大话成像之

数字成像系统 32讲

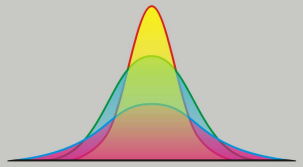
- CMOS sensor 基础

Maver Jiang

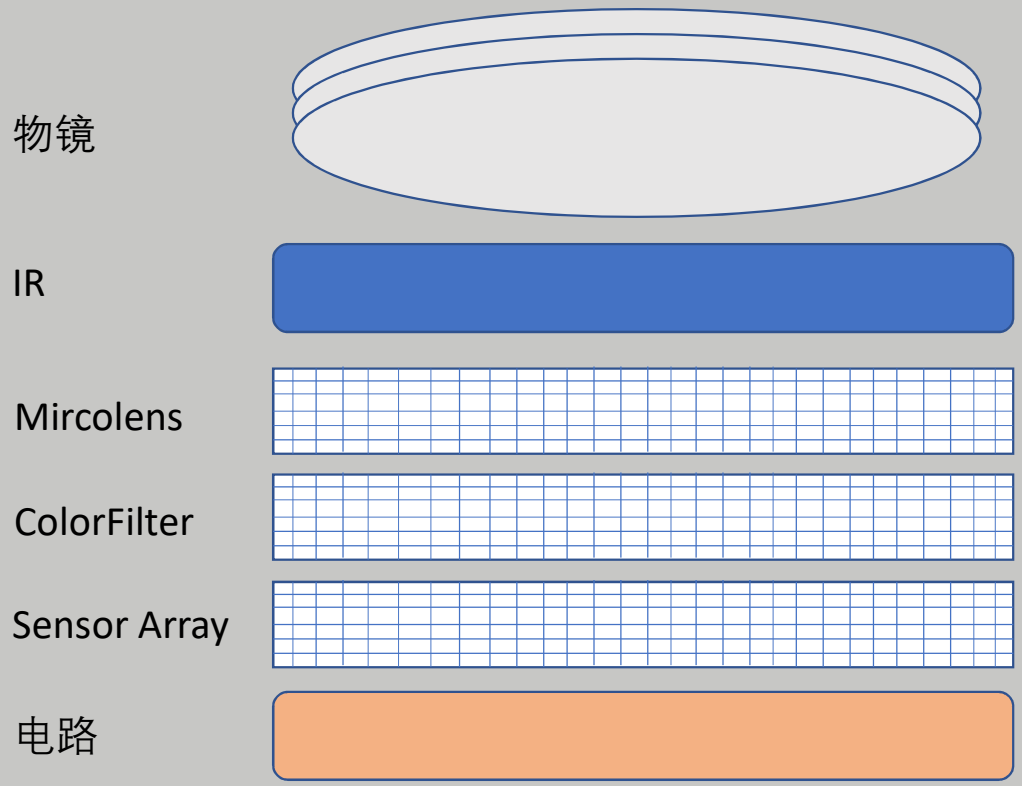
imaging algorithm specialist

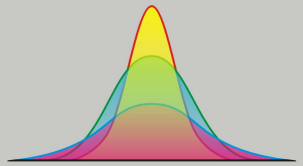
staff image quality engineer

maver.jiang@gmail.com

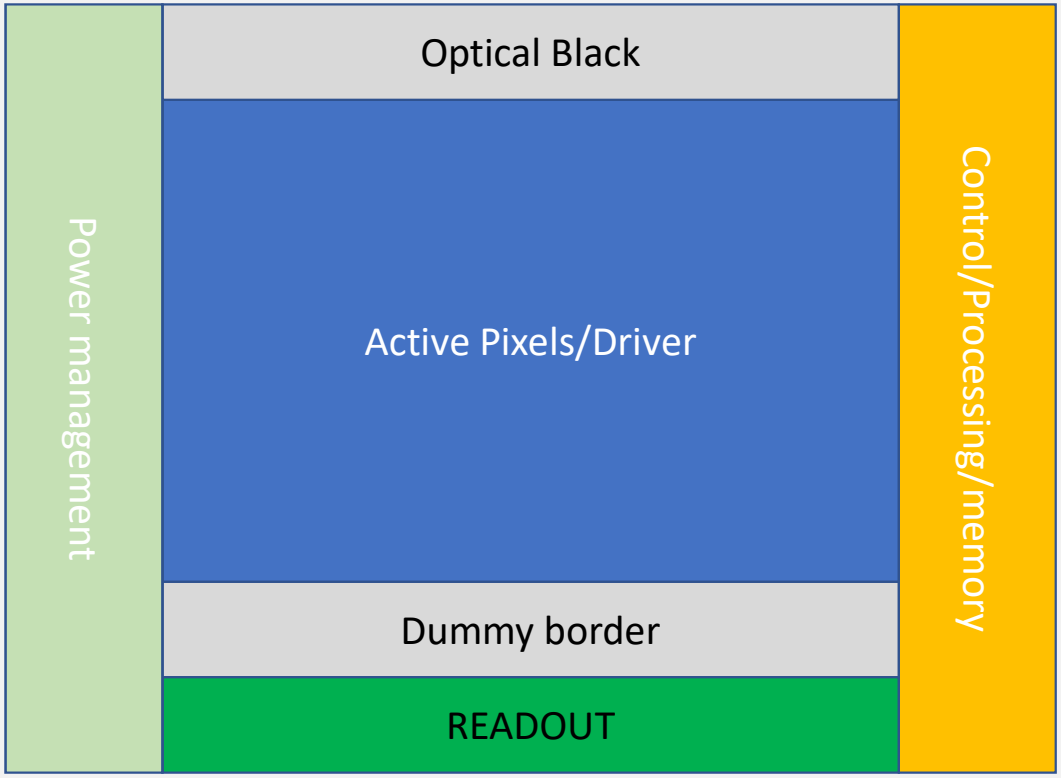


Cmos sensor stack

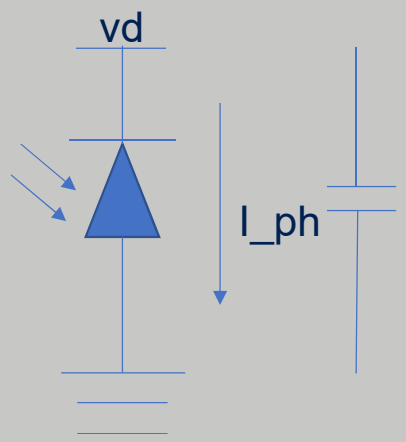


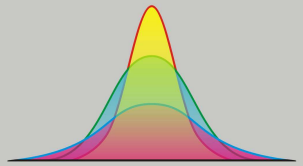


