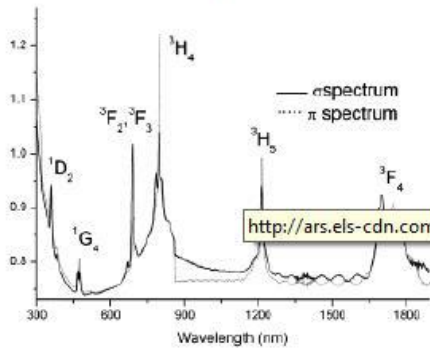
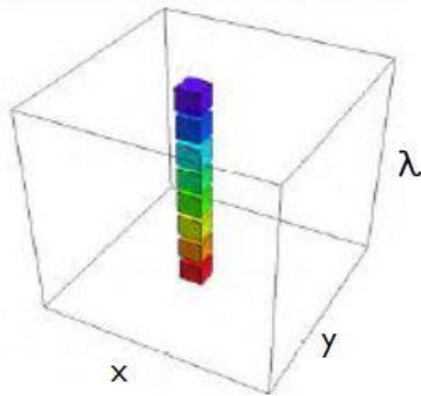


Miniaturized hyperspectral imaging cameras

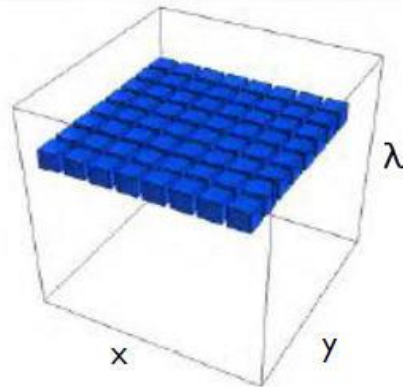
Miniaturized hyperspectral imaging cameras

Hyper spectral imaging (HSI)

Spectrometer

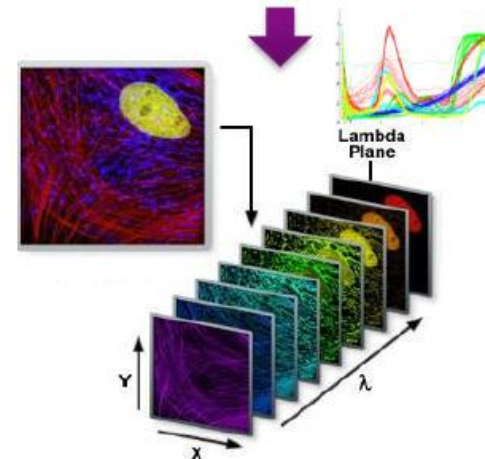
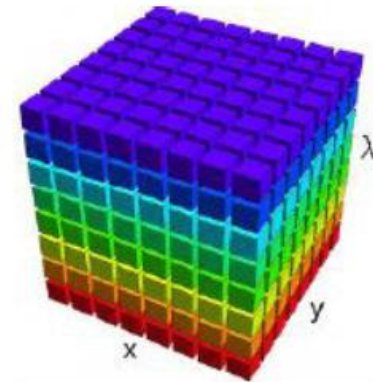


