and Spectral Technologies

- **Optimization of sensor systems & components:** Lens design, Design of spectrally controlled lighting systems

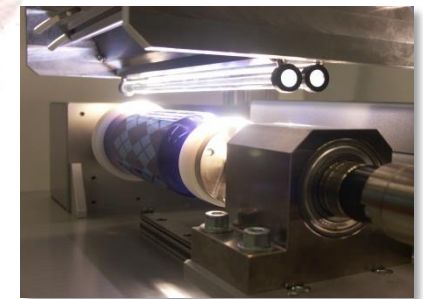
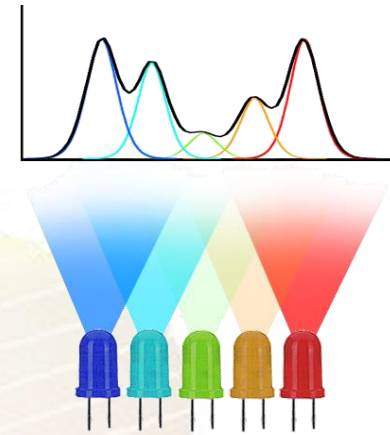


- **Multi- and hyperspectral sensor signal processing:** Sensor design qualification, Calibration methods Spectral reconstruction

- **Application of multi- and hyperspectral measuring devices in image processing system:** Spectral monitoring of lighting conditions

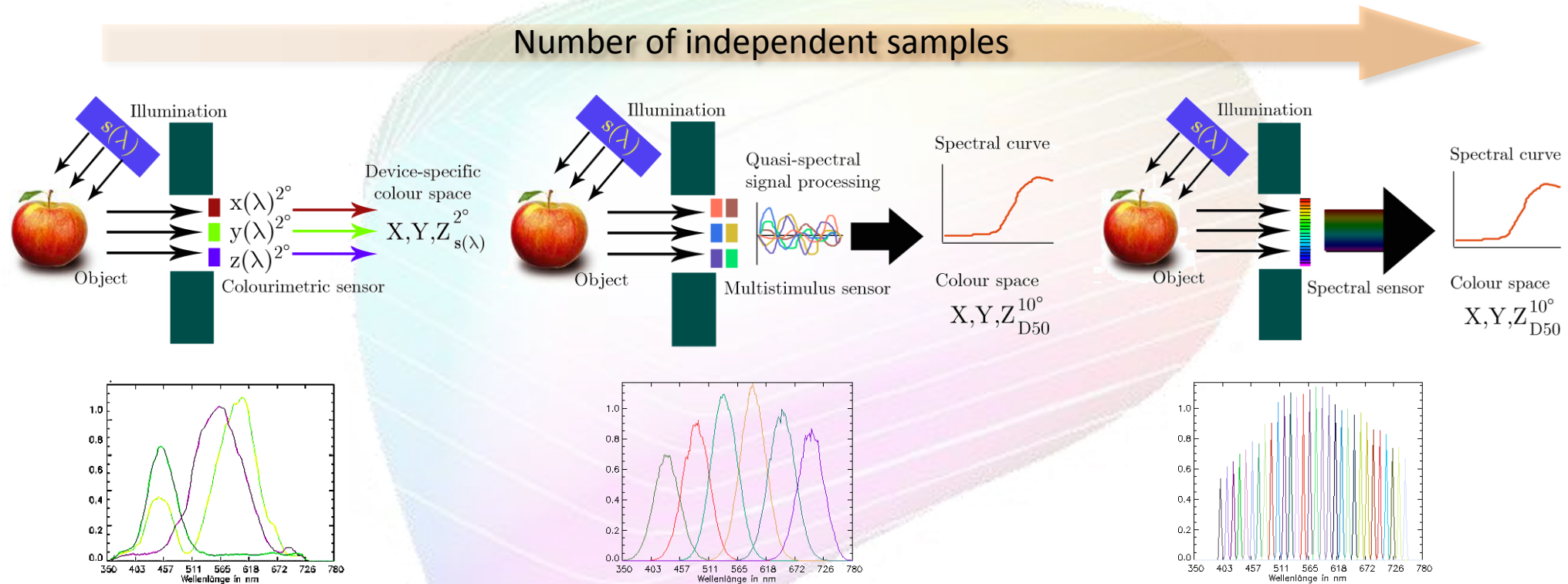


- **Multidimensional image processing and analysis** from clearly defined environments up to complex outdoor scenes



