Image Sensors and Shutter-related Artifacts

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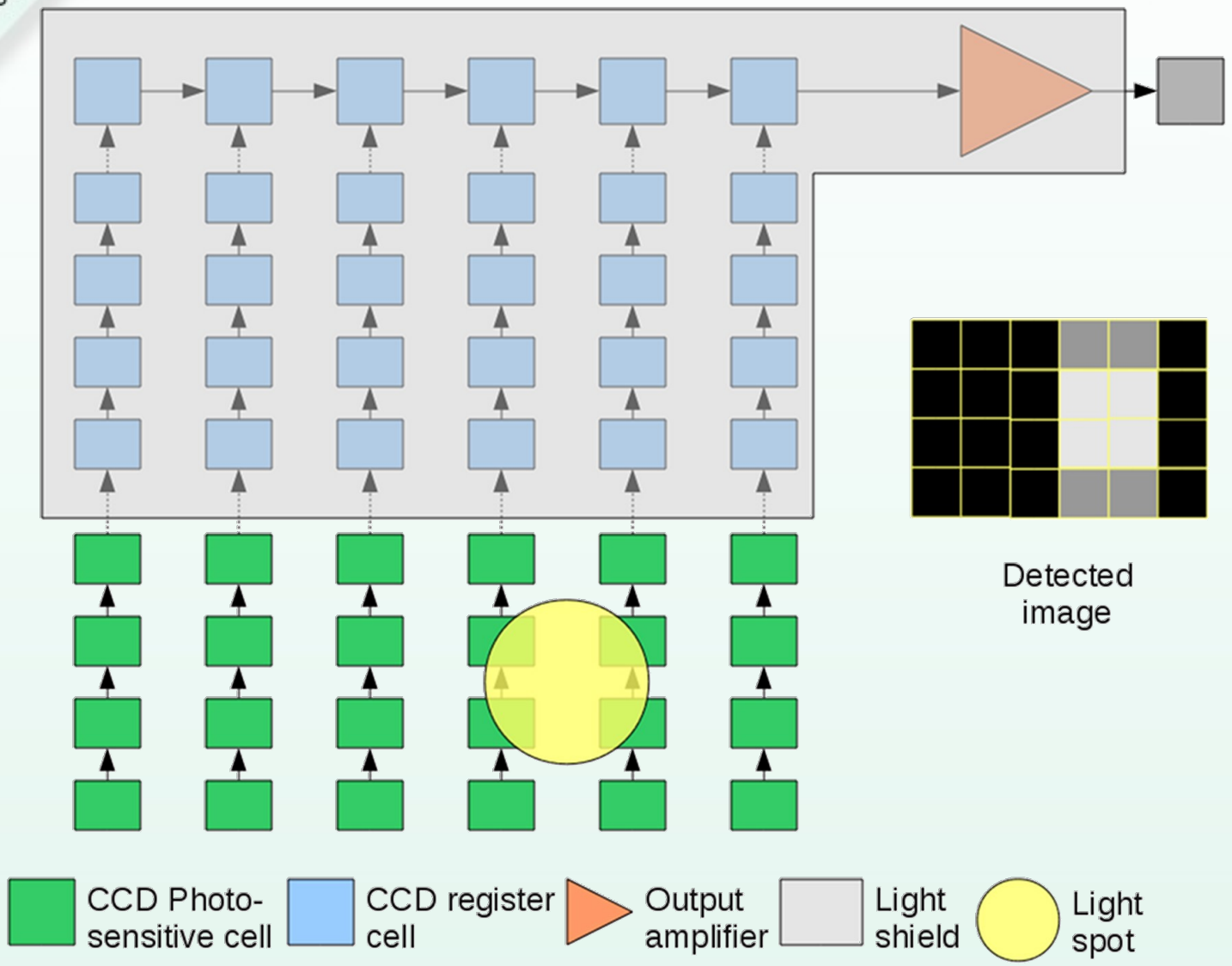
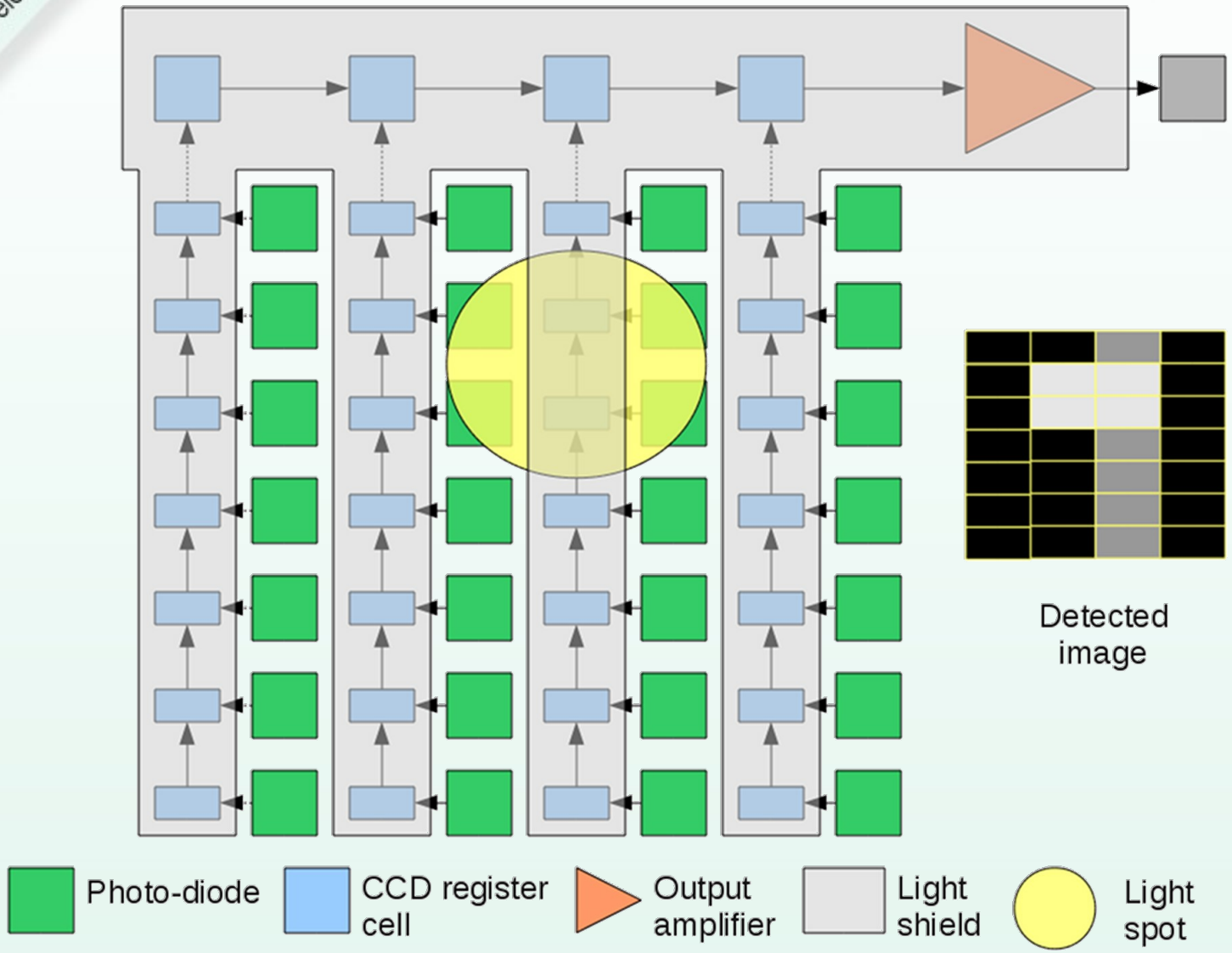
