Club Photo
ORLÉANS
Photo Club

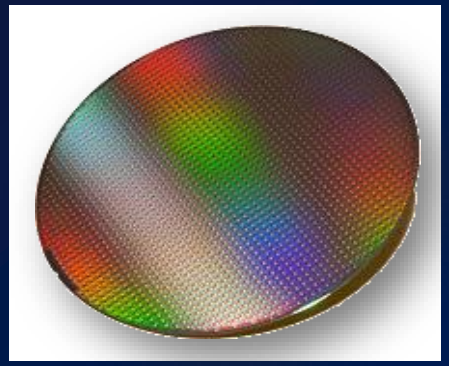
Your Camera Is Colour Blind

CPOPC Photography 101

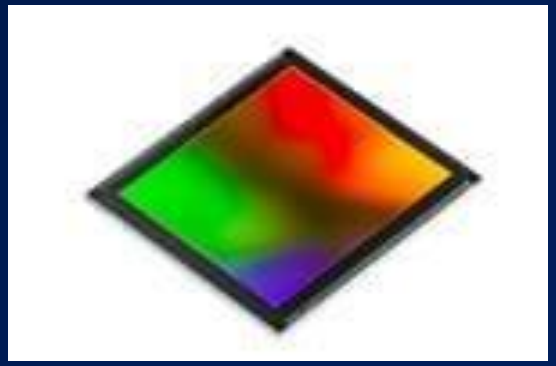
Darren Bessette – February 10, 2024

Image Sensor

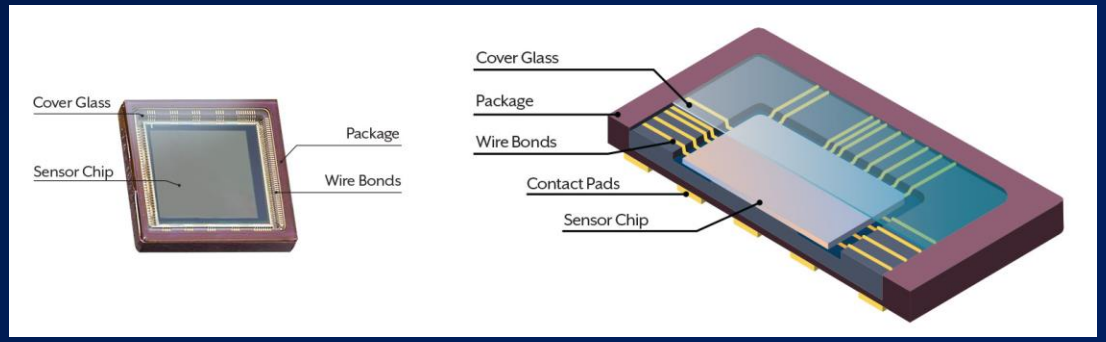
- Piece of silicon that is doped with other elements to create transistors, and other micro-components
- Purpose: Convert photons into electrons that can be measured
- Most common image sensors types: CMOS and CCD
- Bare die vs packaged



