

Imaging UV-VIS Technology Colorimetry Process analysis



UV-VIS HYPERSPECTRAL CAMERA



uniSPEC0.9HSI

LLA Instruments GmbH & Co. KG

uniSPEC0.9HSI

Purpose

The UV-Visible (UV-VIS) hyperspectral imaging camera uniSPEC0.9HSI (figure 1) features three key parameters for successful process analytical technology:

- high spectral resolution (down to 0.365 nm/pixel),
- high spatial resolution (up to 1920 tracks are detected simultaneously) and
- high frame rates (up to 579 fps). This UV-VIS hyperspectral imaging camera was developed for analytical

imaging in the UV to visible range, covering a wide field of applications. Applications include: advanced colorimetry, quality control in printing and coating processes, sorting and quality control of food, feed or minerals. Due to the high spatial resolution, even small objects below 1 mm can be analysed reliably. Fluorescence imaging or screening at high spectral resolution can also be performed with the uniSPEC0.9HSI camera.

Setup

The uniSPEC0.9HSI is based on pushbroom imaging technology (figure 2). The camera consists of an optical UV-VIS spectrograph and a 2D CMOS sensor (actively controlled in temperature by a Peltier element) as detector. Both components are integrated in a dust and waterproof housing (IP65). The spectrometer features distortion-free optical components which were especially designed for UV-visible application. This enables the generation of a distortion free image of the line shaped detection area, avoiding spectral crosstalk between adjacent objects. In addition, the corrected lens' short focal length, allows the measurement of a large field of view at small working distances. For each image point of the line-shaped detection area, a complete spectrum is recorded simultaneously. A spatially-resolved analysis is achieved by subsequent line scans of the object. The spatial resolution enables the identification of small objects in a material stream (≥ 1 mm). For applications requiring a higher spatial re-

solution (≤ 1 mm), specially designed lenses are available upon request. The UV-VIS hyperspectral imaging camera is available in combination with an industrial PC and pre-installed camera control software. Installation bridge, illumination unit and application development software are available as further accessories.

Key characteristics

- High resolution 2D-spectrograph with optically corrected focal plane image
- Camera with low-noise highly-sensitive CMOS sensor array
- Comprehensive tools for setup and service
- Industrial PC incl. Windows® Embedded OS
- Application development software kit based on chemometrical analysis and colorimetry



figure 1: UV-VIS hyperspectral camera uniSPEC0.9HSI

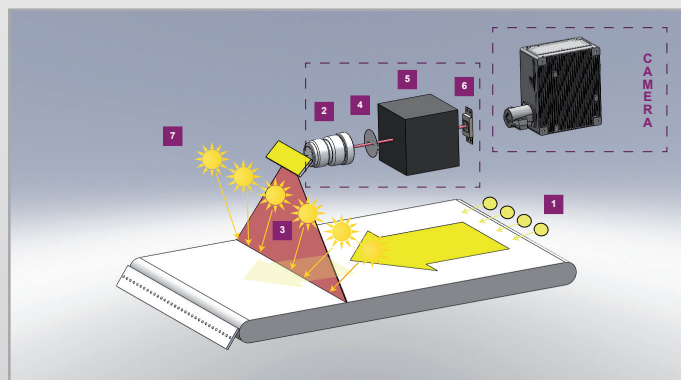


figure 2: Pushbroom imaging technology: 1-Material stream, 2-Lens, 3-Reflected radiation, 4-Entrance slit, 5-Imaging spectrograph, 6-Sensor array, 7-Illumination unit

Applications

Customised identification modules based on chemometrical methods and colorimetry analysis are available upon request. UV-VIS hyperspectral imaging cameras are used for a wide field of applications:

Food industry

- Quality control of food and feed
- Detection of contaminating materials

Plastic industry

- Detection of color variations

Mineral industry

- Mineral analysis (by fluorescence or remission)

Automotive and aerospace industry

- Analysis of the color impression for paints and coatings

Life science

- Spectrally-resolved fluorescence-based screening
- Evaluation of the biological activity of organisms (chlorophyll, hemoglobin)



figure 3: Applications for UV-VIS hyperspectral imaging camera



figure 4: Applications for UV-VIS hyperspectral imaging camera

Analytical Control Software

The UV-VIS camera uniSPEC0.9HSI is delivered including a comprehensive set of software. The control software uniSpecHSI (figure 6) allows the adjustment of the camera parameters, the monitoring of camera status and the acquisition of spectral data. In addition to the camera control options, several standardised interfaces are implemented in uniSpecHSI for data transfer to an external process control. Important camera parameters are password-protected and therefore can be changed by service personnel

only. A variety of application routines can be selected and modified, enabling an easy adaption of the hyperspectral imaging camera to different analysis tasks. LLA offers software KustaSpec (figure 5) including AnaTools for chemometric application development. Implemented chemometric analysis algorithms include: PCR, PLS, Euclid, Fuzzy, neural networks and many more. Software for real-time and offline visualisation of material streams complete the software portfolio.