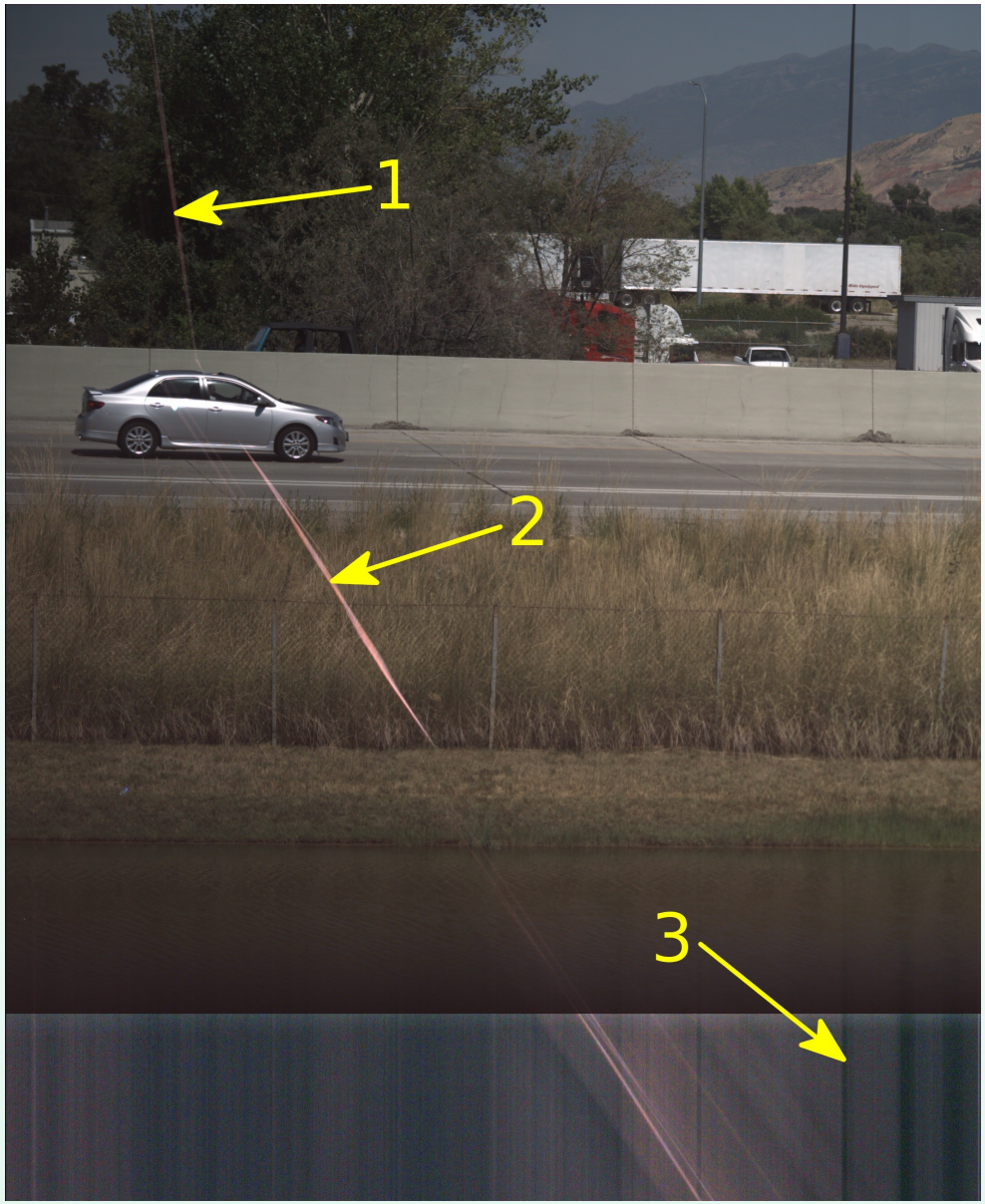
Frame transfer CCD image sensor



