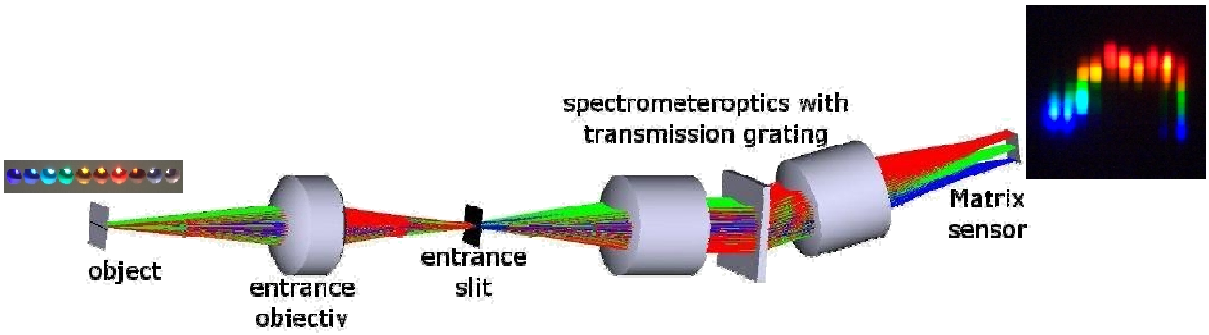
N^2IR – inline VNIR analysis

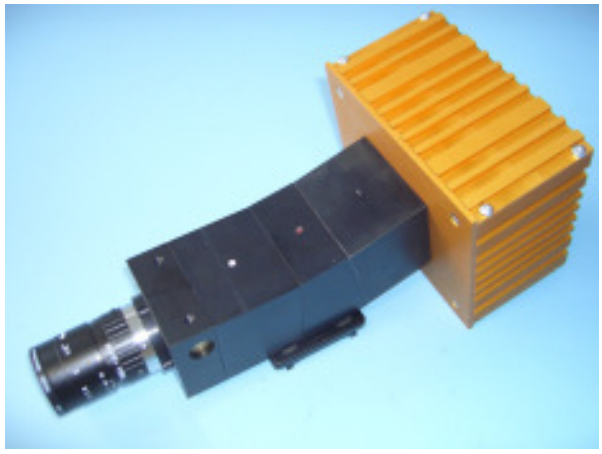


Concept of a spectral imaging system

The complete spectral imaging system for the spectral range of 750 nm to 980 nm is designed for demanding industrial spectroscopic applications. The N^2IR systems are entire units composed of a spectrograph and a smart camera with gigabit Ethernet data transfer and a PC- based real-time classification program. Therefore fast sorting and inspection tasks with high resolution can be operated in real-time. The systems feature a robust design without any moving parts, a homogenous distribution of light over the spatial area and very high data rates.
The system supports multiple classification methods and can optionally be extended by machine vision object recognition. Optionally a thermal halogen illumination or a LED based illumination unit can be purchased. Additionally the system can be provided in an electrical enclosure with a valve bank then adding up to a complete sorting system.

Typical VNIR- applications:

- **Analysis and sorting of plastics**
- **Quality control and sorting of food and agricultural products**
- **Biomedical applications**
- **Chemical analysis**
- **Inline measurement of coating thickness (e.g. semiconductor industry)**



Spectral Imaging System N^2IR

inno-spec GmbH · Sigmundstraße 220 · B7 · D-90431 Nürnberg
Telefon 0911 376691 - 0 · Telefax 0911 376691 - 10 · e-mail info@inno-spec.de
Geschäftsführer: Dipl.-Ing. (FH) Oliver Grass · Registergericht Nürnberg: HRB 21954
Ust.-Id.-Nr.: DE 8 14 446 856 · Internet www.inno-spec.de

Today NIR spectroscopy is an established method for analysis, classification and sorting of plastics, agricultural products and food. Mostly multiplex and scanning systems are used in a large range of applications in plastic recycling of plastic packing material. Those devices are working at the NIR spectral range between 1000 nm and 2000 nm in field use. Compared to colour sorting systems however they have the drawback of low resolution (spatial and temporal) and very high expenses for sensor systems. With an increasing demand for systems for sorting of small goods (sorting of flakes and food industry) the requirements for resolution and lower costs are increasing. Therefore NIR spectral imaging systems are used in these applications for some time now. They use an imaging transmission spectrograph and a 2D sensor array.
The "N^2IR inline VNIR system" is available for such applications from now on. Due to low priced sensor systems with high resolution, applications can be realised that were until now reserved for colour sorting. It is possible now to identify and sort particle sizes of less than 5 mm diameter with working width of 2 m and tape speed of 2 m/s.
Highest recognition qualities can be realised by a combination of data preprocessing at hardware level (FPGA based) and real-time pc based classification and object recognition. Basic user programs can be developed by the customer. Moreover costs for the system are moderate because many components used in image processing in the visible spectral range can be employed. Additionally light in the VNIR range is well suited for penetrating biological materials as water does not absorb in this spectral range. In the range of 600 nm to 950 nm water, which is present in most biological materials, has a very low absorption coefficient which enables sufficient depth of penetration and hence analysis even under the surface. Therefore the system provides an opportunity to transfer established analyses from laboratory to processes and ensure inline monitoring.

