



How SWIR Imaging contributes to the optimization of automatic quality control in the food industry

2013 |

Overview

- Xenics in Short
- New Architecture
- Products Line Overview



Module 1:

Xenics in Short

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Mission Statement

Our mission is

- to be a leading provider of infrared cameras and detectors,
- based on a strong knowledge background of infrared detector technology,
- achieved via continuous innovation,
- application and market driven, and
- combined with a flexibility towards our customers to find a solution to their specific infrared problem.

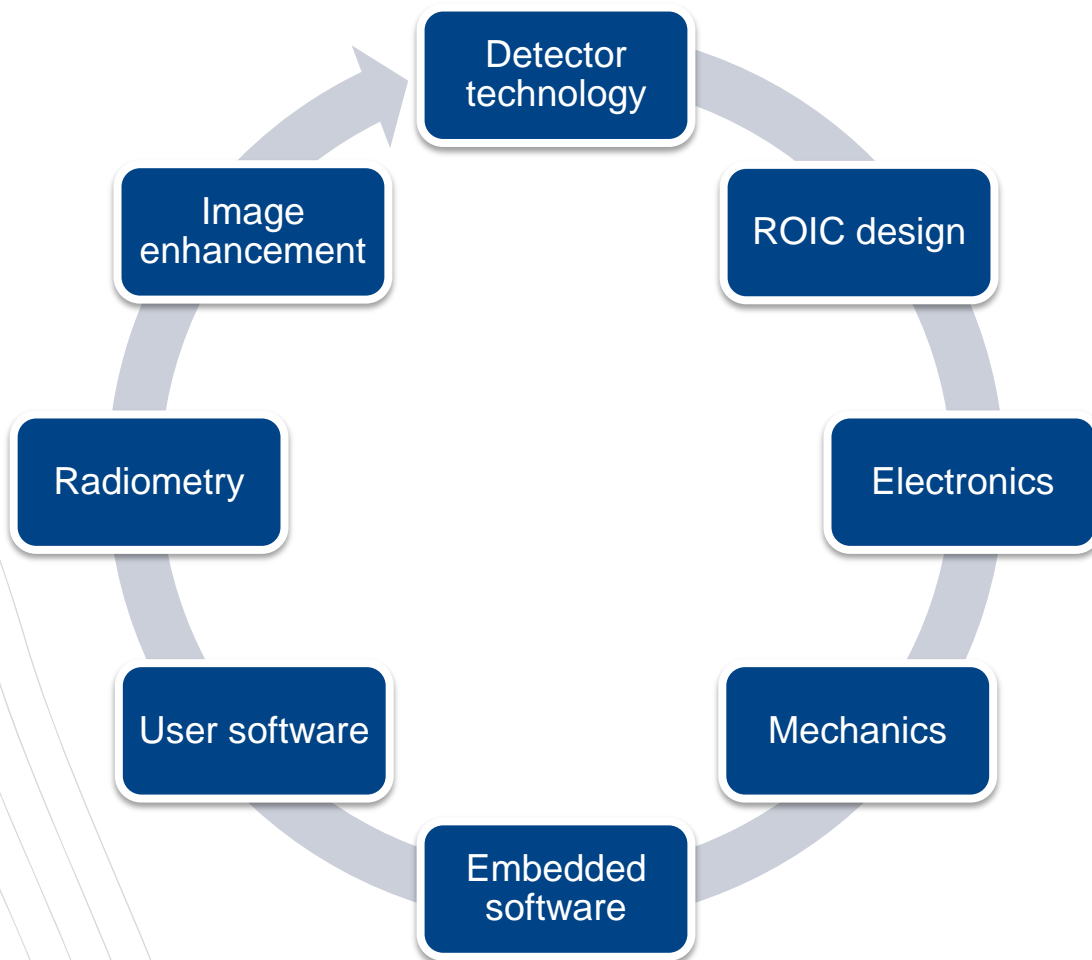
Company History

- Independent supplier of infrared cameras and detectors
- Europe's leading supplier of SWIR InGaAs imaging detectors
- Founded October 16th, 2000
- Spin-off of IMEC
- Share capital
 - Start-up capital 3.75 million Euro
 - 2nd round investment July 2003 1.50 million Euro
 - Warrants Dec 2009 1.92 million Euro
- R&D Funding
 - R&D funding IWT 4.00 million Euro
 - R&D funding EU 4.00 million Euro
 - R&D loan A380 program 13.00 million Euro
- Profitable since 2004
- Number of personnel worldwide 80
- Headquarters in Leuven, Belgium



