Leistungsstarke SWIR-Kameras in der industriellen Bildverarbeitung und Prozesskontrolle

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High performance SWIR cameras in machine vision and process control

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Caméras SWIR haute performance en vision industrielle et contrôle de procès

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Outline

• Introduction
  - Xenics n.v.
  - Brief portfolio overview

• Industrial SWIR applications
  - Line scan and area scan incl.
  - Space / Remote Sensing
  - Food sorting
  - Semiconductor
  - 3D metal printing
INTRODUCTION
Xenics – Introduction & History

• Independent, European supplier of IR cameras & detectors
• Europe’s leading designer and supplier of 1D and 2D InGaAs detectors, cores and cameras
• Founded October 16th, 2000 as Spin-off of IMEC (Institute for nano-electron. & digital techn. of University Leuven)
• Profitable since 2004
• Focus on SWIR linescan and areascan
  - Master different steps (sensor – module – camera)
• Regional growth:
  - 2003 start of SWIR InGaAs camera sales
  - 2008 office in Singapore (sales, production)
  - 2010 office in Boston/USA (sales, support)
Targeted market segments

- Machine Vision
- Process Monitoring
- Safety & Security
- Transportation
- Medical
- Scientific and research
# IR technologies provided by Xenics

<table>
<thead>
<tr>
<th></th>
<th>Reflective IR</th>
<th>Thermal IR</th>
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<tbody>
<tr>
<td><strong>X-Ray</strong></td>
<td>VIS</td>
<td>MWIR</td>
</tr>
<tr>
<td><strong>UV</strong></td>
<td>NIR</td>
<td>LWIR</td>
</tr>
<tr>
<td>UV</td>
<td>SWIR</td>
<td></td>
</tr>
<tr>
<td><strong>Visible</strong></td>
<td>Near IR</td>
<td>Mid Wave</td>
</tr>
<tr>
<td><strong>Near IR</strong></td>
<td>Short Wave</td>
<td></td>
</tr>
<tr>
<td><strong>0.01-10 nm</strong></td>
<td>1.1-2.5 um</td>
<td>3.0-5.0 um</td>
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<tr>
<td><strong>10-400 nm</strong></td>
<td>750-1100 nm</td>
<td>7.0-14 um</td>
</tr>
<tr>
<td><strong>400-750 nm</strong></td>
<td>1 um</td>
<td></td>
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</tbody>
</table>

- **Signal comes from reflected light on object**
- **Signal comes from object temperature**
XENICS line scan cameras SWIR

Pixels

2048x1

Lynx series
(2013)

2048-12.5μ-GigE/CL

1024x1

1024-12.5μ-GigE/CL

512x1

512-25μ-GigE/CL

Manx series
(2019)

2048-12.5μ-tbd

1024-12.5μ-tbd

512-12.5μ-tbd

2048-12.5μ-CXP

1024-12.5μ-CXP

512-12.5μ-CXP

line rate / Hz

10k

40k

... tbd

260k

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Manx – based on 3rd gen XLIN
the “new Ultra-HighSpeed Lynx” for demanding applications

- **Lowest noise** for a 2048 pixel linescan SWIR camera
  - ROIC with low read noise
- **Line rate** – fastest linescan SWIR camera
  - 260kHz vs 40kHz (Lynx 512/1024) or 10kHz (Lynx 2048)
- **TE cooler** for sensor temperature stabilization
  - Constant offset
- And:
  - Industrial camera design
  - Interface CXP
  - Flexible on-board image correction
  - Optional fan or heatsink (detachable)
XENICS area scan cameras SWIR

Frame rate / Hz

640 x 512

Cheetah-640-110Hz-TE3-CL
Wildcat-640-244Hz-TE1-CL/USB3
Bobcat-640-100-TE1-GigE/CL
Cheetah-640-800-TE1-CL
Cheetah-640-1700 TE1-CL

320 x 256

Xeva-320-100-TE3-CL/USB2
Xeva-320-350-TE3-CL/USB2
Bobcat-320-100-TE1-CL/USB2
Xeva-320-100-TE1-CL/USB2
Xeva-320-350-TE1-CL/USB2
Bobcat-320-400 TE1-GigE/CL

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Typical layout of Indium Gallium Arsenide 1D and 2D detectors