Entrance objective: Usually c-mount mega pixel objectives made for machine vision applications are used as entrance objectives. Objectives optimised for the VNIR spectral range can be purchased at inno-spec on request.

Order sorting filters: Since CMOS or CCD sensors are sensitive at wavelengths between 200 nm and 1000 nm, we recommend using spectrographs with order sorting filters. These filters can be mounted to the entrance objective or integrated into the spectrograph. Moreover special filters can optimise the spectral intensity characteristics. Please ask for more detailed information.

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Spectrograph	
Optical and spectral characteristics	
Spectral range	650nm-1000nm
Dispersion[1]	70 nm/mm
Spectral resolution[2]	9 nm FWHM (with 30µm slit)
Spatial resolution[2]	rms spot radius < 35µm
Bending of spectral lines along spatial axis (smile)[3]	Smile < 45 µm
Bending of spatial lines along spectral axis (keystone)[3]	Keystone < 15 µm
Numerical aperture	F/2.0
Slit sizes	50µm, 100µm (further sizes on request)
Slit length	14 mm
Grating efficiency	> 55%
Spectrograph angle	16,5°
Stray light	< 1%
Recommended sensor size	max 2/3"
Entrance objective	c-mount mega pixel objective or special customised objective
Camera unit	
Sensor	Monochrome CMOS mega pixel sensor
Pixel	Max 1280(spectral) x 1024 (spatial)
Sensor pixel rate	Max. 48 Mpix/ second
Dynamic range	68,2 dB
Bit depth	10 bit
Gain	adjustable
FPGA	Spartan 3E
Memory	36 Mbit dual port SRAM, 8 Mbit flash
Interfaces	Gigabit Ethernet, RS485 for parameterising
Power	24 V
Mechanical characteristics	
Dimensions, OEM	(W)120 x (H) 115x (L) 205 mm
Weight	1400 g
Housing, OEM	anodised aluminium (black)
Objective threat	standard c-mount
Operational conditions	
Temperature (shipping)	-20 ... +65 °C, non-condensing
Temperature (operating)	+5 ... +50 °C, non-condensing

[1] Spectral range and the according dispersion can be customized to your application upon request.

[2] Spectral and spatial resolution also depend on the entrance objective as well as the used imaging sensor.

[3] A correction matrix for MATLAB can be supplied for correction upon request.

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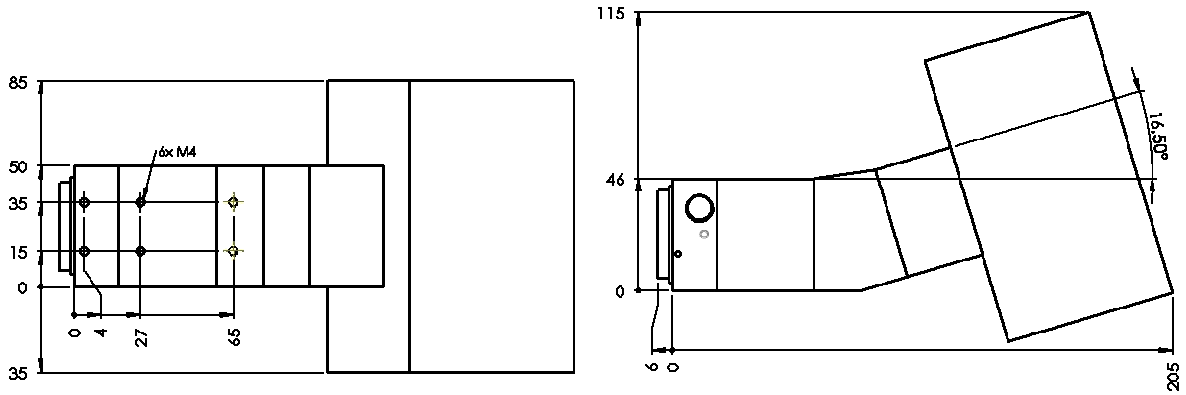
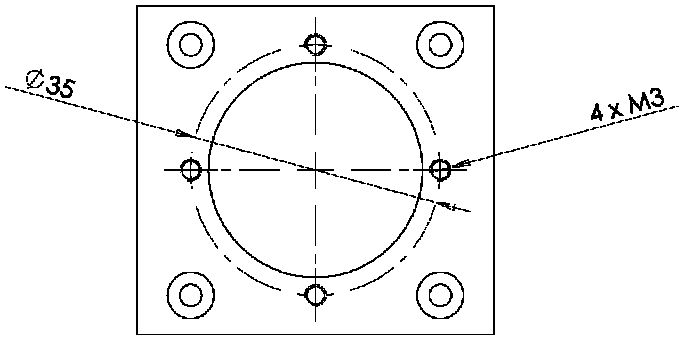
Mechanics:



Mechanical dimensions of the N²IR with FPGA camera



Mechanical drawing for connection of camera and spectrograph

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