www.xenics.com

Core Competences





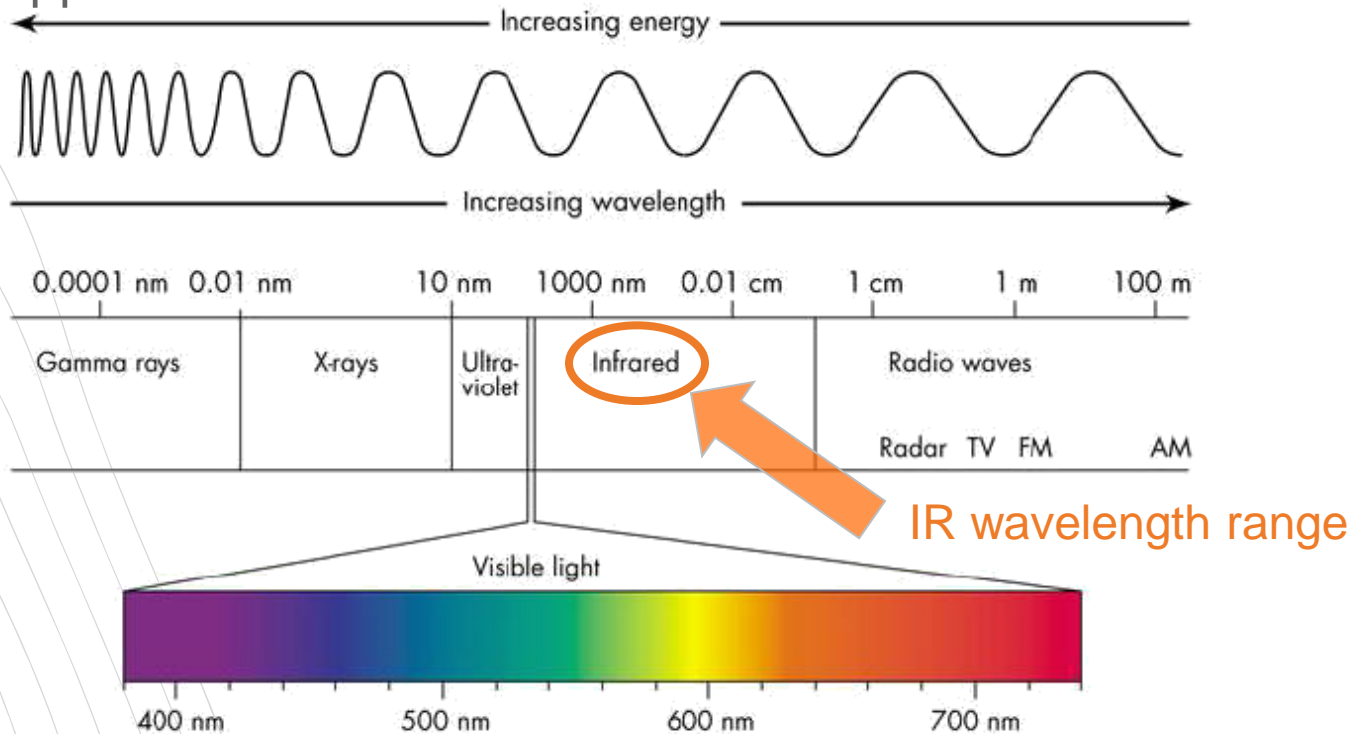
Module 2:

What is Infrared Radiation

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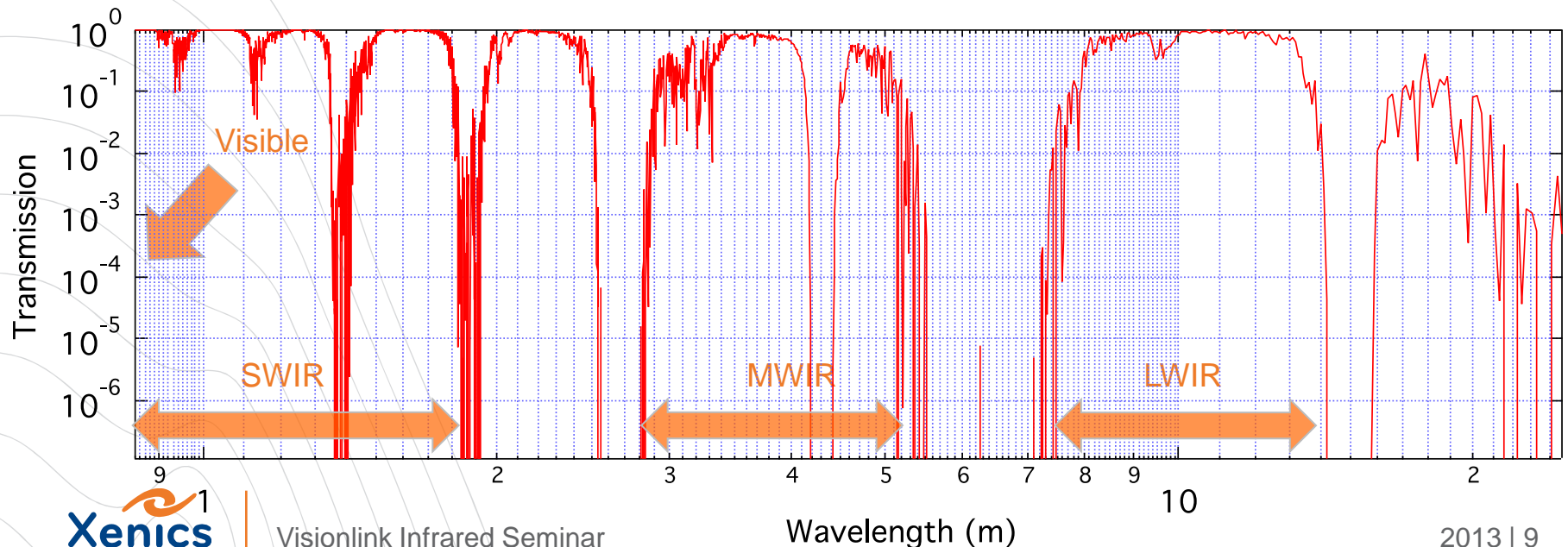
Radiation

- Basically we know now that :
 - There is radiation all around us
 - It comes with nature (it is natural)
- Each type of radiation leads to different applications
- Different domains can be distinguished :
 - Gamma, X-Rays, UV, IR, Radio, ...

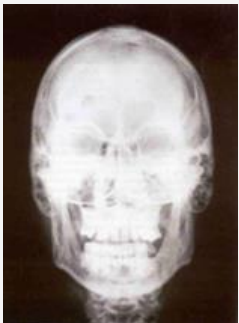








Transmission

- Not all radiation can “travel” free in space
 - Different molecules “absorb” specific wavelengths
 - *Due to molecular interaction*
 - This creates so called “transmission windows”
 - *Only radiation from these zones is perceivable*



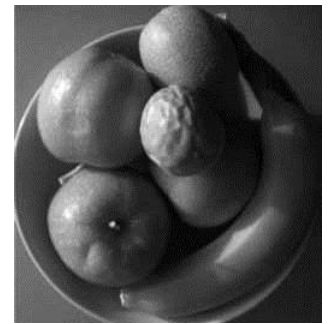
What is Infrared Imaging?