Silicon Wafer

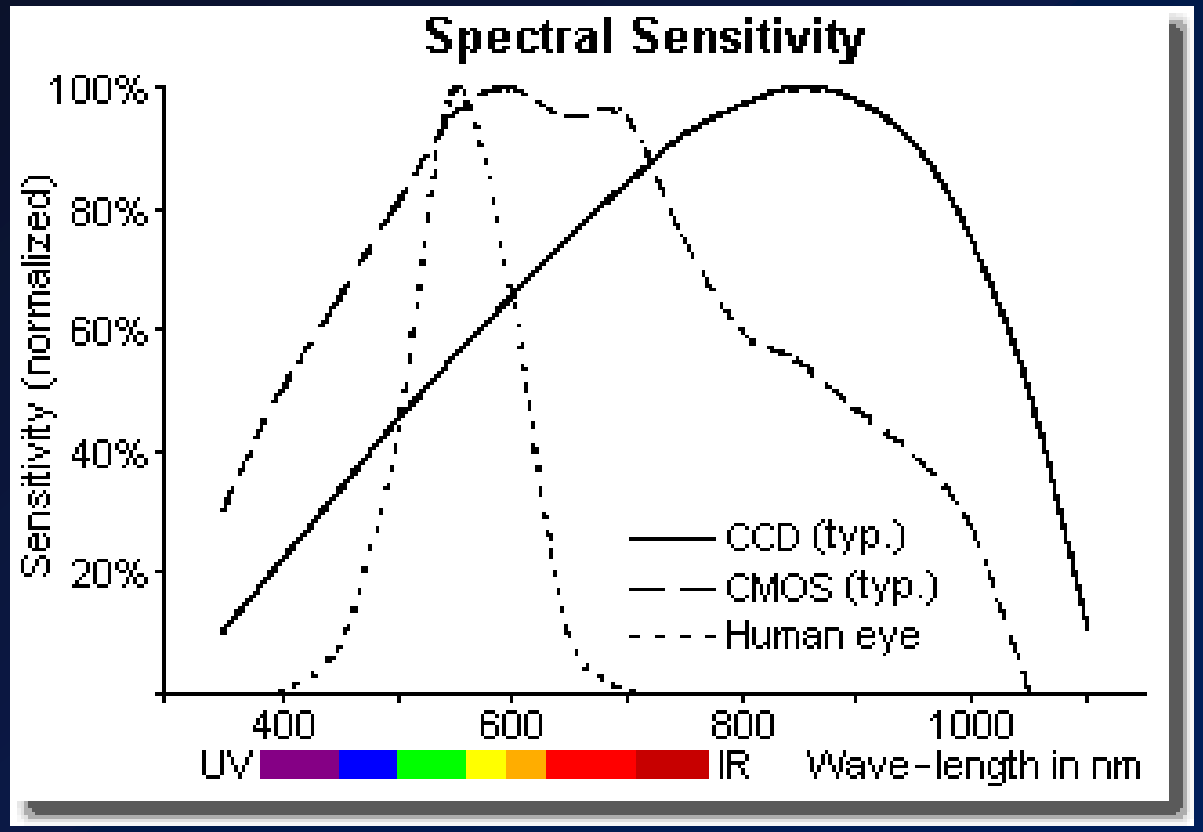


Bare Die Sensor

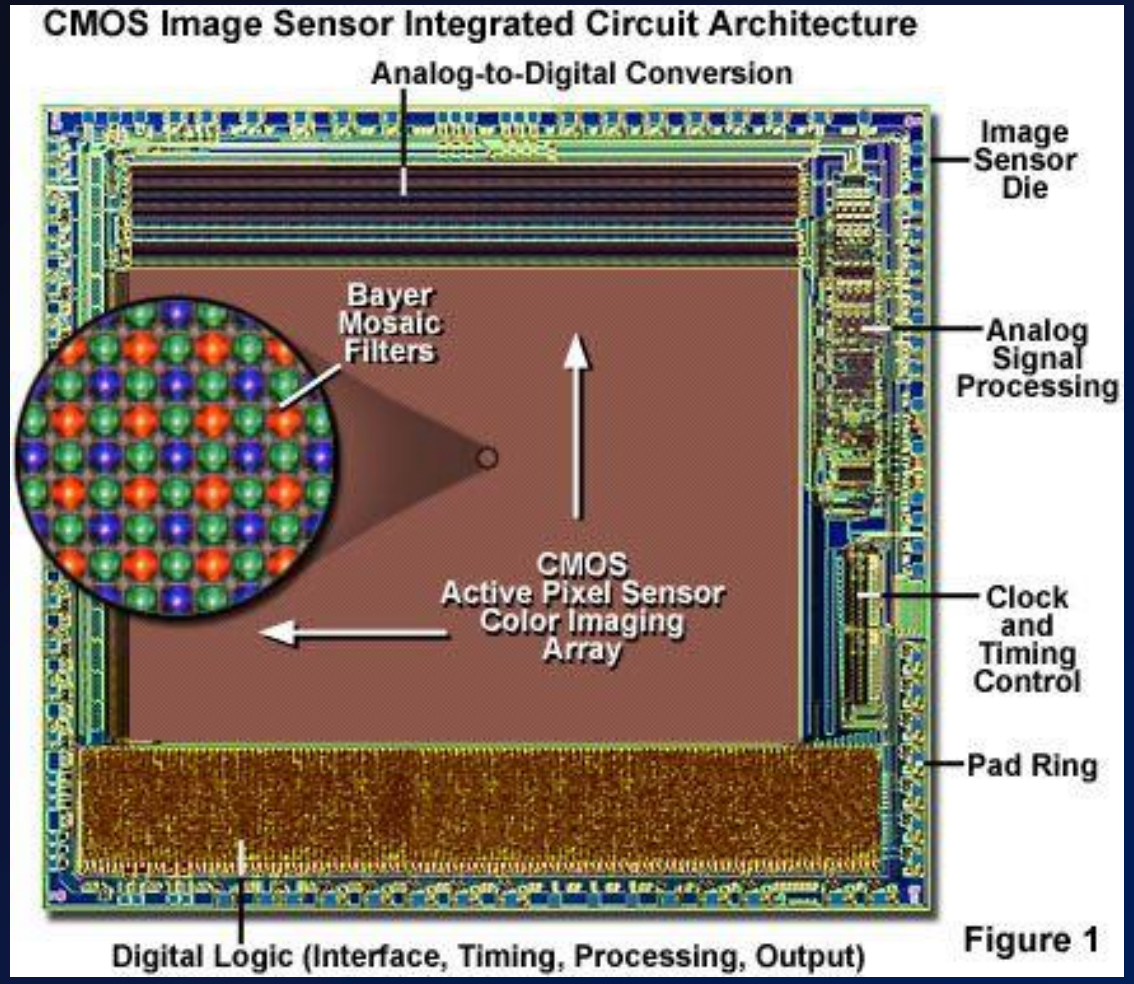


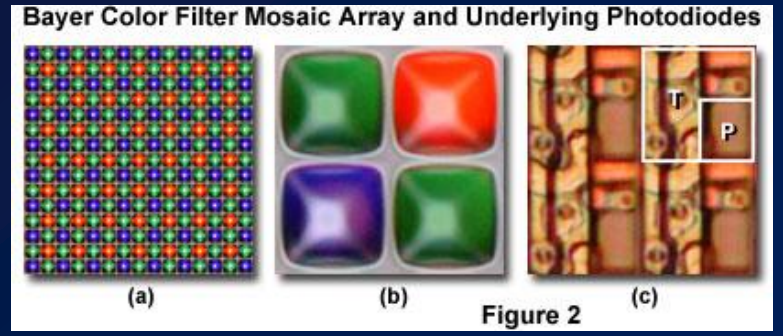
Packaged Sensor

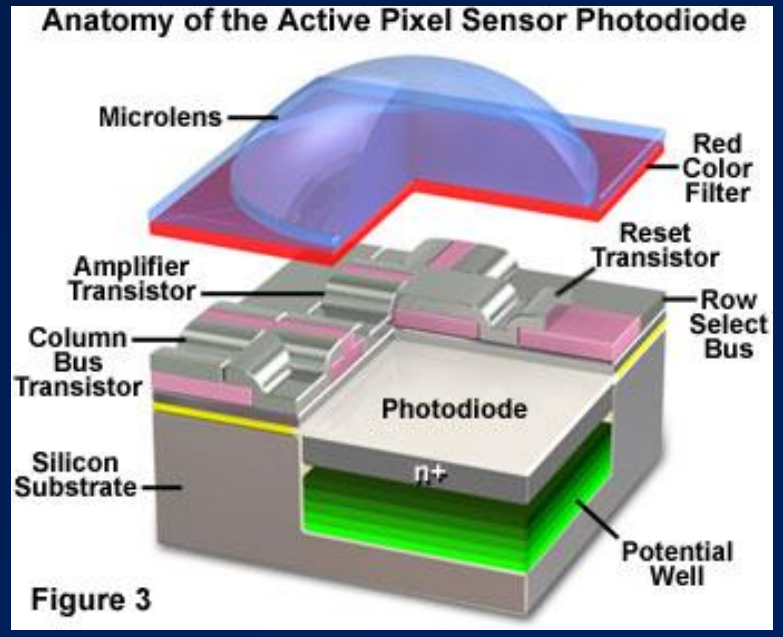
Spectral Response