Interline transfer CCD image sensor



“Smear” artifacts of the interline transfer CCD image sensor (KODAK KAI-11002)

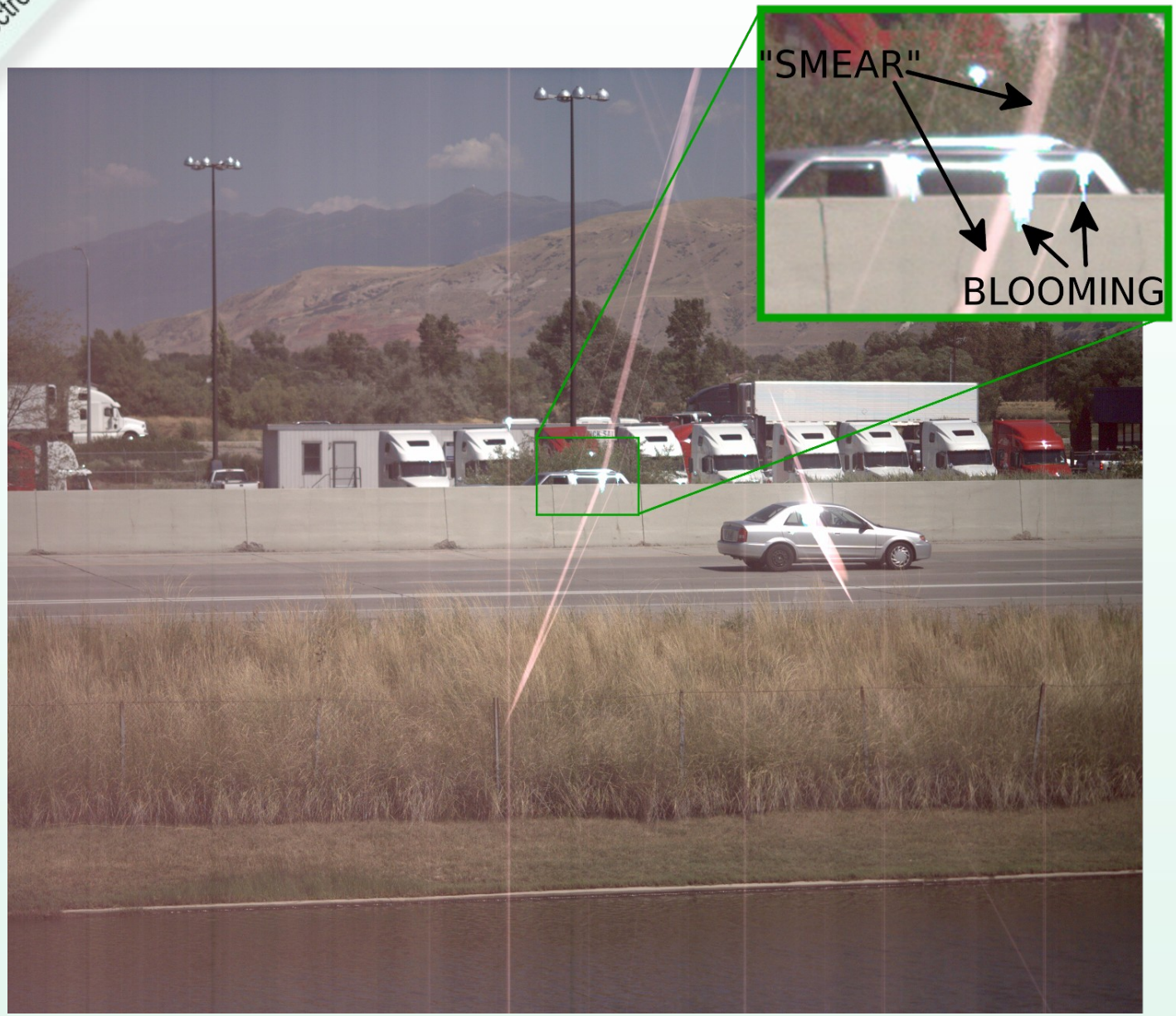


1 - smear during fast pre-exposure vertical pixels shift (clearing CCD)