						
X-Ray	UV	VIS	NIR	SWIR	MWIR	LWIR
X-Ray	Ultra Violet	Visible	Near IR	Short Wave	Mid Wave	Long Wave
0.01-10 nm	10-400 nm	400-750 nm	750-1100 nm	1.1-2.5 um	3.0-5.0 um	7.0-14 um

Pictures used with permission of Dr. Austin Richards

Imaging in the SWIR

- SWIR images are similar to visible ones
 - Persons and objects can be recognized
- However :
 - No Blue/Green/Red (gray)
 - Imaging at night it possible
 - Images depend on material behaviour at SWIR wavelengths





Module 3:

New Architecture

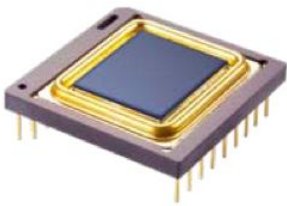
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Origin of the Architecture

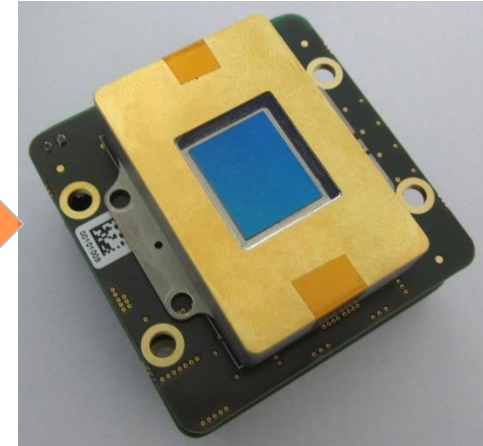
- New Generation of Sensors
 - More dynamic range
 - Lower noise
 - More compact
- Modularity
 - Platform for variation on video output
 - Platform for variation on sensor type
 - Platform for variation on on-board processing
- Compactness
- Manufacturing
- Market price

Sensor Boards

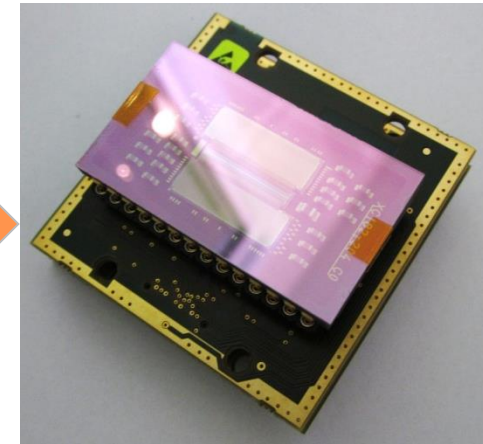
- First step in camera development :
 - Sensor interface
- This PCB contains :
 - Signal conditioning
 - *Receive sensor signals*
 - *Guarantee signal integrity*
 - Circuit bias elements
 - *Provide required electrical signals*