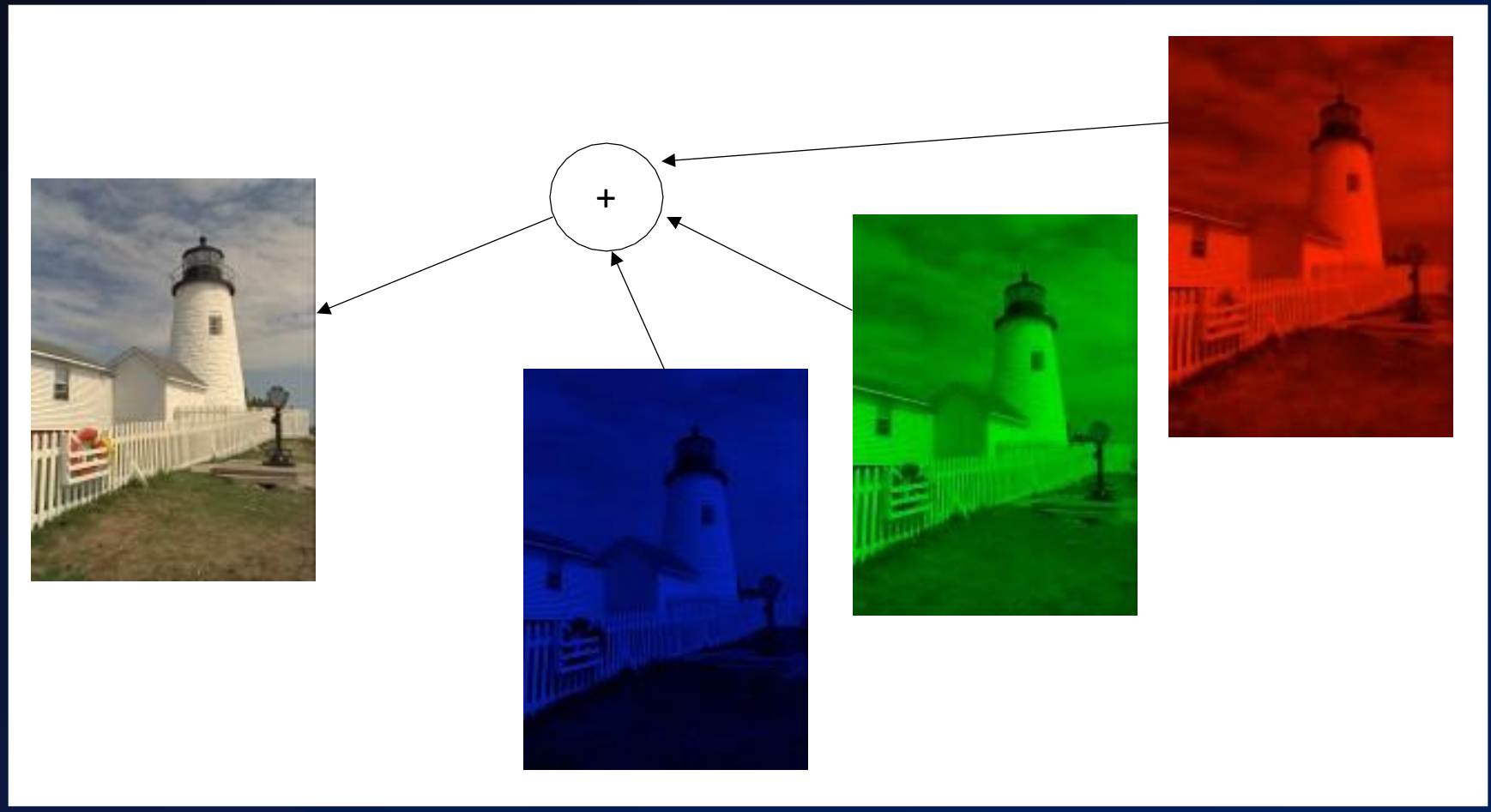
Sensor and Pixel Architectures





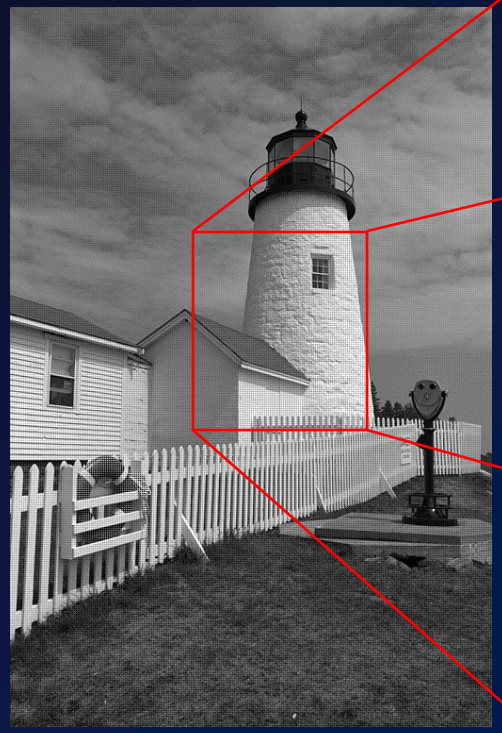


Colour Planes

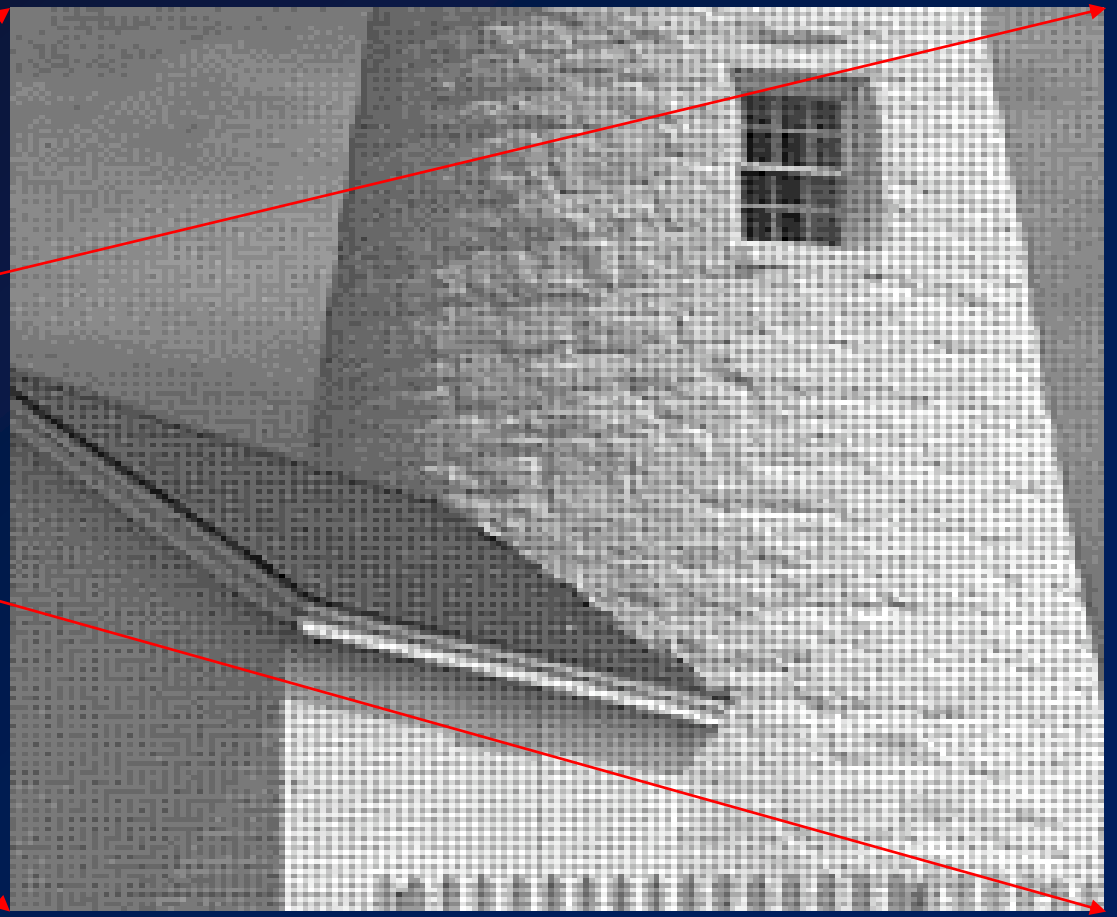


Raw Image

Full Colour Image



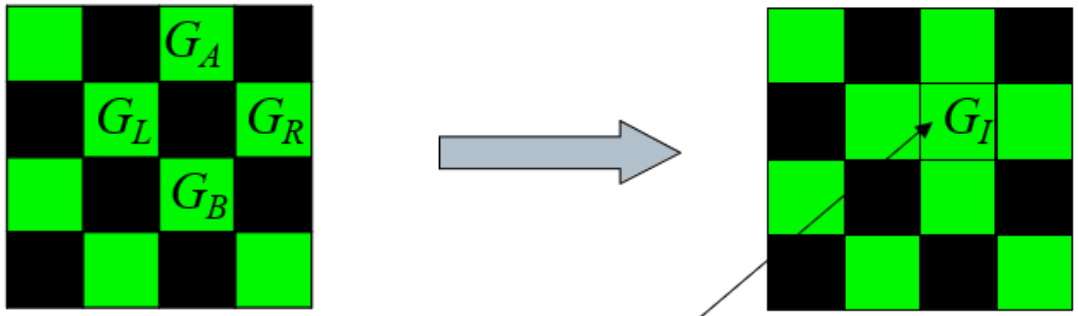
Raw Image