sensor floorplan

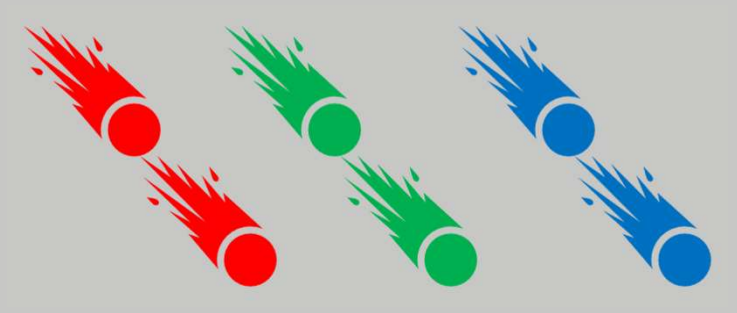


PCB



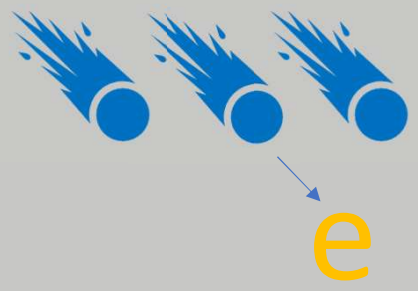


光子（Photon）与量子效率quantum efficiency

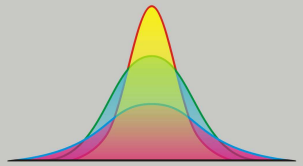


4.41E-19焦耳

Color filter

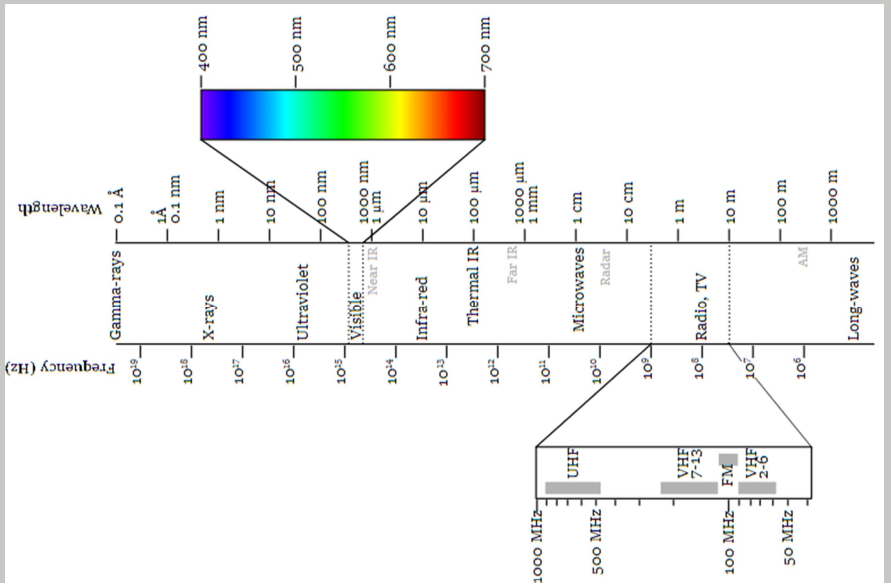


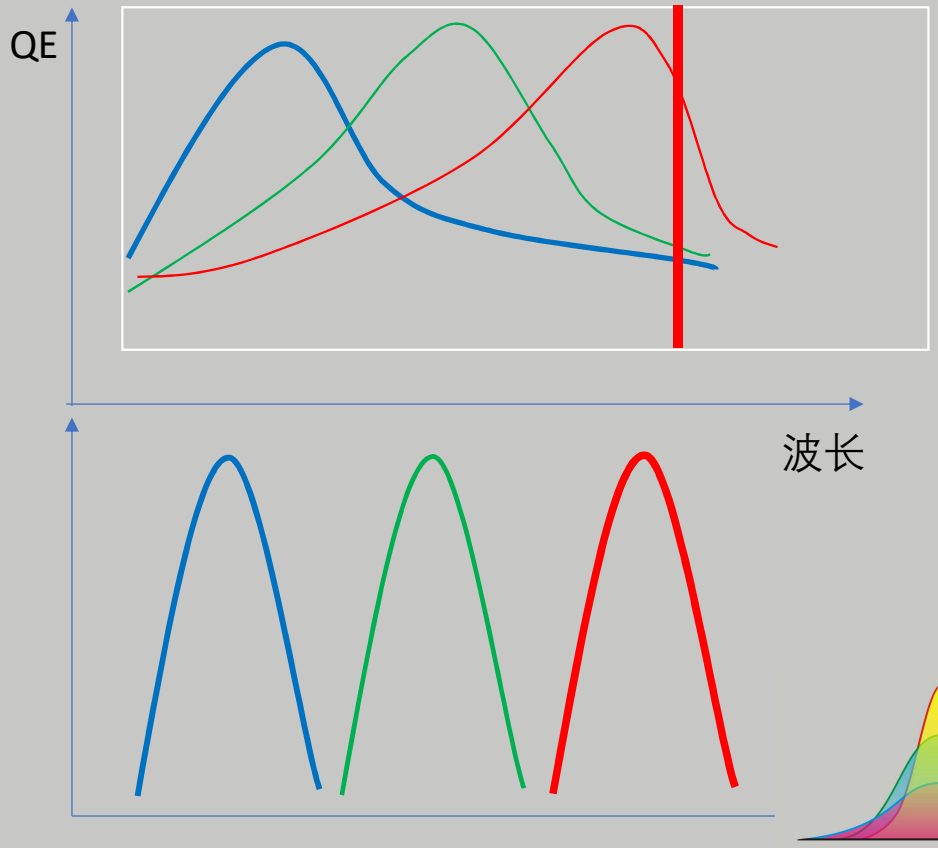
E=hc/ λ
Total_Power = sum_of (all photons)
QE = 1/3 in this case



与量子效率QE有关的几个重要概念

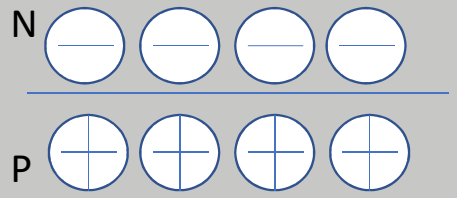