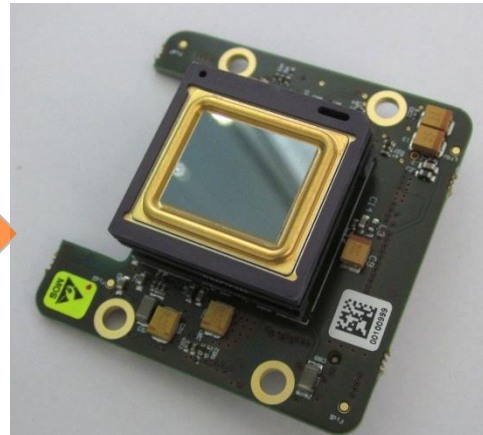
2D Array Interface



Line Array Interface



Bolometer Interface



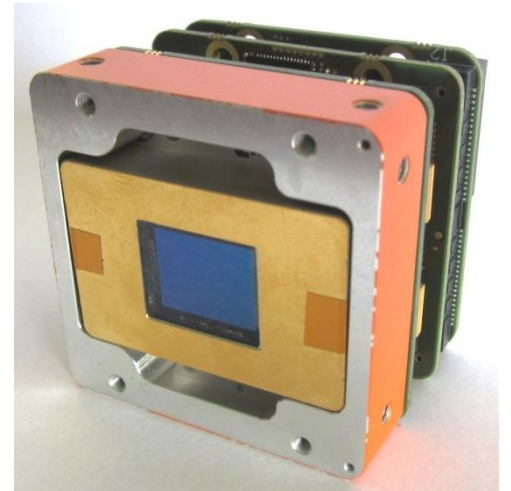
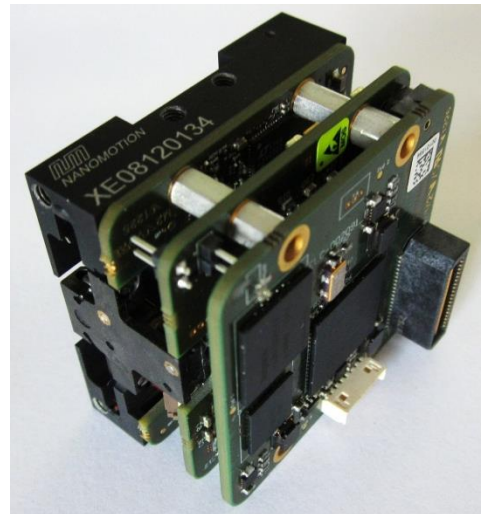
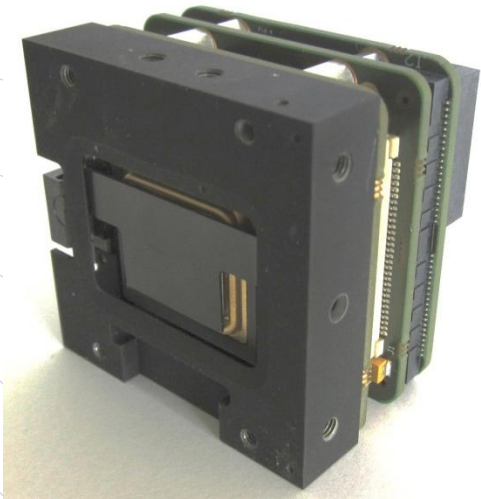
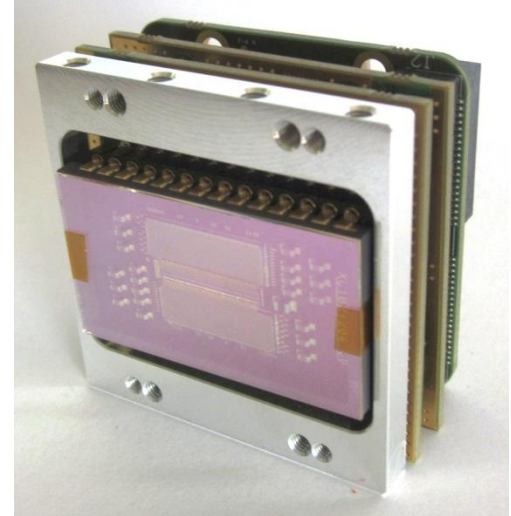
Processing Board

- FPGA board
 - Provides digital interface
 - *Based on user settings*
 - Collects digitized signal
 - Implements required algorithms
 - *NUC (Non-Uniformity Correction)*
 - *Shutter and cooler control*
 - *Thermography*
 - Provides output signal
 - *In correct data format*
 - *GigE/CL/Avid/BT.656/...*



Final Assembly

- All these components are compatible
- Allow construction of different configurations
 - Cold finger (cooled devices)
 - Shutter (if required)
- Basic version is an OEM Module



Final Assembly with Housing

- To obtain a camera, the stack is combined with
 - Housing
 - Front (for lens mount)





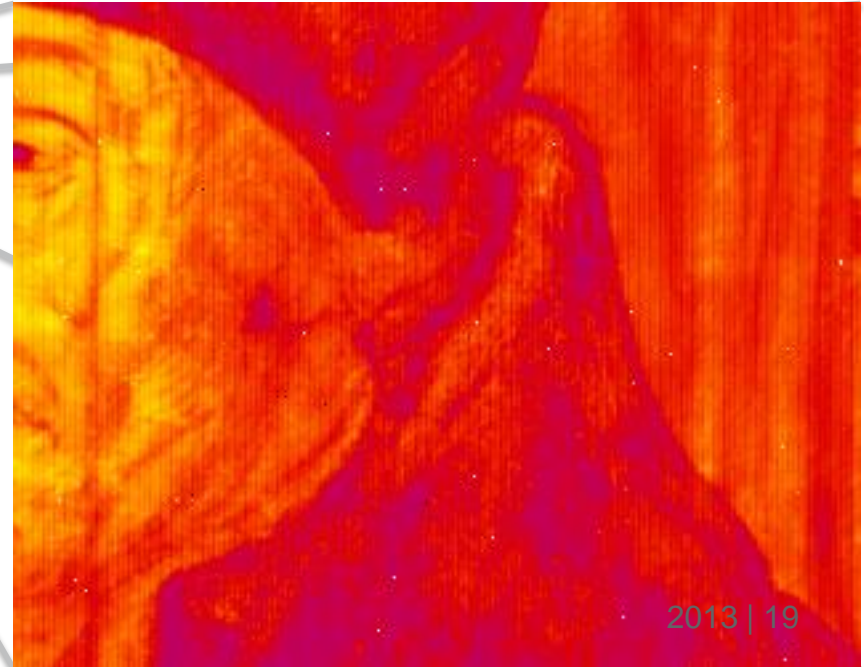
Module 4:

SWIR Imaging for Food Industry

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Art Inspection

- Advantage using SWIR camera for reflectography
 - Portability (complete system with laptop fits in hand luggage)
 - Real time imaging at 25 Hz
 - No special illumination required
 - On site inspection (no need to remove the paintings)



