CMOS sensors are coming at age

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JAI
Is a camera manufacturer with global presence and operates via own sites and distribution in more than 40 countries.
What JAI is doing
A unique blend of technologies & competencies

- Area scan and line scan camera technology
- Software engineering
- Image pre-processing techniques
- High-speed interfaces
- Optical knowledge
- Imager and multi-imager technology
CMOS sensors are coming at age

Consumer market drives development

(2014 CMOS image sensor market landscape)

(Yole Développement, January 2015)
Will CMOS replace CCD?

CMOS imagers have become viable alternatives in many applications

**PAST ISSUES**
- Non uniformity
- Noisy images
- Rolling shutter
- Shutter leakage

**LATEST CMOS TECHNOLOGY***
- High Sensitivity, High Dynamic Range and High frame rate
- Dual noise reduction of the Analogue and Digital CDS
- Global shutter
- Better shielded memory - no unwanted parasitic light

*) Sony Pregius IMX CMOS
Correlated double sampling
As known from CCD

Reduces non-uniformity caused by subtle pixel-to-pixel variations in feedthrough noise and well depth.
Global Shutter

New more advanced pixel designs enable global shutter, allowing CMOS imagers to freeze motion like electronic shutter in CCD imagers.
Improved shutter efficiency

New CMOS imagers have significantly improved ability to block parasitic light leakage during readout

Example: 1:50000 is common today
Today CMOS and CCD can still co-exist

CMOS advantages

- Low Power consumption
- Flexible Readout (ROI, binning etc.)
- Frame rate
- NIR

Applications in:
- MV incl. high speed
- ITS

CCD advantages

- Format/Resolution
- Dynamic Range
- Electronic Shutter
- Image Quality

Applications in:
- FPD inspection
- Wide FOV aerial mapping
CMOS sensor architecture

From BSI to stacked BSI
# Sensor comparison

<table>
<thead>
<tr>
<th>JAI camera</th>
<th>CM-200</th>
<th>BM-141</th>
<th>GO-2400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>ICX274 (CCD)</td>
<td>ICX285 (CCD)</td>
<td>IMX174 (CMOS)</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Sony</td>
<td>Sony</td>
<td>Sony</td>
</tr>
<tr>
<td>Size</td>
<td>1/1,8&quot;</td>
<td>2/3&quot;</td>
<td>1/1,2&quot;</td>
</tr>
<tr>
<td>Resolution</td>
<td>1920 x 1200</td>
<td>1384 x 1036</td>
<td>1936 x 1216</td>
</tr>
<tr>
<td>Pixel size (µm)</td>
<td>4,7</td>
<td>6,45</td>
<td>5,86</td>
</tr>
<tr>
<td>Temp dark noise (e-)</td>
<td>8,35</td>
<td>11,9</td>
<td>7</td>
</tr>
<tr>
<td>Saturation capacity (e-)</td>
<td>7969</td>
<td>36000</td>
<td>32513</td>
</tr>
<tr>
<td>Dynamic range (dB)</td>
<td>59</td>
<td>62,4</td>
<td>73</td>
</tr>
<tr>
<td>QE</td>
<td>59%</td>
<td>55%</td>
<td>76%</td>
</tr>
</tbody>
</table>
Latest generation CMOS (Sony Pregius) outperform previous global shutter CMOS and CCD sensors
CMOS has excellent NIR sensitivity

Comparison (spectral response)
Flexible readout

Example SP-12000 (CMV12000)

MULTI-REGION OF INTEREST (MULTI-ROI)

- Faster image processing. Only regions of interest are computed.
- More flexible options compared to other cameras.
- Up to 32 simultaneous areas.

VIDEO OUTPUT FORMAT
Versatile and adaptable

Example GO-2400 (IMX174)

5.86 μm PIXEL PITCH + ROI CREATES MANY POSSIBILITIES

2 megapixels, 1936 x 1216
Up to 48 fps

2x2 binning, 968 x 608
64 fps *

SXGA 1024 x 768
99.5 fps *

VGA ROI, 640 x 480
154.5 fps *

= Lens circle

= Active pixels

*)8bits
JAI CMOS camera range:

Spark Series

The ultimate in megapixels-per-second performance.

Advanced area scan cameras delivering high resolution, high frame rates, and high image quality.
SPARK SERIES

THE WORLD’S FASTEST
12 MEGAPIXEL INDUSTRIAL
CMOS AREA SCAN CAMERA

189 FPS @ 8-bit

SP-12000-CXP4
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Go Series
Small industrial cameras at a great price/performance point.
Megapixel cameras with small dimensions, high frame rates and cutting edge sensor technology.
GO-2400 (IMX174)

Available in all GO-2400 models:

- Single and multi-ROI capabilities
- 2X binning (monochrome), including asymmetric
- ALC - automatic level controlled exposure mode (auto gain + auto shutter)
- Sequence trigger mode
  - Automatically change exposure & ROI between triggers
- Built-in LUT for gamma and other transformations.
- In-camera CMOS pattern corrections.
- Pixel blemish compensation.
- Flat field shading correction.
- 8, 10 and 12-bit output (Bayer/monochrome).
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Sweep+ Series
The choice for superior color line scan.
High performance prism-based line scan cameras combining color precision, light sensitivity, line rate, ease of use, and multi-spectral options.
High performance COLOR LINE SCAN CAMERAS

SW-2000T and SW-2000Q models with Camera Link and CoaXPress

SW-2000T/Q
- 20 μm x 20 μm pixels
- 80,000 lines/s
- Signal/Noise ratio: 55 dB
- Dynamic range: 66 dB

SW-2000T-CL
- 3 CMOS 3 x 2048 pixels

SW-2000Q-CL
- 4 CMOS R-G-B + NIR 4 x 2048 pixels

SW-2000T-CXP2
- 3 CMOS R-G-B 3 x 2048 pixels

SW-2000Q-CXP2
- 4 CMOS R-G-B + NIR 4 x 2048 pixels
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**Sweep Series**
Large pixels for better sensitivity and scan speed.
Monochrome CMOS line scan cameras with extra large pixels for high sensitivity and fast scan rates with less light required.
High Performance MONOCHROME LINE SCAN CAMERA

SW-2000M with Camera Link and CoaXPress

- Custom CMOS line sensor
- Pixel size: 20 µm x 20 µm
- Resolution: line of 2048 pixels
- Line rate: 80 kHz @ 12 bits
Summary

- Typical CMOS camera runs at 3X to 10X higher frame rate (same resolution)
- Typical CMOS camera requires <50% power (same resolution)
- Newest CMOS imagers exhibit standard dynamic range higher than most CCDs and some support built-in HDR modes
- CMOS quickly replacing CCDs, except for selected scientific, astronomy, and other specialized applications
THANK YOU
for seeing the possibilities

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