Color camera



<http://ars.els-cdn.com/content/image/1-s2.0-S0038109805002346-gr4.gif>

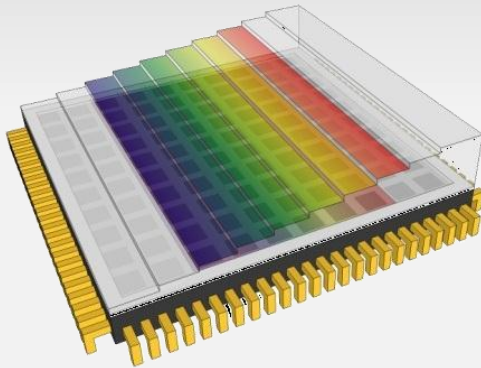
Hyperspectral camera



HSI sensor types from imec

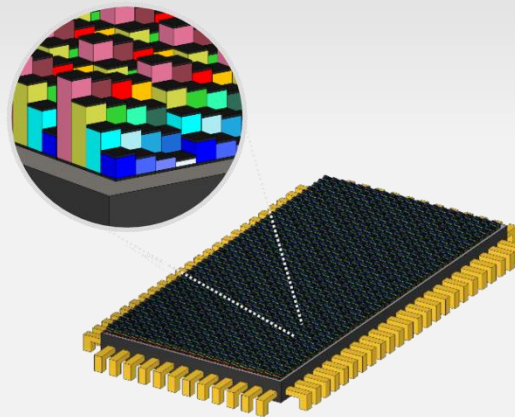
filter layouts

Linescan



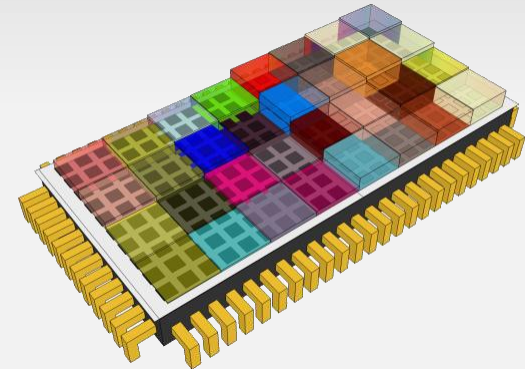
'wedge' design
100 bands
600 - 1000 nm

Snapshot Mosaic



'per-pixel' design
4x4: 470 – 630 nm
5x5: 600 – 1000 nm

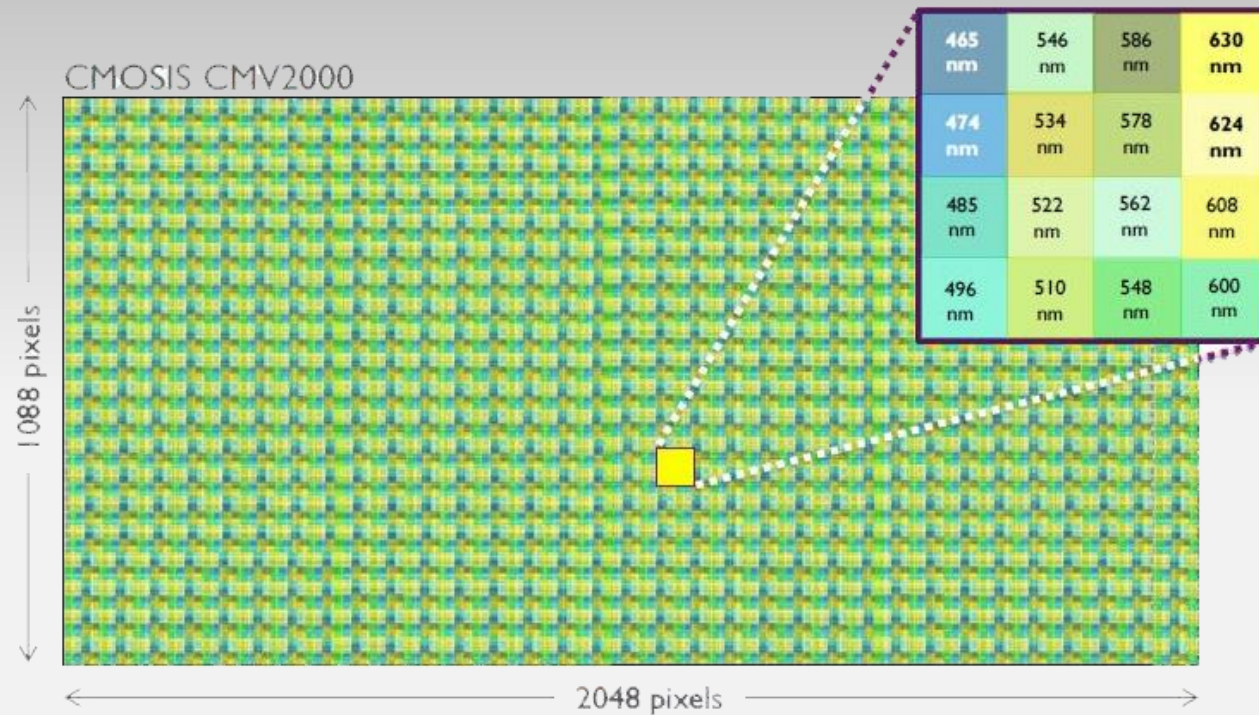
Snapshot Tiled



'area' design
32 bands
600 – 1000 nm

Snapshot Mosaic (imec)

