CMOS Sensors: HDR and e2v

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14.02.2011
HDR
New Sensor with Extremely High Dynamic Range
In scenes with a large dynamic range, conventional image sensors are limited.
A Definition of Dynamic Range

Ratio of the largest brightness value to the smallest brightness value:

\[ D = 20 \cdot \lg \left( \frac{l_1}{l_2} \right) \text{dB} \]
The dynamic range of a daylight scene exceeds the capabilities of **conventional CCD sensors**.
Method of functioning:
Conventional sensor with integrating pixel

$t$ integration

Charge level
uEye UI-1120.
A dimmed light bulb with a CCD sensor…
uEye UI-1120.
A different situation...

40W

40W with short exposure
uEye UI-1120.
Effects of overexposure ...

...CCD

...CMOS
The **dynamic range of a linear sensor** is limited by the saturation of the pixels.
uEye UI-1120.
We need HDR (High Dynamic Range)!

- Log. Intensity (Lux): 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10^4, 10^5, 10^6
- Response: CCD 60 dB, CMOS, Human Eye 100 dB, HDR > 120 dB
The new HDR sensor is based on the principle of a solar cell and has a 1000x higher dynamic range than CCDs.
Method of functioning: HDR sensor with photovoltaic pixel
Method of functioning:
HDR sensor with photovoltaic pixel

- No exposure time. No motion blur.
- No overexposure. No information loss.
uEye HDR sensor example:
Light bulb
uEye HDR sensor example:
Traffic situation with back light
uEye HDR sensor example:
Traffic situation with brightness fluctuation
A sensor with a logarithmic curve does dynamic compression in the pixel.
uEye UI-1120.
Sensor technical data

Real logarithmic HDR images
CCIR / D1 resolution (768 x 576)
1/1.8” diagonal

Square pixels with 10µm
No microlenses
45% fillfactor

Visible and IR QE
Rolling readout
Max. 50 fps

Type: NCS0806
http://www.new-imaging-technologies.com/media/doc/12_nsc0806-flyer-v2.pdf
For best results, use **12 bit raw data** in image processing tasks.

8 bit raw data

12 bit raw data
Cameras with high bit depth are required using the full potential of the uEye HDR sensor.

12 bit raw image
Cameras with high bit depth are required using the full potential of the uEye HDR sensor.

After contrast adjustment
Cameras with high bit depth are required using the full potential of the uEye HDR sensor.
uEye UI-1120.

Support

A white paper will help to understand the new technology.
http://www.ids-imaging.com/whitepaper.php

Free SDK, Viewer, Sourcecode and online manual.

www.ueyesetup.com
uEye UI-1120.
Announcements

German: [http://www.youtube.com/user/uEyeTV](http://www.youtube.com/user/uEyeTV)
English: [http://www.youtube.com/user/uEyeTVe](http://www.youtube.com/user/uEyeTVe)
HDR sensors are mainly suitable for the following areas of use:

- **Very high dynamic range**
- **Unpredictable brightness fluctuations**
- **Long time exposure**
New: EV76C560

1.3 Megapixel CMOS sensor

1280 x 1024 pixel

Global and rolling shutter

Mono and Color version

Optical 1/2“ class (exact: 8.7mm diagonal)

5.3µm pixel, square

Max. 60 fps
e2v
UI-1240

CMOS pixel details

- 13,000 e- fullwell
- 62 dB Dynamic range
- 41 dB SNR

- Standard EPI 8e- RMS
- Double EPI (IR enhanced factor 2) 3e- RMS

* values for rolling shutter mode
Sensitive: QE up to 62%
The sensor is working up to 200 Krads.

Advantages compare to a CCD sensor by 10x thinner silicon
Study 2: 200 Krads test shows an increased black level caused by Temperature and Radiation
Impact:

The results of this work demonstrate that e2V has a commercial CMOS imager process that has potential for flight applications in extreme radiation environments and could lead to a scientific CMOS imager that satisfies JPL’s near term future flight camera requirements.

Future testing could focus on displacement damage from protons, electrons and neutrons and how their damage affects device performance.
We offer more than 1200 different variations of a camera

Also OEM versions with sensor and interface on one pcb or separated sensor pcb.
Thank you!

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