Raw Image Zoom

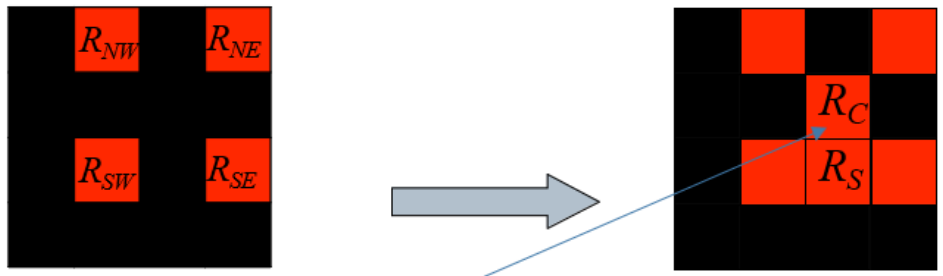
Demosaicing – Colour Interpolation

Green channel: bilinear interpolation



$$G_I = \frac{1}{4}(G_L + G_R + G_B + G_A)$$

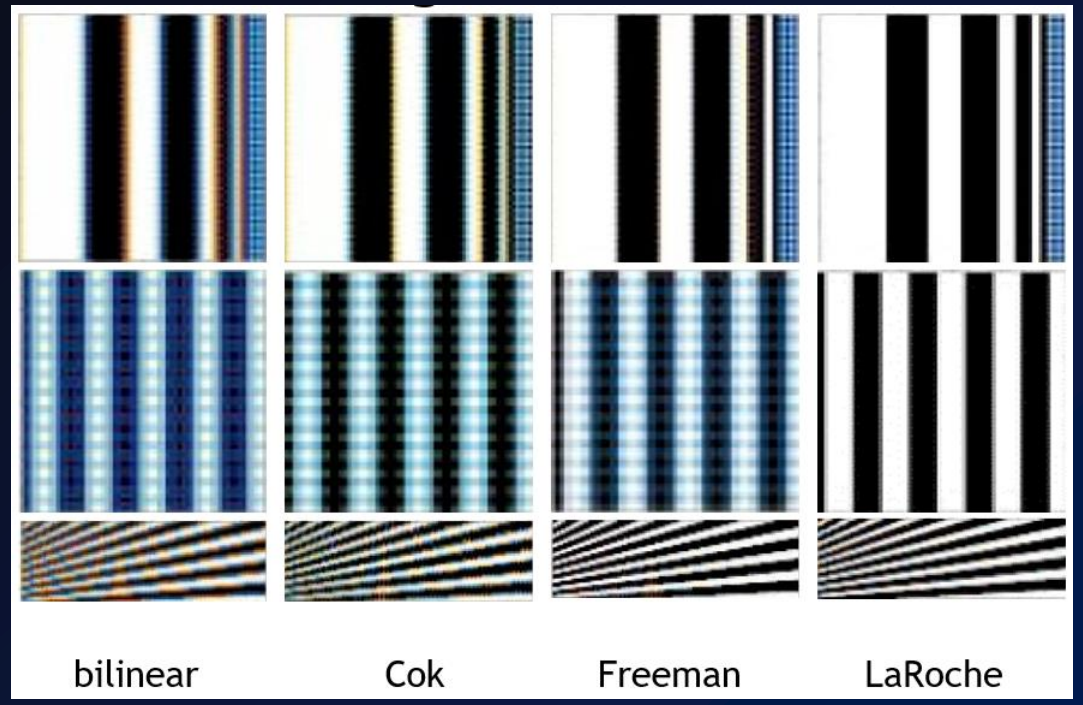
Red channel: bilinear interpolation