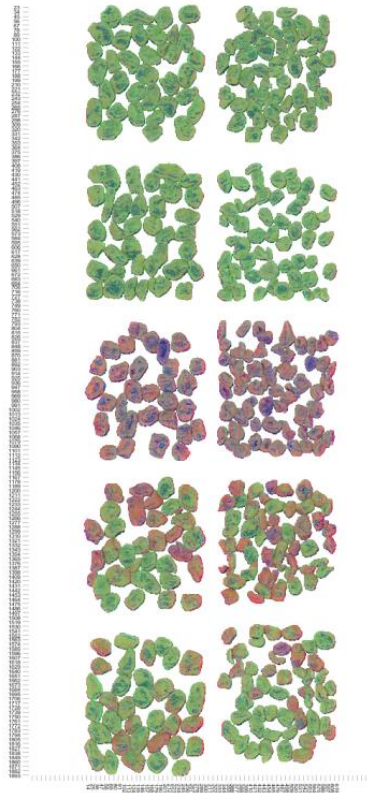
Art Inspection

- More examples
 - Underlying scetch



Industrial Applications

Food Industry



Classification

Greenish:
Higher moisture,
Softer

Reddish:
Lower moisture,
higher protein,
Harder

Heterogenous
sample sets

Industrial Applications

Food Industry

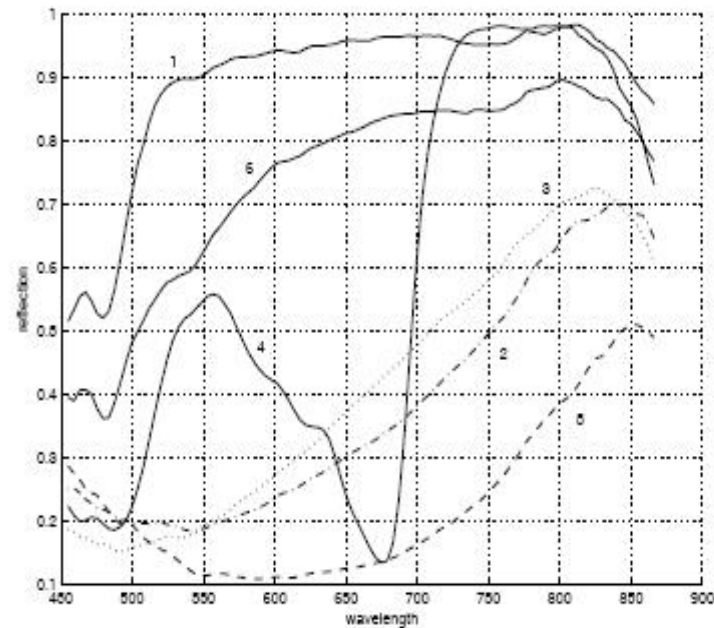
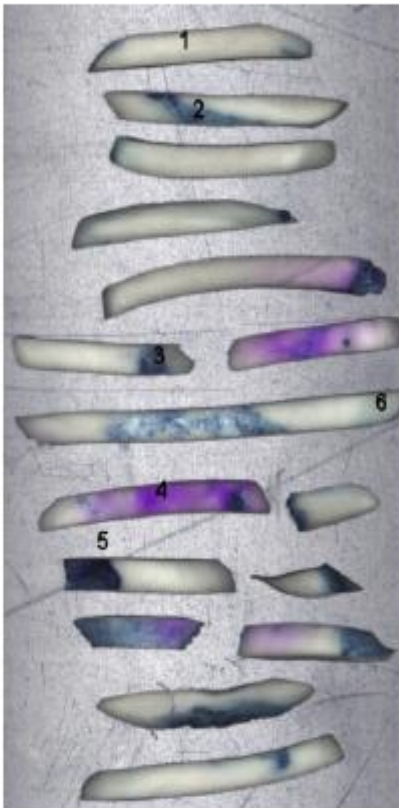


Figure 2. Several typical French fries defects and diseases with their corresponding spectra. 1=good flesh, 2=peel, 3=damage, 4=greening, 5=external rot, 6= browning

Industrial Applications

Food Industry



Industrial Applications

Food Industry



Industrial Applications

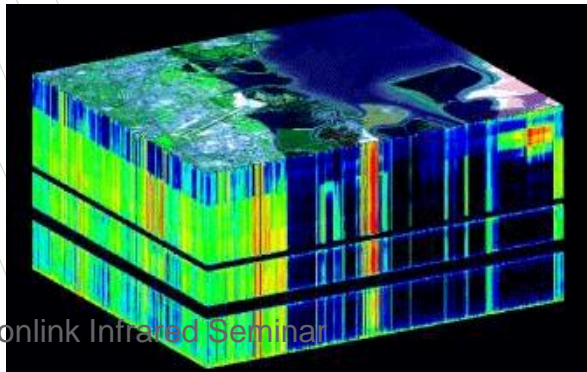
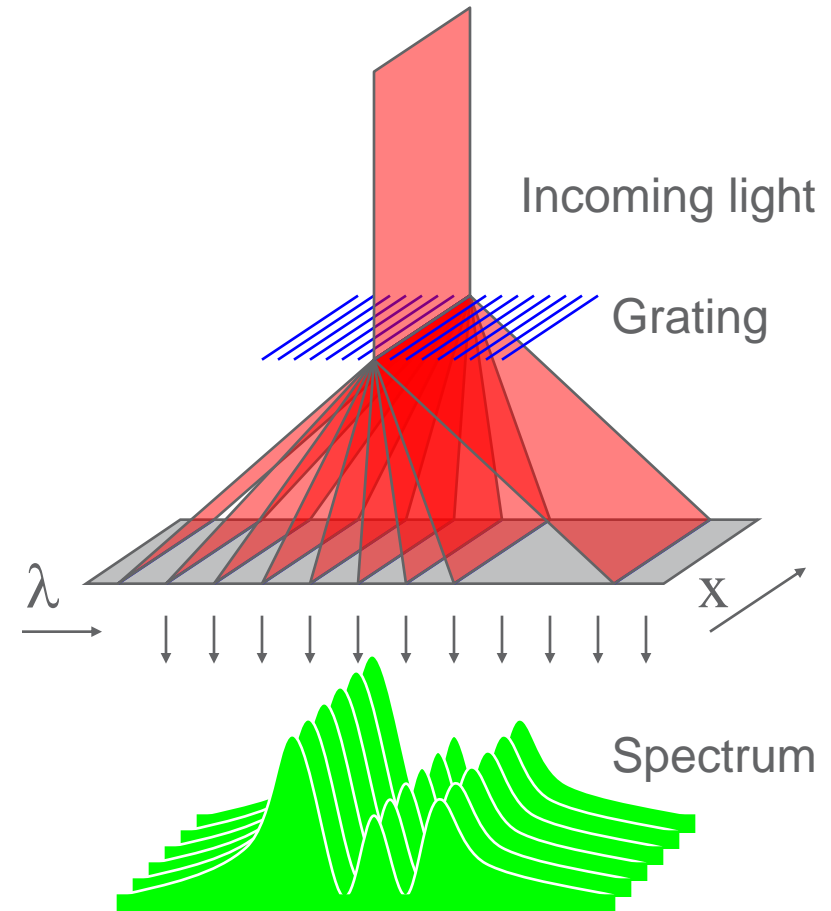
Food Industry