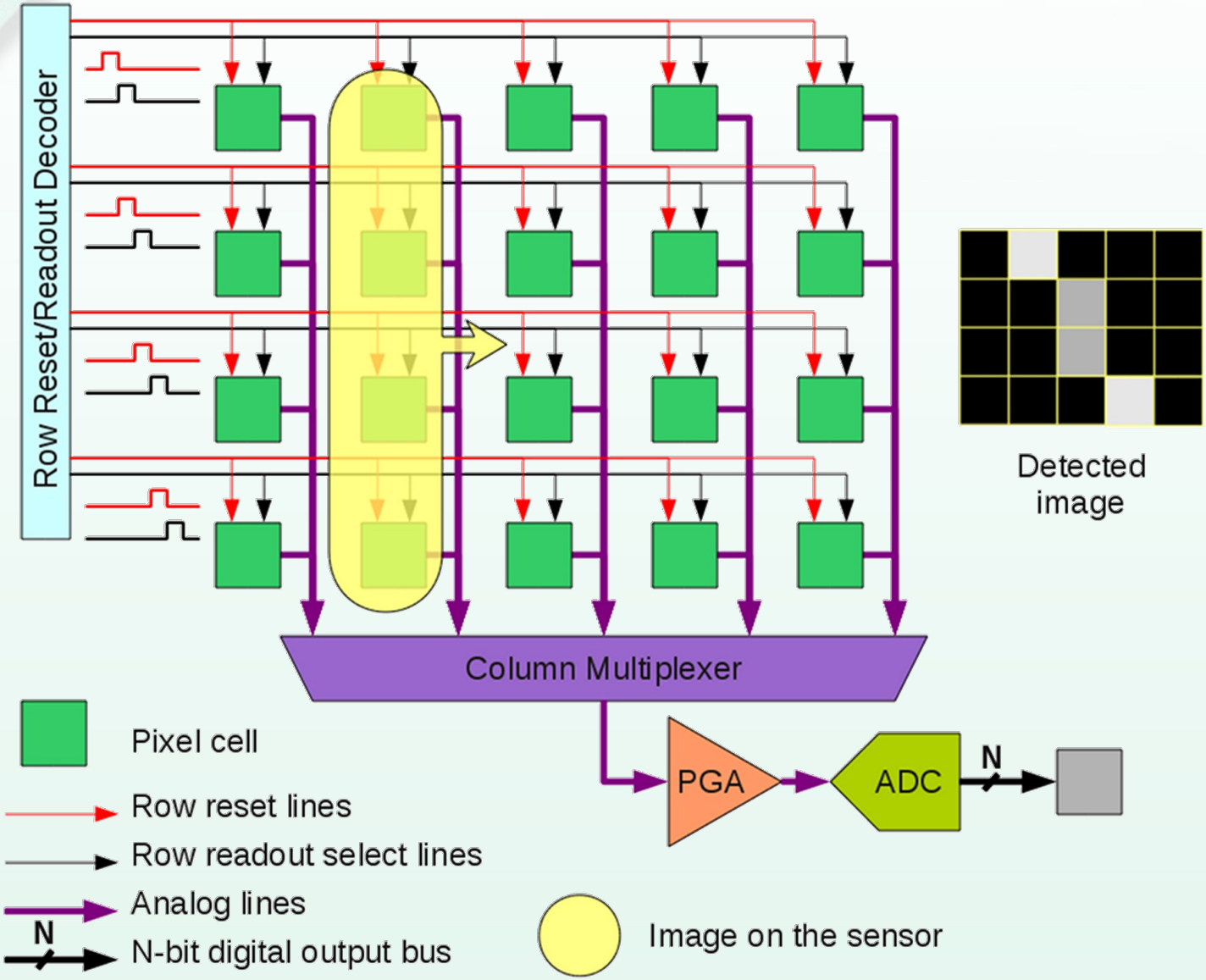
2 - smear during slower vertical shift (readout)

3 – vertical smear from the stationary objects (dark pole above)