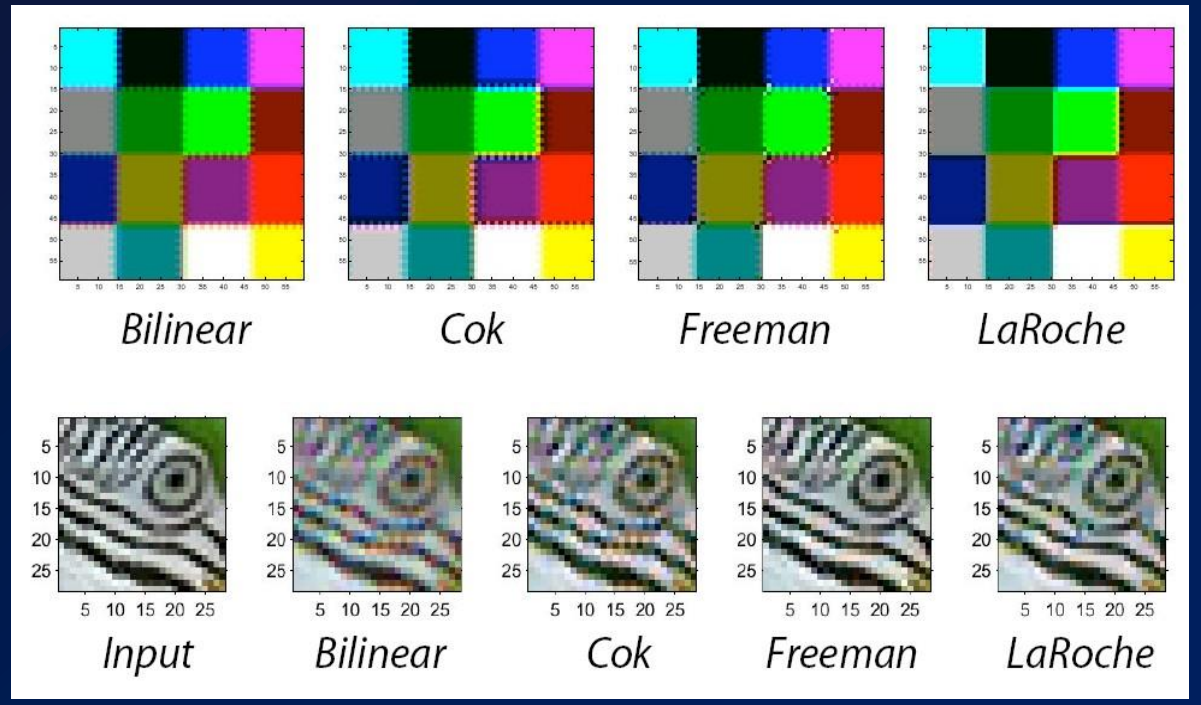


$$R_C = \frac{1}{4}(R_{NW} + R_{NE} + R_{SW} + R_{SE})$$

$$R_S = \frac{1}{2}(R_{SW} + R_{SE})$$

Demosaicing - Issues





Reproducing Colour Under Different Lighting

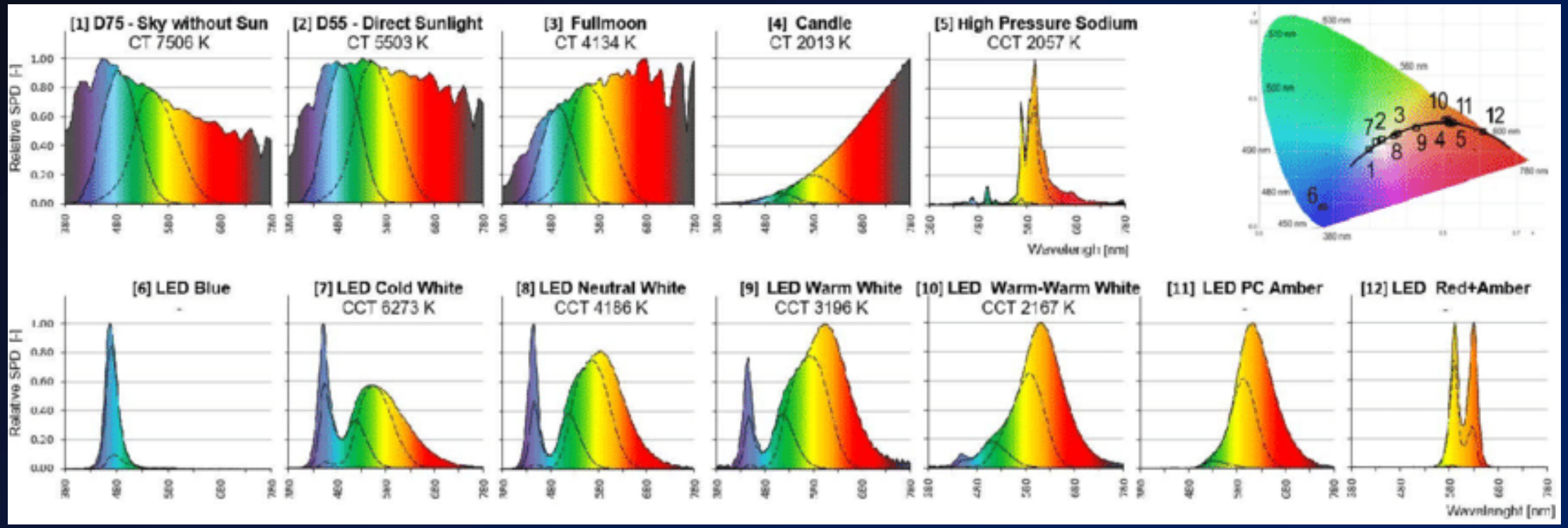