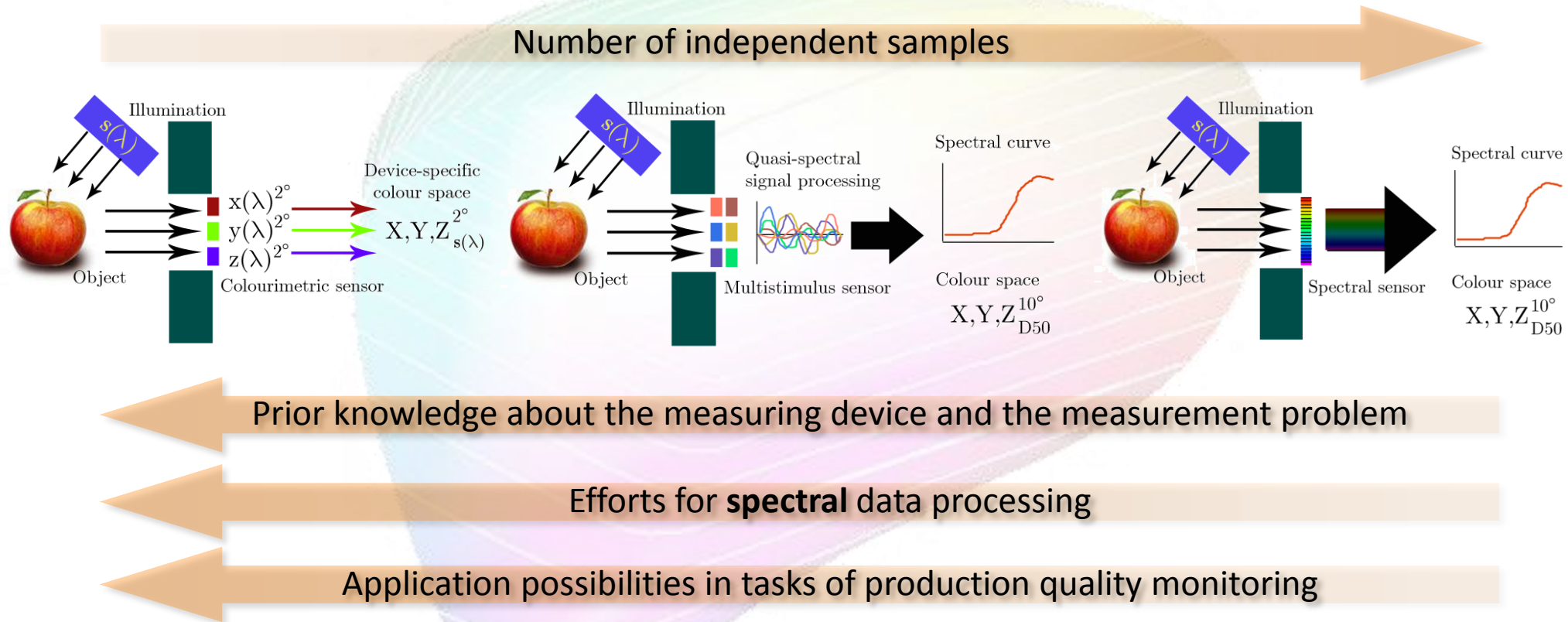
Multispectral, hyperspectral or spectral measurement

Spectral signatures: Device independent measures of spectral features of materials and/or lighting-material interactions



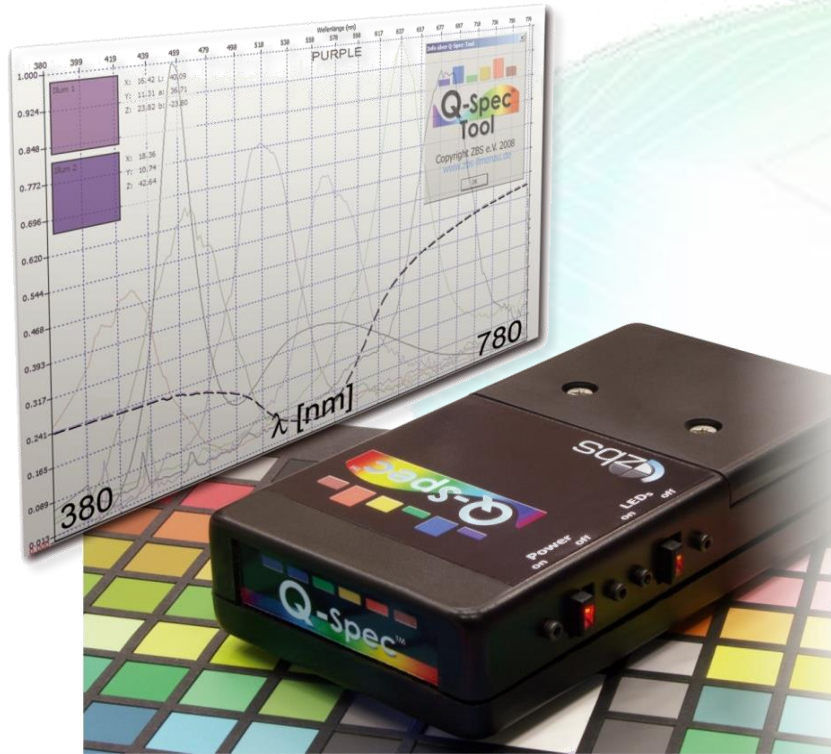
Multispectral, hyperspectral or spectral measurement