“Smear” and blooming artifacts in the interline transfer CCD image sensor

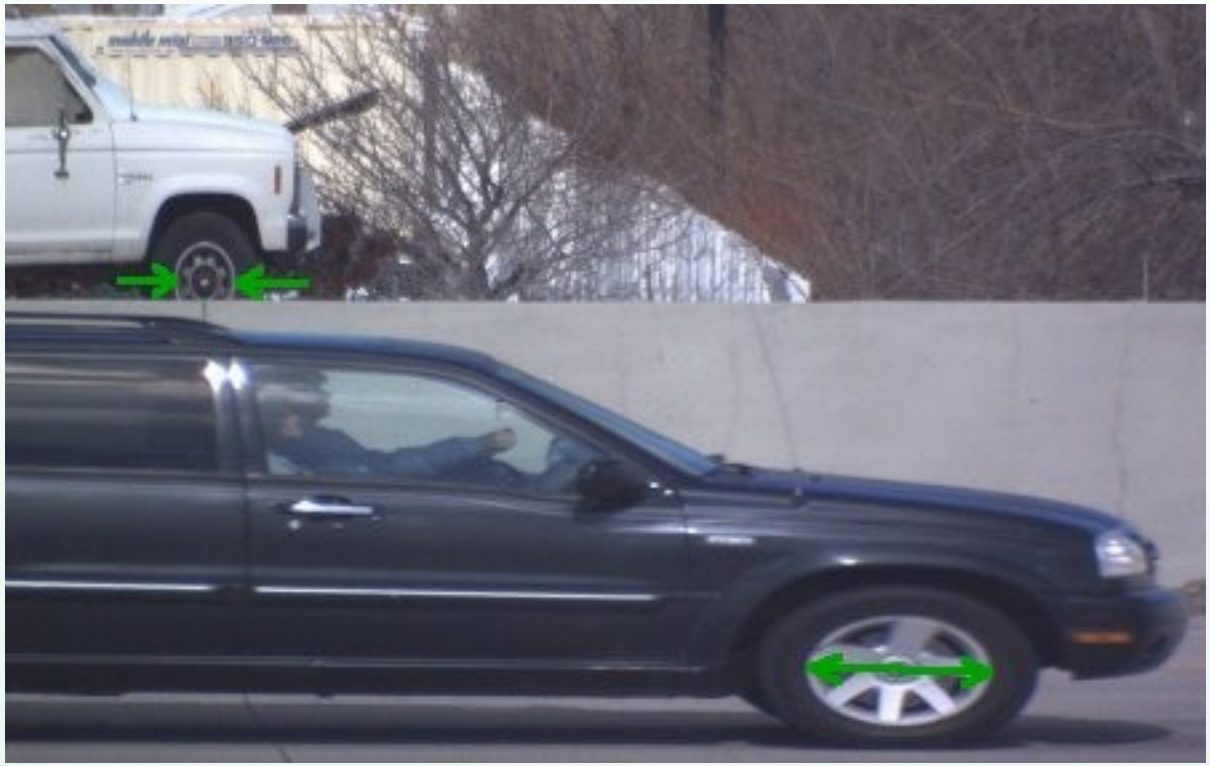


CMOS image sensor with the electronic rolling shutter (ERS)

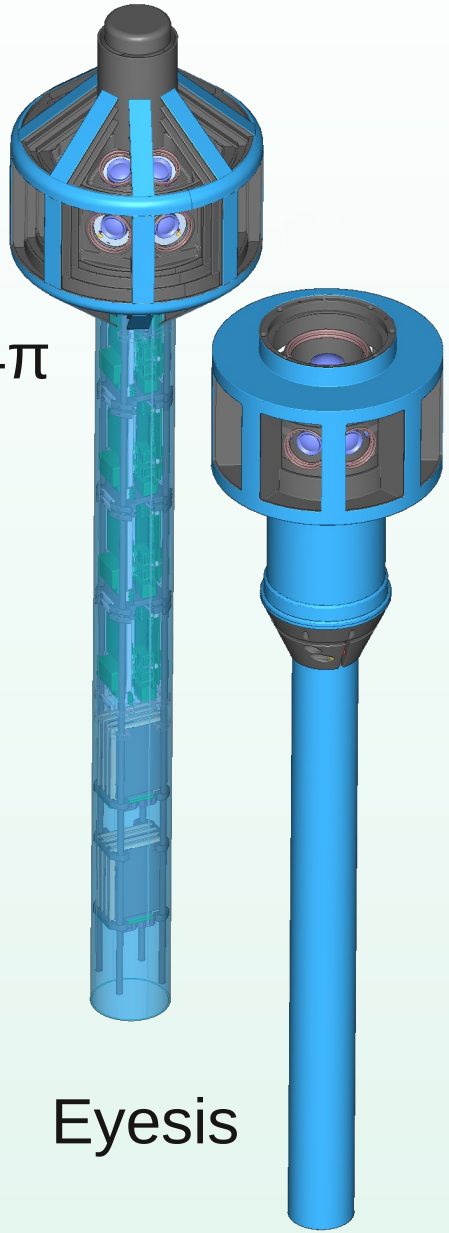


ERS distortions of the moving objects, horizontal sensor scan lines (landscape mode)

ERS distortions of the moving objects, vertical sensor scan lines (portrait mode)