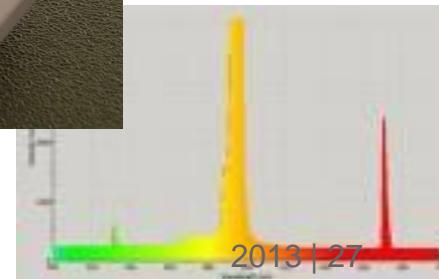
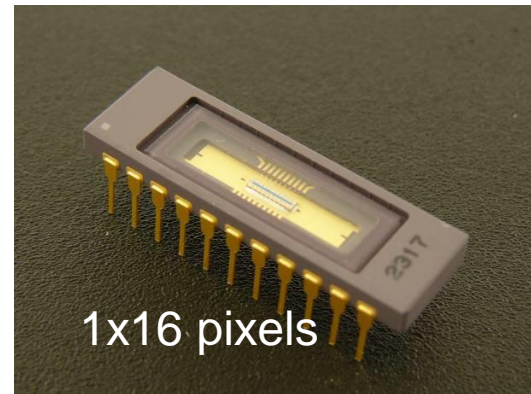
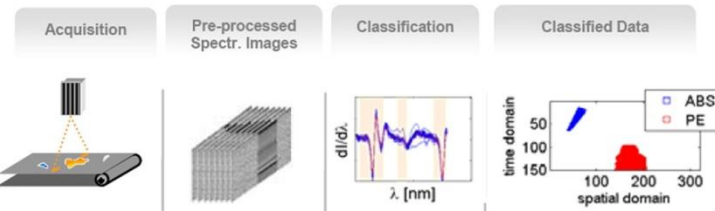
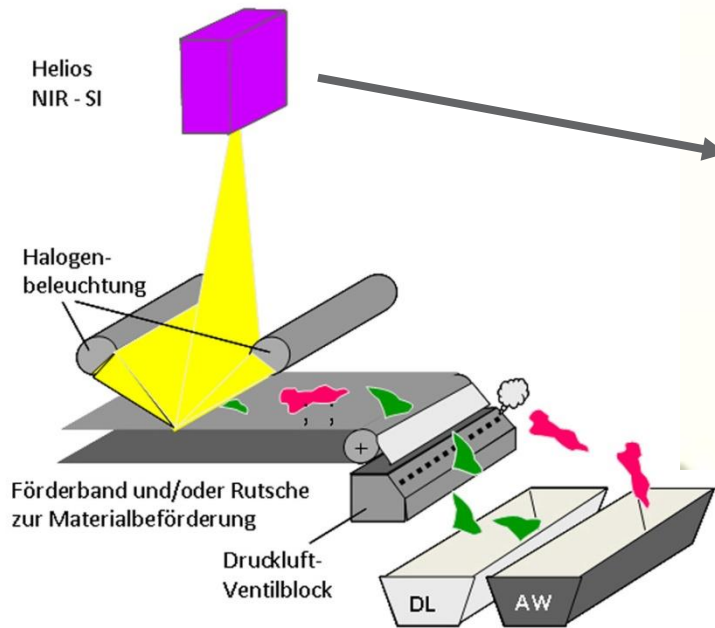
Courtesy of ITRES, published in Photonics Spectra

Hyperspectral imaging

- Identical to Spectroscopy
 - But for each individual pixel
 - On one line
- Very usefull
 - It delivers an image
 - Tells us what is on the image
 - Delivers us a “cube”
 - *2D : image*
 - *3D : spectral information*