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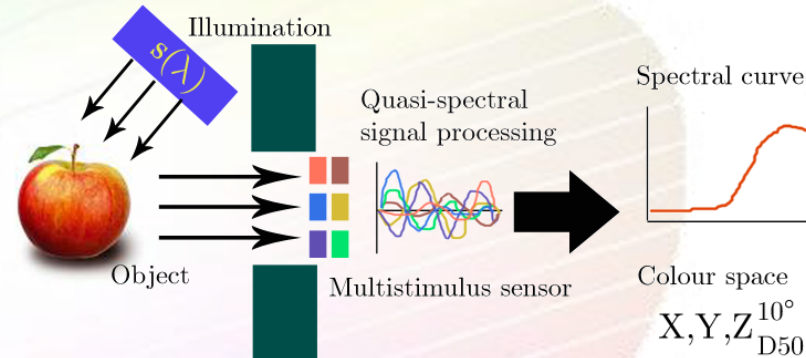
- mostly adapted for special cases of application
- small, robust, fast
- budget-friendly

Q-Spec™ hyperspectral measuring principle and OEM-devices



Q-Spec™-prototype for spectral incident light measurements

absolute, precise
device independent measurements
with Q-Spec™ – spectral reconstruction



versatile, scalable
spectral measurement processing
for arbitrary hyperspectral sensors

modular
Q-Spec™ – software modules
or measuring devices

integrable, very fast, robust, easy to manage measuring devices
based on MAZeT-multiple color sensors