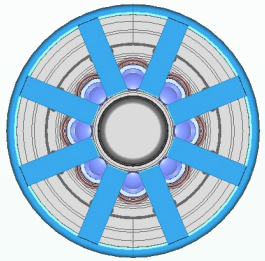


Eyesis panoramic cameras layout

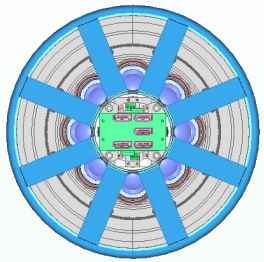


Eyesis4π

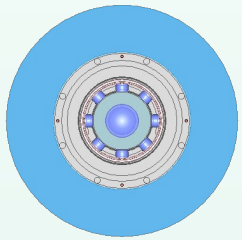
Eyesis



Eyesis4π
top view



Eyesis4π
bottom view

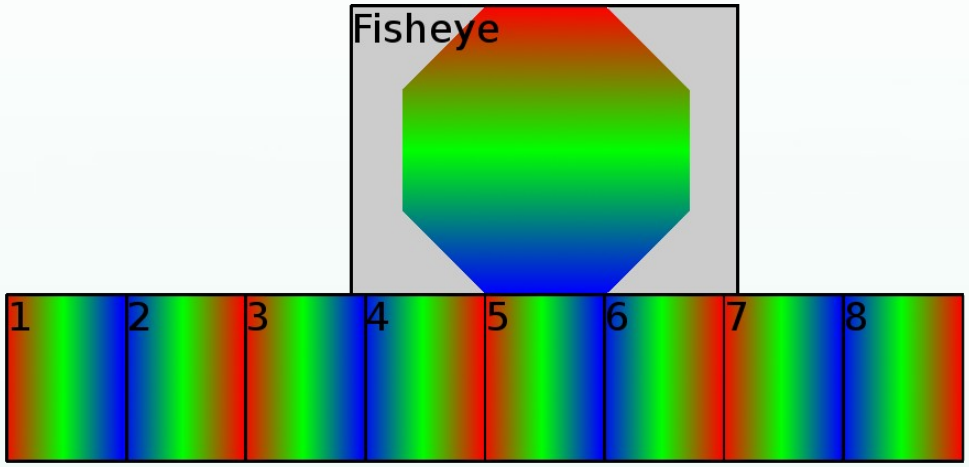


Eyesis
top view

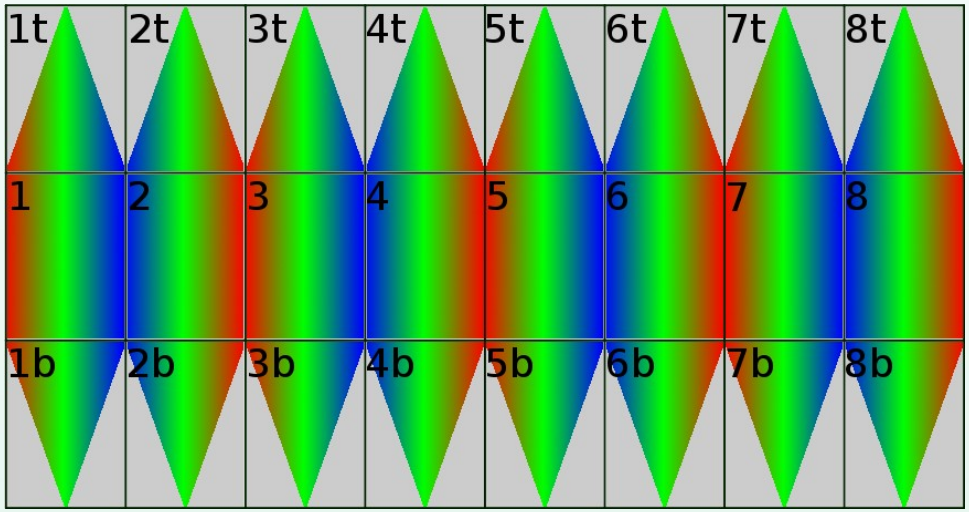
Eyesis
bottom view

Eyesis and Eyesis4π sensors readout sequences

Eyesis
8+1=9 sensors



Eyesis4π
3*8=24 sensors



Color indicates time of the pixels readout

Correction of “wobbling” caused by the ERS in the video

1 F. Liu, M. Gleicher1, H. Jin and A. Agarwala Content-Preserving Warps for 3D Video Stabilization. In *SIGGRAPH*, 2009 http://pages.cs.wisc.edu/~fliu/project/3dstab.htm

2 S. Baker, E. Bennett, S. Bing Kang, and R. Szeliski Removing Rolling Shutter Wobble. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition,* 2010 http://research.microsoft.com/apps/pubs/default.aspx?id=121490

Some fun with (non-corrected) ERS in the videos:
http://www.huffingtonpost.com/2011/07/14/iphone-guitar-rolling-shutter-video_n_898303.html