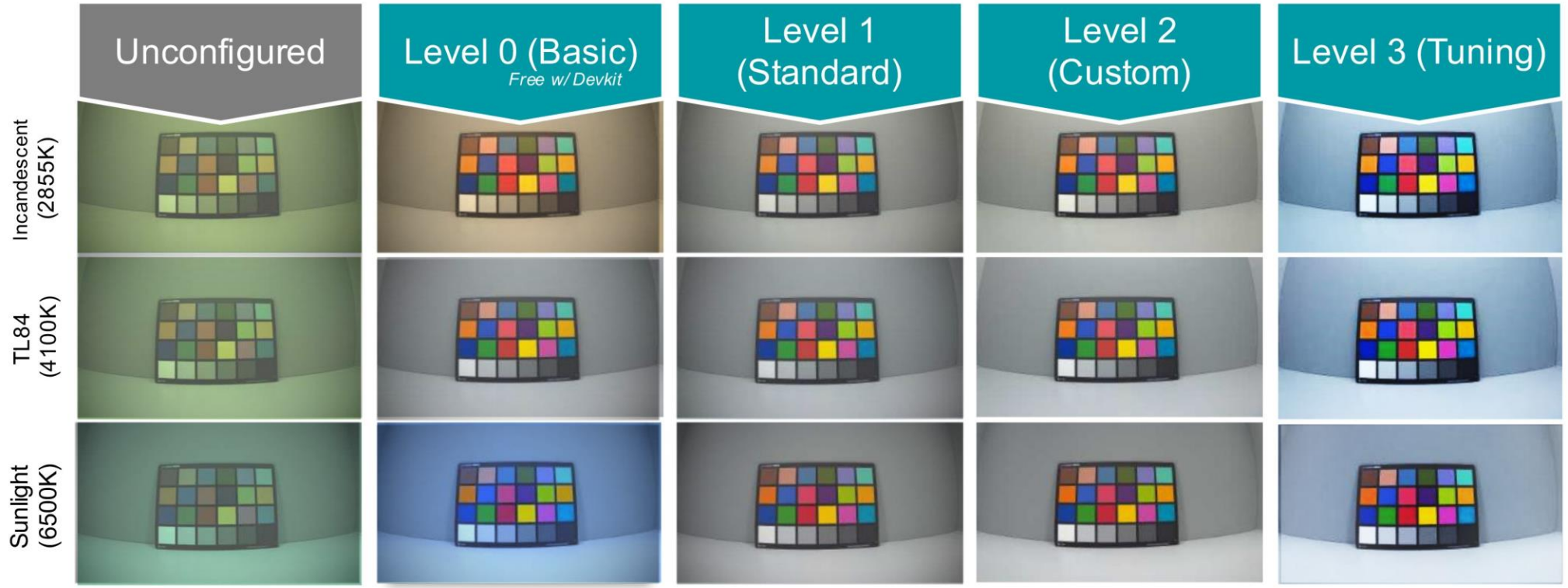


Image Tuning



Summary

- Cameras/sensors do not see colour
  - Need to filter light that hits each pixel to get colour info
- Colour information is interpolated for missing pixels using neighbour pixels
  - Can cause colour artifacts in final images
- Not all light sources provides full visible light spectrum
  - Need to tune and balance image output to align with how humans see targets

Possible Lights to Bytes Workshop

- In depth view of how cameras/image sensors convert photons to digital images on a screen
- Image sensor architectures, functions, features
- Light/energy spectrums definitions and how to “see” them
- Demosaicing, Colour Correction Matrices, and Image Tuning
- Camera design, components and features