Q-Spec™ **hyperspectral** measuring principle and OEM-devices

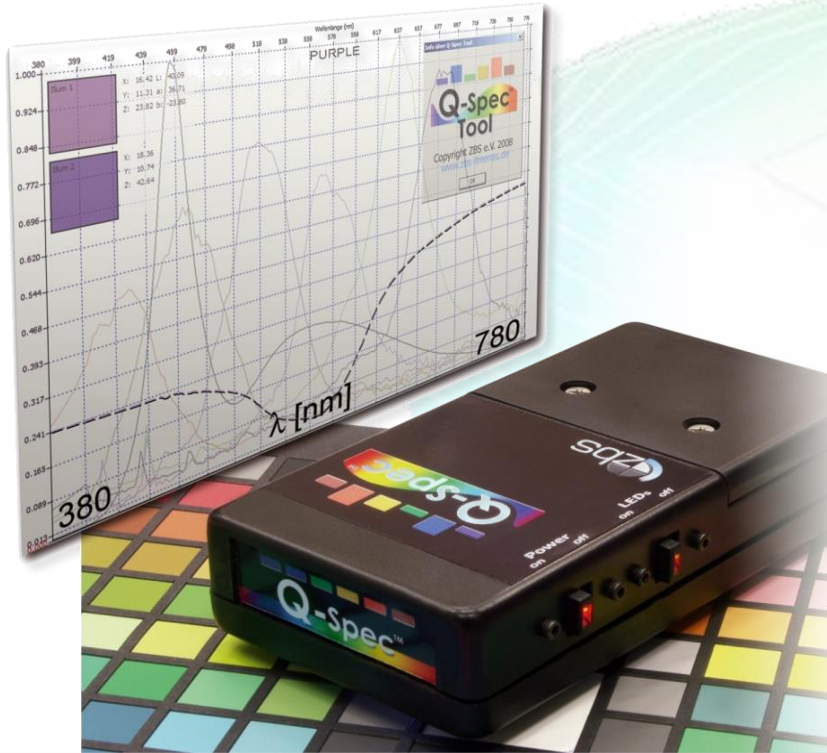
Applications

Spectral based **colorimetric** monitoring

in the field of industrial quality management,
medicine or color reproduction

Spectral control and monitoring

of **a priori known** lighting conditions and sources



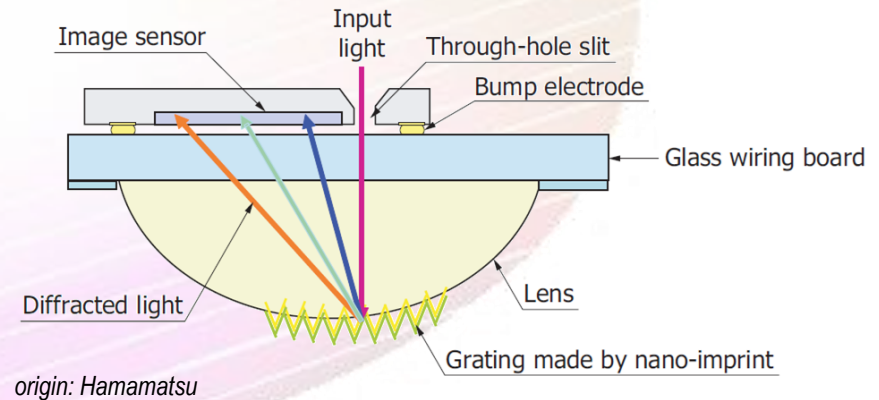
Q-Spec™-prototype for spectral
incident light measurements

SpecWorks™-MSM - miniaturized **spectral** measuring devices



SpecWorks™-MSM-VIS prototype for spectral incident light measurements

small, integrable, robust, easy to manage measuring devices
based on miniaturized Hamamatsu Mini Spectrometers



fast, real spectral measurements from 340 to 1100 nm

precise, raw wavelength resolution 12 nm

universal analog signal interface and **simple** data processing

improvable with **Q-Spec™- spectral reconstruction**

SpecWorks™-MSM - miniaturized **spectral** measuring devices

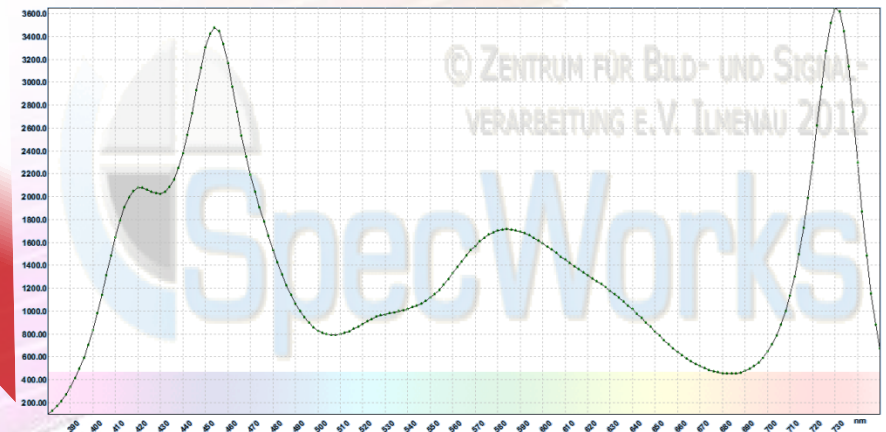
Applications

SpecWorks™-MSM-VIS: Stand-alone or OEM-device

Spectral monitoring in the field of industrial quality management, medicine or color reproduction



SpecWorks™-MSM-VIS prototype for spectral incident light measurements



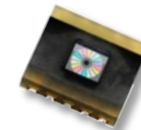
SpecWorks™-MSM-VIS: LED-based lighting
45° / 0° - measurement geometry

Spectral control and monitoring
of **arbitrary** lighting conditions and sources

Conclusions

Comparison of spectral measuring principles / miniaturized systems (2012)

Measuring device	multispectral colorimetric	hyperspectral	spectral
Compactness / Modularity	+++	+++	++
Measurement time	++	++	+
Signal Processing / Calibration	-	+	+++
Quality and usability of the measurements	- / 0	+ / ++	++ / +++
Costs	+++	++	0
Process integration	+++	+++	++



Further informations

Thank you for your attention !

Further informations about our activities

www.zbs-ilmenau.de or www.zbs-ilmenau.de/farbe.html