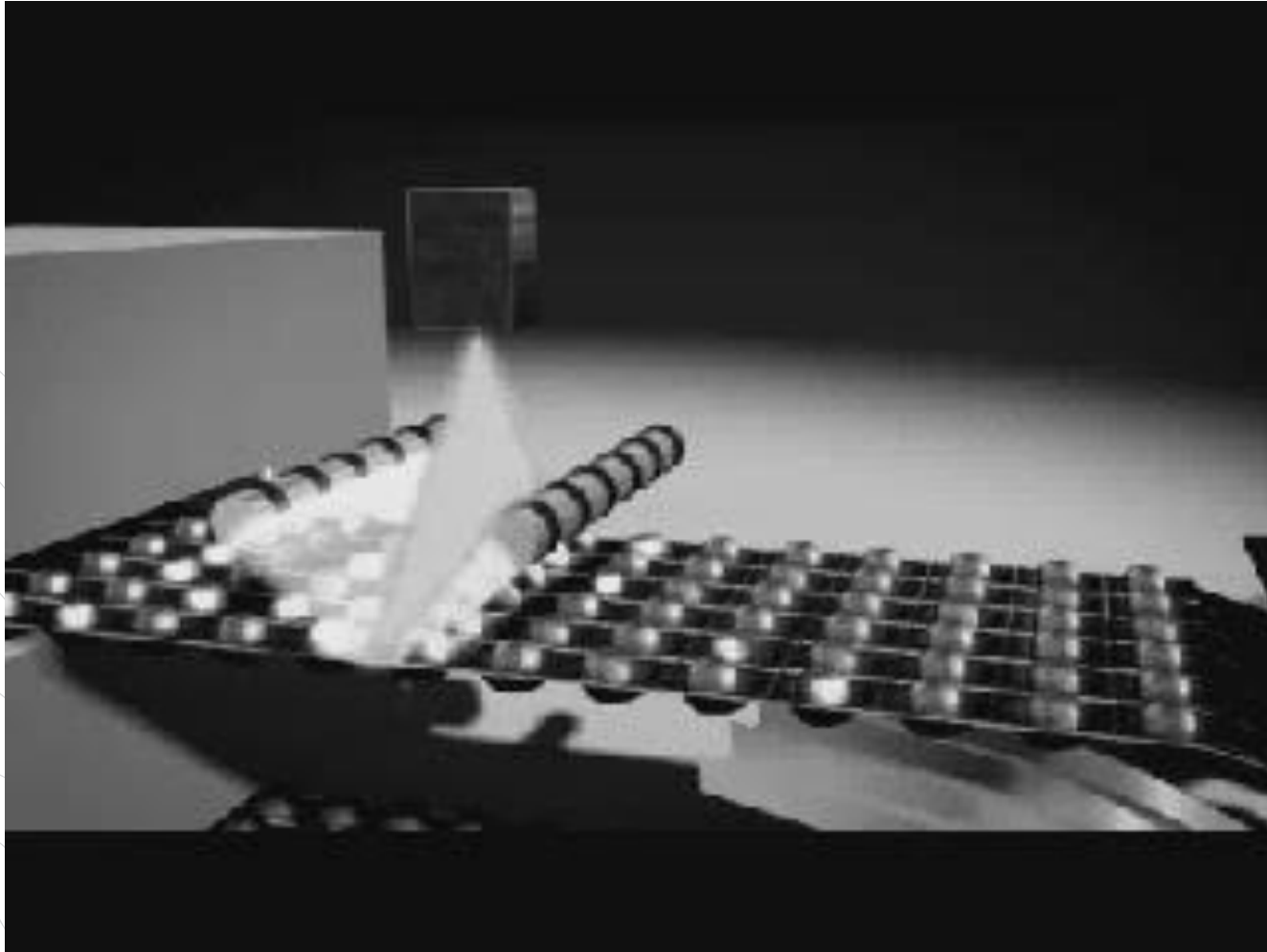


Industrial Applications Using a spectral filter



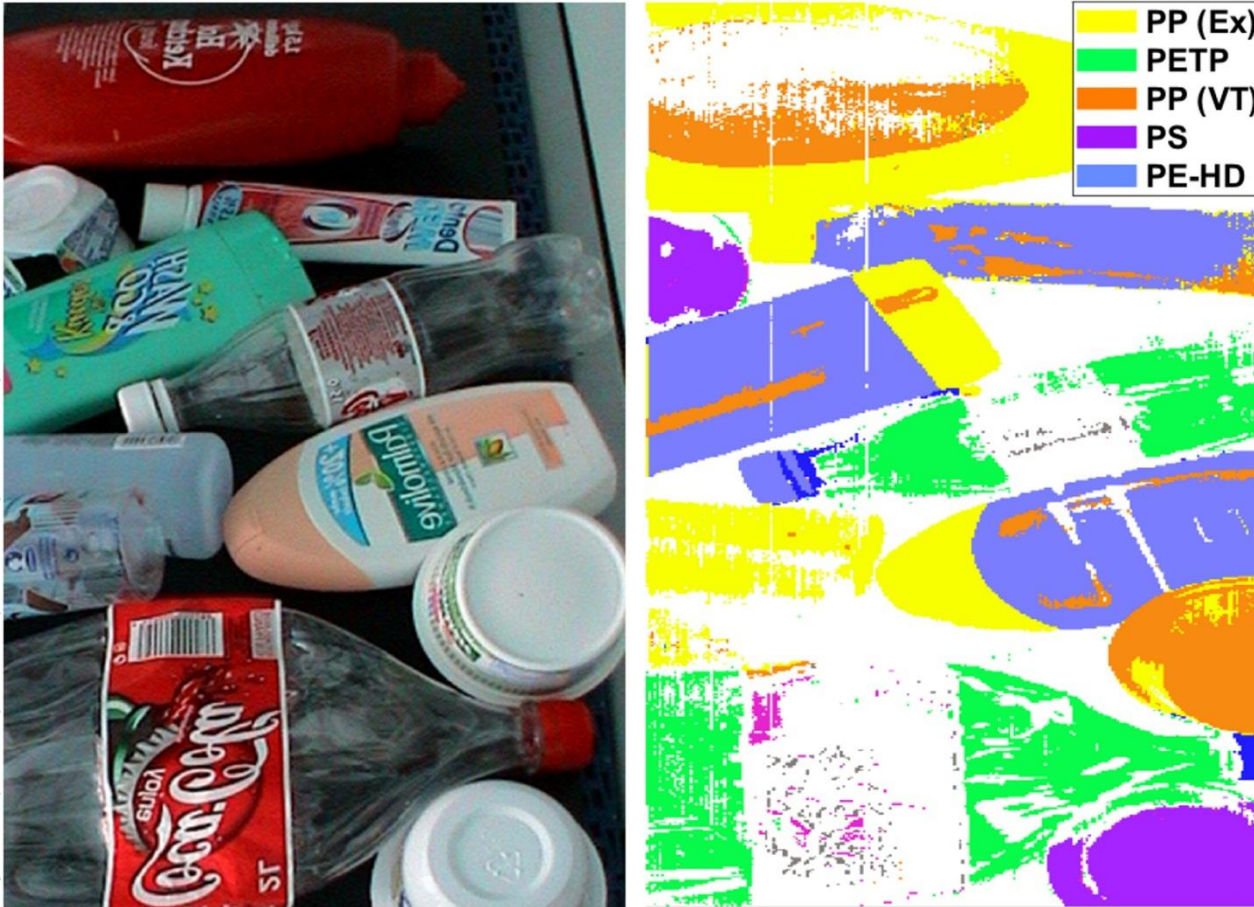
Industrial Applications

Food Sorting - Line Scan Imaging



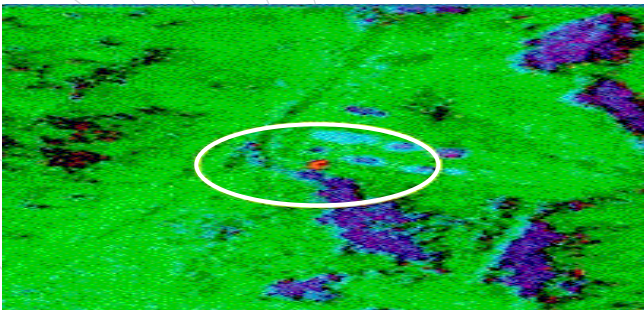
Industrial Applications

Waste Sorting - Line Scan Imaging

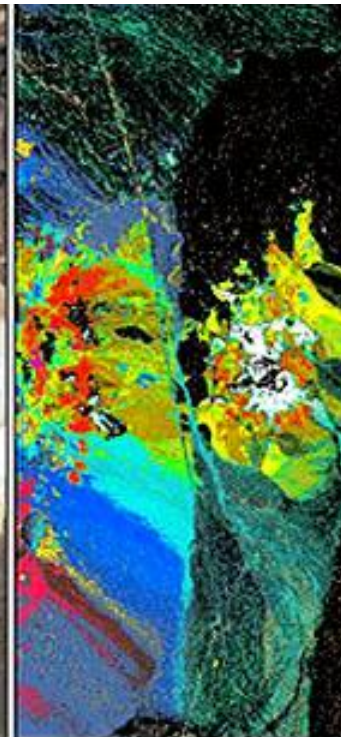


Hyperspectral imaging

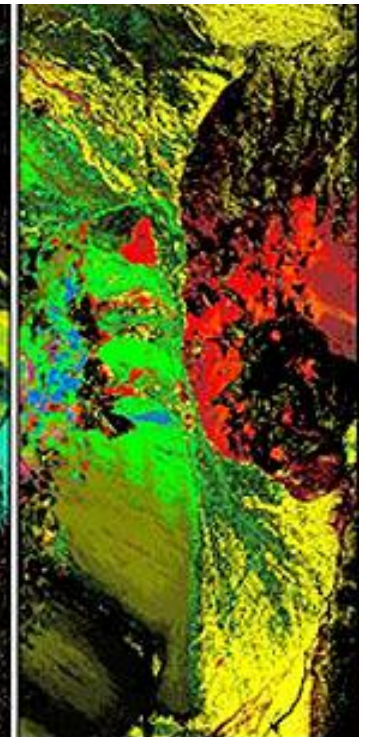
- Very interesting for material observation or identification



True Color



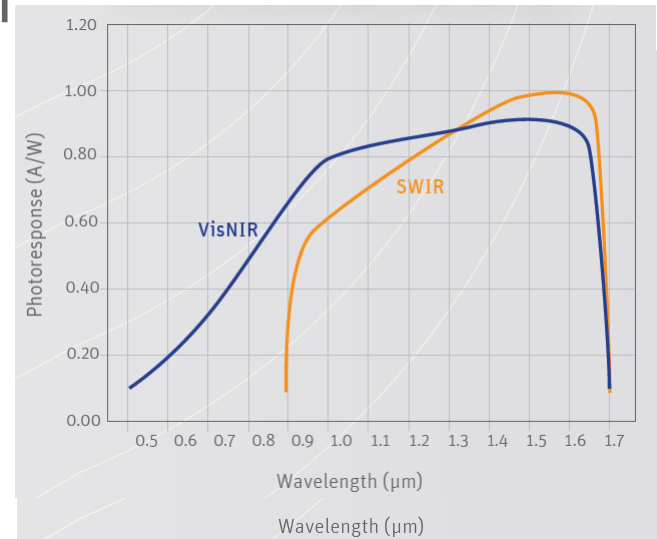
Minerals I



Minerals II

Bobcat 640

- Smallest SWIR camera for machine vision applications
- GigE, CameraLink or CoaXpress interface
- Spectral response: 0.9 μm up to 1.7 μm
- VisNIR option: 0.5 μm up to 1.7 μm
- Resolution: 640 x 512; Pitch: 20 μm
- AD conversion: 14-bit
- TE-1 cooled
- Frame rate: 100 fps
- ROI
- Various C-mount lenses



Bobcat 640



- GigE vision for ease of integration
- Compliant with any software that supports GenICam
- Power over Ethernet
- CameraLink
- Easy to export
- Exchangeable C-mount lenses
- On-board Image processing
- Variable integration time
- ITR and IWR mode
- VisNIR option
- Industrial components to increase operating temperature range

Lynx Series

- Smallest SWIR line scan camera for machine vision
- GigE, CameraLink or CoaXpress interface
- Spectral response: 0.9 μm up to 1.7 μm
- Resolution: 512; Pitch: 25 μm , 1024; Pitch: 25 μm and 2048; Pitch: 12,5 μm
- AD conversion: 14-bit
- Un-cooled
- Frame rate: 40 kHz or 10 kHz
- Various Gain modes
- Uncooled
- Various C-mount lenses, optional U-mount

Lynx Series

- GigE vision for ease of integration
- Compliant with any software that supports GenICam
- Power over Ethernet
- CameraLink
- Easy to export
- Exchangeable C-mount lenses
- On-board Image processing
- Variable integration time
- ITR and IWR mode
- Industrial components to increase operating temperature range





Thanks!

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