XIMEA camera MQ022HG-IM-SM4X4-470-620

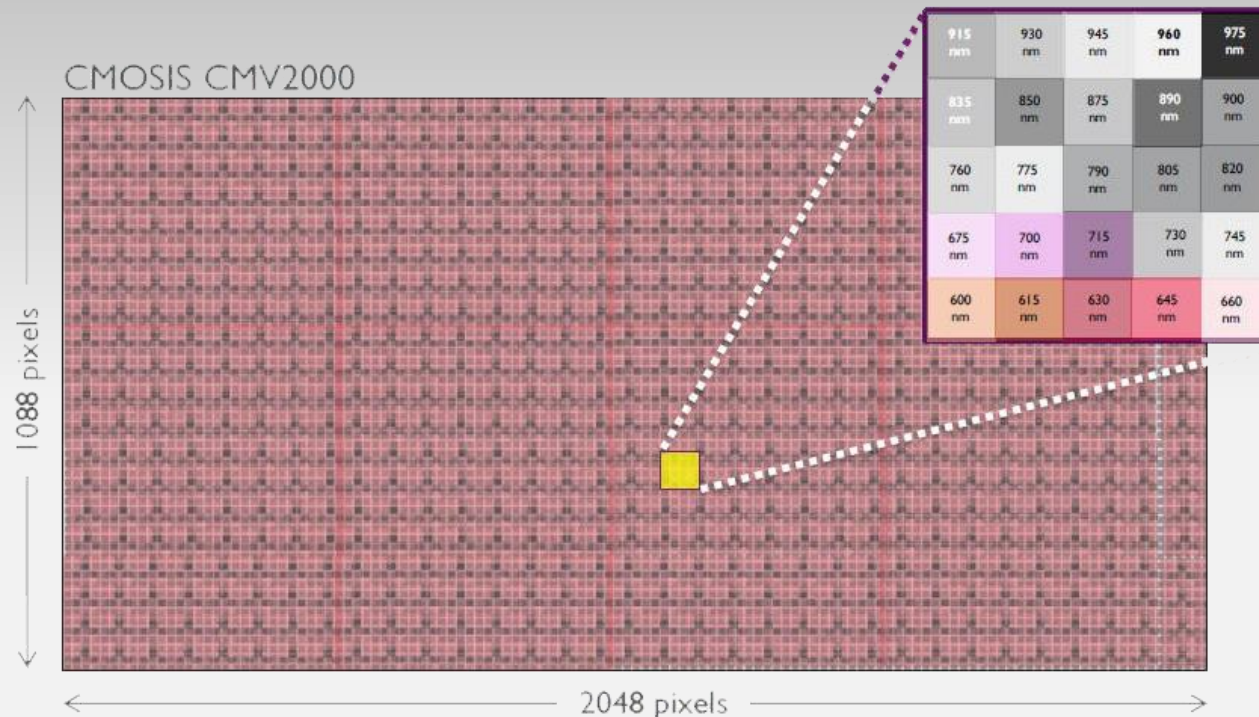


Key specification

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)

Snapshot Mosaic (imec)

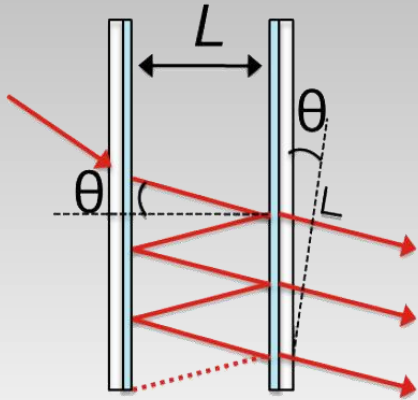
XIMEA camera MQ022HG-IM-SM5X5-600-1000



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)

Fabry-Perot interference filter



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

A filter designed for a specific wavelength λ 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.

