Miniaturized hyperspectral imaging cameras
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Hyper spectral imaging (HSI)

Spectrometer  Color camera  Hyperspectral camera

http://ars.els-cdn.com/content/image/1-s2.0-S0038109805002346-gr4.gif
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HSI sensor types from imec

filter layouts

**Linescan**
- ‘wedge’ design
- 100 bands
- 600 - 1000 nm

**Snapshot Mosaic**
- ‘per-pixel’ design
- 4x4: 470 – 630 nm
- 5x5: 600 – 1000 nm

**Snapshot Tiled**
- ‘area’ design
- 32 bands
- 600 – 1000 nm
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Snapshot Mosaic (imec)

XIMEA camera MQ022HG-IM-SM4X4-470-620

Key specification
- Spectral resolution: 4x4 mosaic = 16 bands in 465-630nm
- FWHM: ~ 15nm
- Spatial resolution: from 512x272 (per band)
- Speed: up to 170 data-cubes / s (full sensor frame)
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Snapshot Mosaic (imec)

XIMEA camera MQ022HG-IM-SM5X5-600-1000

Key specification

- Spectral resolution: 5x5 mosaic = 25 bands in 600-975nm
- FWHM: ~ 16nm
- Spatial resolution: from 409x217 (per band)
- Speed: up to 170 data-cubes / s (full sensor frame)
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Fabry-Perot interference filter

Transmitted wavelength: $k\lambda = 2nL\cos\theta$

A filter designed for a specific wavelength $\lambda$ will also transmit several other wavelengths, e.g. $\lambda/2$ and the wavelength of the second order harmonics (on snapshot mosaic sensors).

The sensor is designed to work in a specific spectral range (active range).

Wavelength ranges outside of the active range must be cut off by bandpass filters.
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Bandpass filters (SM 5x5)

Bands with first order response at 840 – 1000 nm have a second order response at 600-675 nm.

Band pass filters to retain second order peaks: 600-875 nm or 675-975 nm
Band pass filter for the full active range: 600-975 nm
Calibration data

Each sensor is calibrated individually!

The complete calibration data is delivered (and stored to the XIMEA cameras).
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HSI – industrial applications

- Medical Imaging
- Microscopy and Endoscopy
- Precision Agriculture
- Remote Sensing
- Mineralogy
- Environmental Monitoring
- Life science instrumentation
- Optical sorting
- Food inspection
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Waste sorting white plastics

Color image
Camera MQ022CG-CM
CMOSIS CMV2000

5x5 snapshot mosaic, halogen lamp illumination, filter set 675 – 975 nm

NIR (intensity)  HSI separated
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Food / organic sorting green leafs

Color image
Camera MQ022CG-CM
CMOSIS CMV2000

5x5 snapshot mosaic, halogen lamp illumination, filter set 675 – 975 nm

NIR (intensity)

HSI separated
Food / organic sorting green leaves

5x5 snapshot mosaic, halogen lamp illumination, filter set 675 – 975 nm

NIR (intensity)  HSI separated
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Miniaturization

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Software environments

Support for
- Windows
- Linux
- Mac-OS

Compatible with
- USB3-Vision
- GenICam GenTL
- XIMEA API / SDK

Running on
- Intel x86 / x64
- ARM (Cortex A9 +)
- embedded platforms
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HSI software partners

perception park, Graz, Austria
www.perception-park.com
- Chemical Color Imaging
- integrates with existing image processing systems
- short development time

NICTA, Canberra, Australia
www.scyllarus.com
- powerful, full featured hyperspectral imaging engine
- automatic recovery of scene illuminant
- available for license as C++ API, standalone application and Matlab toolbox
Supported software libraries

Extremely compatible

compatible with more than 30 popular machine vision libraries…
Yes, we can …

… compare apples with pears!

4x4 snapshot mosaic, halogen lamp illumination, filter set 450 – 650 nm
Thank you for your attention