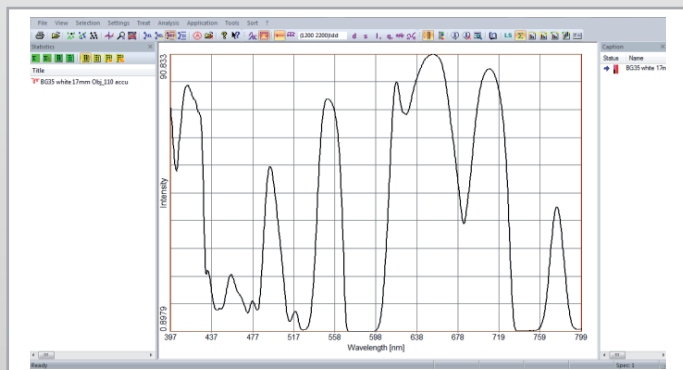


figure 5: Spectral analysis software KustaSpec

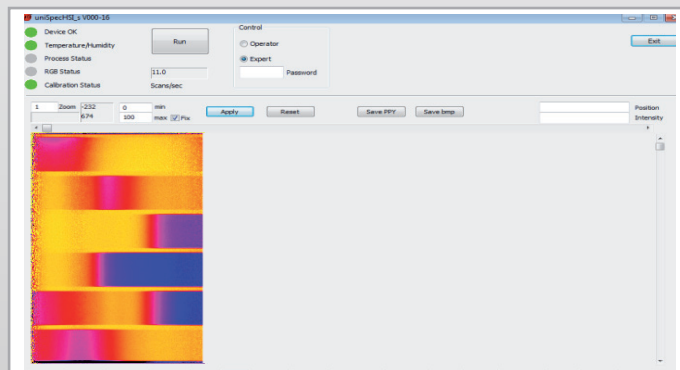


figure 6: Control software uniSpecHSI

Technical Data

Mode	Full Frame	Binning Mode uniSPEC1.7HSI	Binning Mode uniSPEC1.9HSI uniSPEC2.2HSI ^{sens}
Sensor	CMOS, actively temperature-stabilised		
Spectral Range	350 nm - 950 nm		
Spectral resolution	0.365 nm	2.19 nm 1.1 nm	3.66 nm 1.83 nm
Frame Rate	Min. / Max. 11 frames/s	Three-fold Min: 96 frames/s Max: 115 frames/s Six-fold Min: 96 frames/s Max: 358 frames/s	Five-fold Min: 158 frames/s Max: 343 frames/s Ten-fold Min: 158 frames/s Max: 579 frames/s
Exposure Time	Min. 22 µs Max. 30 ms	Min. 4 µs Max. 10 ms	Min. 4 µs Max. 6 ms
Number of Measurement Tracks	Max. 1920	Three-fold Max. 640 Six-fold Max. 320	Five-fold Max. 384 Ten-fold Max. 192
Objective Lens	Standard lens F/1.9 / 10 mm Other focal lengths available on request		
Power Supply	24 V, 2.5 A		
Environmental Conditions	+5 °C to +45 °C, Relative humidity 10% to 90 % (non-condensing)		
Weight	16.8 kg		
Dimensions	295 mm x 166 mm x 345 mm (LxWxH)		

Illumination Unit PMAmSi	
Setup	PMAmSi, double-sided, with reflectors, for vertical clearance 300 mm (LR30) or 500 mm (LR50)
Conveyor Belt Width / FoV	500 mm to 2000 mm with one camera 2000 mm to 2800 mm with two cameras

Setup	
Distance Camera-Belt	Belt width x 1.08 (uniSPEC0.9HSI _s) Belt width x 1.89 (uniSPEC0.9HSI _w)
Vertical Clearance	300 mm (LR30) or 500 mm (LR50)
Conveyor Belt Speed	Up to 2.5 m/s
Particle Size Sorting Material	0.5 mm - 40 mm
Process Interface	TCP/IP or UDP Protocol (1 Gigabit Ethernet)
Connection	Push-Pull sockets for power supply and Ethernet connection
Protection Level	IP67
Delivery Set	UV-VIS hyperspectral imaging camera, control-PC with software for control and analysis, power supplies for camera and PC
Optional Accessories	Deflexion unit for objective lens, installation bridge (above belt or free-fall configuration), control cabinet

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