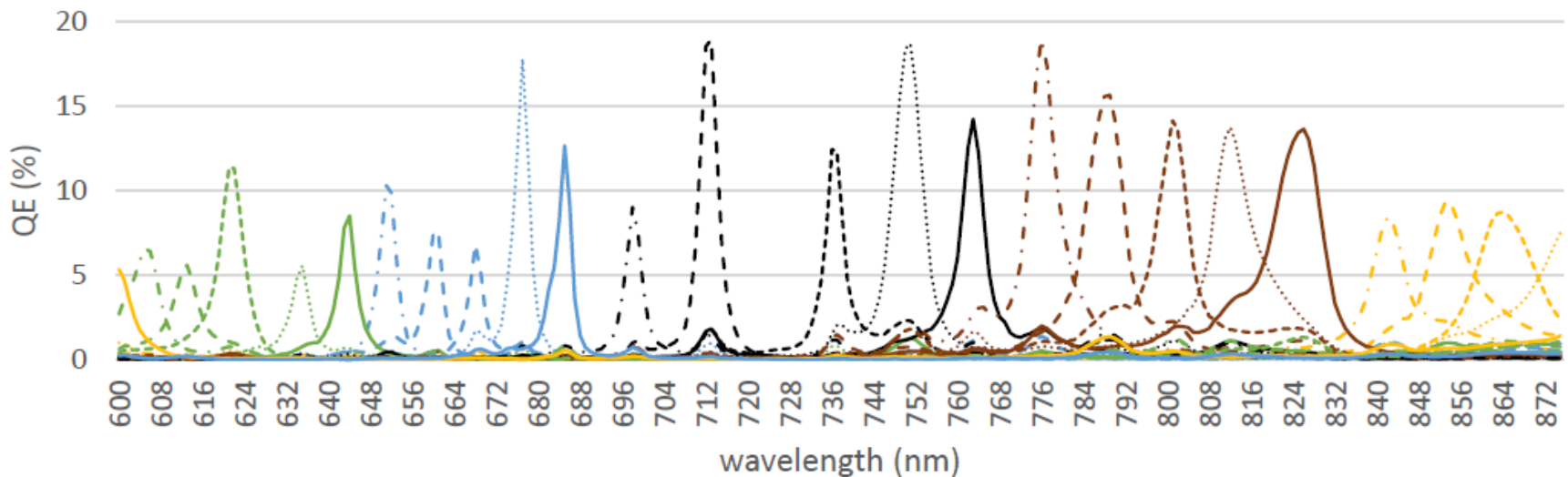
Bandpass filters (SM 5x5)

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

Filter responses with band pass 600-875nm
of a SMM 5x5 NIR hyperspectral sensor



Calibration data

Each sensor is calibrated individually!

The complete calibration data is delivered (and stored to the XIMEA cameras).

HSI – industrial applications

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

Waste sorting white plastics

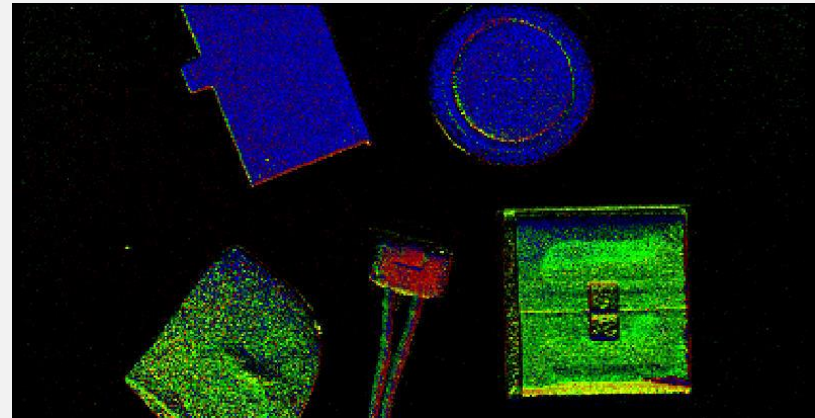


Color image
Camera MQ022CG-CM
CMOSIS CMV2000

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



NIR (intensity)



HSI separated

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)

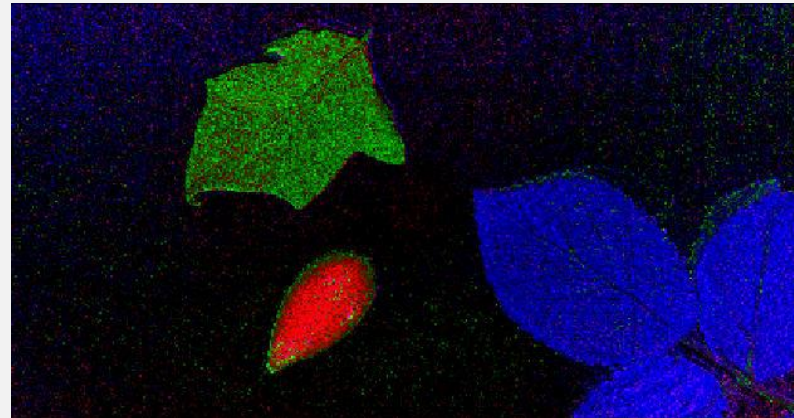


HSI separated

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



NIR (intensity)



HSI separated

Miniaturization

Miniaturized hyperspectral imaging cameras

**kompakteste
Hyperspektral
Kameras**

ximea

xiSpec
26 x 26 x 30 mm, 31g
16 bis 150 Hyperspektral-Bänder
170 HSI-Cubes/Sek.