HYBRID DETECTOR ARCHITECTURE
InGaAs Hybrid integration

- Flip-Chip join by thermocompression:
  - Pressure – Temperature - Time
- Required accuracy:
  - Accuracy better than 2 μm
  - Planarity ~ 5 μm
Overview of common use cases with InGaAs 1D and 2D products

SWIR APPLICATIONS
Linescan InGaAs (Gen 1)

- XLIN 128/256/512
- Xenics ROIC XRO3501 (256 pixels)
  - Double sided 512
- Square pixels for imaging
- Rect. pixels for spectroscopy
- Remote sensing (space) - 2007
  - Xeva “Lin”

Water absorption band at 1.450nm
Linescan InGaAs (Gen 2)

- XLIN 512/1024/2048
- Xenics ROIC
  - XRO3504 (512 pixels)
  - XRO3508 (1024 pixels)
- Square pixels for imaging applications
- Rectangular pixels for OCT and spectroscopy
- Camera Lynx 512/1024/2048
  - CameraLink or GigE
  - 49 x 49 x 53 mm³
Linescan InGaAs (Gen 2)

• Applications
  - Machine vision – sorting (food)
  - Detection of foreign materials
    ▪ Based on water content
    ▪ Frozen fruits & vegetables
  - Lynx 512/1024 camera
    ▪ best product for application

Water absorption band at 1.450nm

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Solar Cell Inspection (EL)

- **Product**
  - Xeva-1.7-320 / 640, XS-1.7-320
  - Bobcat-1.7-320, Cheetah-640CL

- **Key features**
  - Wavelength up to 1.7um
  - Resolution

- **Benefits**
  - Detect defects, cracks, impurities
  - Detection in ms vs. sec for CCD
  - Mono, multi Si; Thin film Si; CIGS; Cells or modules
Linescan InGaAs (Gen 2)

- Applications
  - Machine vision – semiconductor (solar)
    - (micro-)crack detection & PL
    - Poly- and monocristalline Si wafers
    - Si bricks
  - Lynx 2048 camera
    - Best product for application
Applications linescan

- Inspection – semiconductor wafer
  - See through silicon (solar wafer)
  - Light source SWIR (line-array of LEDs)
  - Reflection/transmission/transflection
- Photoluminescence inspection (solar wafer)
- Food sorting
  - Light source SWIR (pulsed LEDs)
  - Foreign objects – based on water content
- Glass bottle inspection (hot end)
  - Thermal emission in SWIR
  - Defects in glass hollow ware
  - Inner and outer wall
Applications areascan

- Semiconductor device inspection
  - Dicing damage
  - Crack detection
  - Alignment verification
- SWIR InGaAs camera
- Seeing through silicon
- Lighting (SWIR)
- Microscopy applications
Applications areascan

- Additive manufacturing
  - 3D laser printing of metals (typically Ti and Al)
    - *Mitsubishi Heavy Industries Technical Review Sept 2018*
Thermal radiation in SWIR?

- Max Planck (1858...1947)
  - Nobel Prize for Physics 1918
  - Radiance over wavelength
    - *For object temperature*

Temperature of the sun 5.778K

1.7μm InGaAs and lower: Thermal radiation can be seen from ca. 300°C object temperature and more
Conclusions

- SWIR cameras
  - Linescan and areascan
  - Xenics vertically integrated – strong focus on SWIR 1D and 2D

- Applications in machine vision and process control
  - Semiconductor inspection
    - See through silicon
    - Electro or Photo-luminescence
  - Food sorting
    - Water absorption band
  - Additive manufacturing

Vertically integrated manufacturing

- Wavelength 0.9 - 1.7 μm
- Fully independent production of InGaAs sensors, cores and full cameras
- 3 levels of customisation to meet your application needs
- Continued R&D to produce breakthrough sensors & cameras
Infrared @ Xenics

• Xenics offers
  - A vast choice of industrial reliable SWIR/MWIR/LWIR detectors and cameras
  - Thermographic calibration option for LWIR thermal imaging cameras
  - Analytic Software End-User Packages and C# and LabVIEW SDKs for integration
  - Dedicated technical support incl. application teams via established sales channel partners
Thank you for your attention

... and looking forward to see you at our booth during the STEMMER TechForum!