Linescan • Mosaic • Tiled

basieren auf den der kleinsten und
leichtesten USB3.0 Kameraserie

xiQ

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



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

Miniaturized hyperspectral imaging cameras

Supported software libraries

Extremely compatible

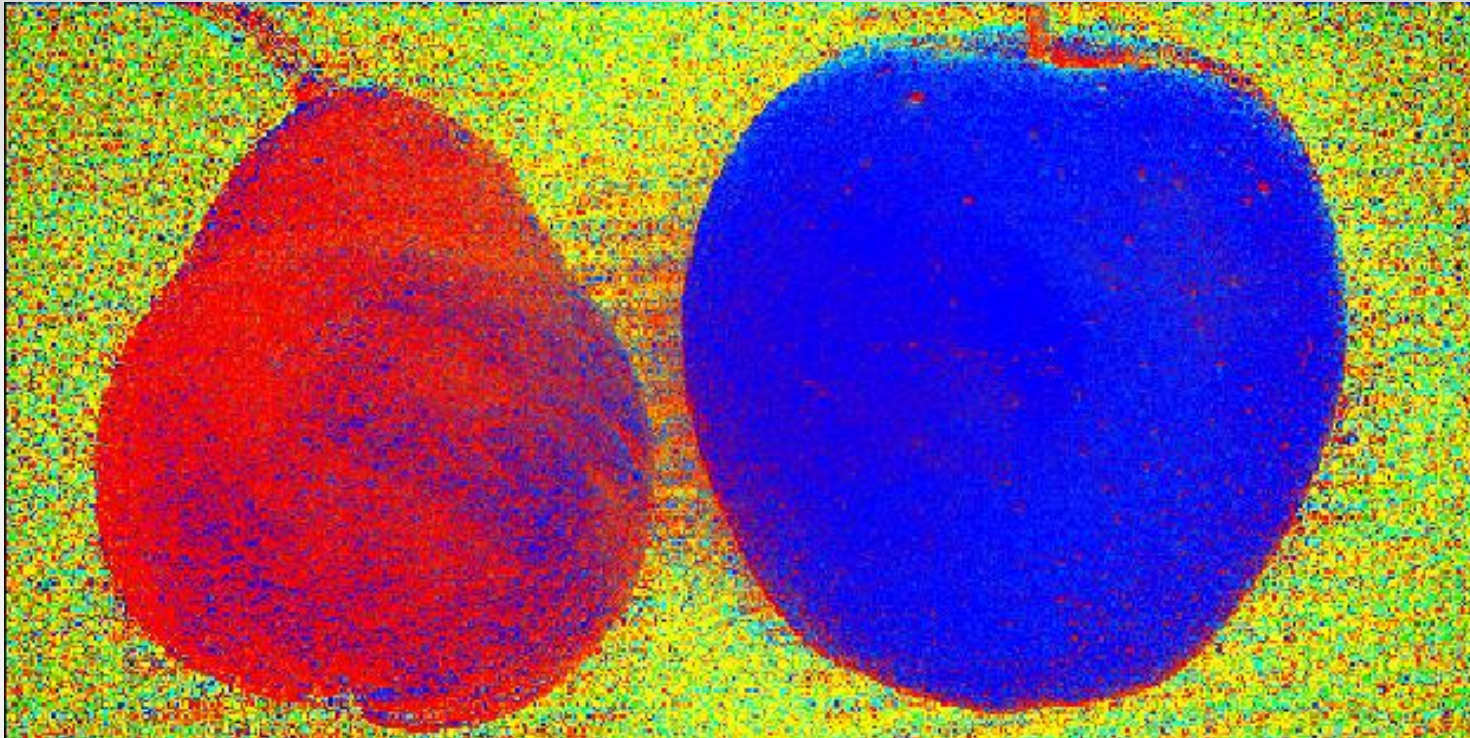
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compatible with more than 30 popular machine vision libraries...

Yes, we can ...

... compare apples with pears !



4x4 snapshot mosaic, halogen lamp illumination, filter set 450 – 650 nm

Thank you for your attention