- QE是衡量某个颜色通道某个频率/波长的光子转换成电子的效率
- IR cutter----cut near IR
- Crosstalk
- Sensitivity 感光度=QE X Pixel_Size

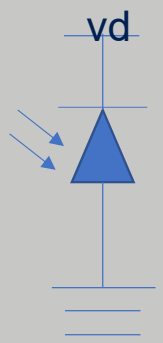




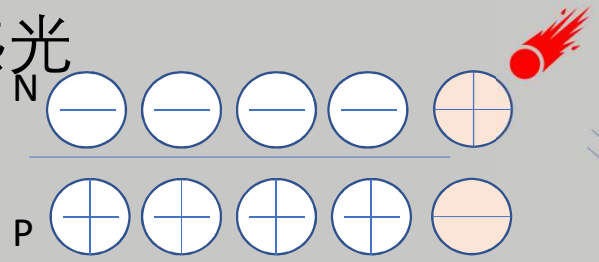
感光过程

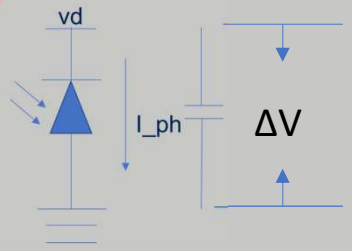
- 充电----reset



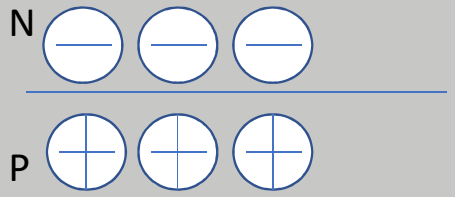


- 感光





- 放电



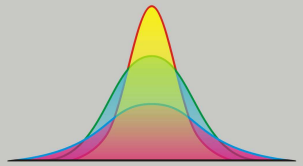
Δ Q = Ne x e x QE

Q = V x C

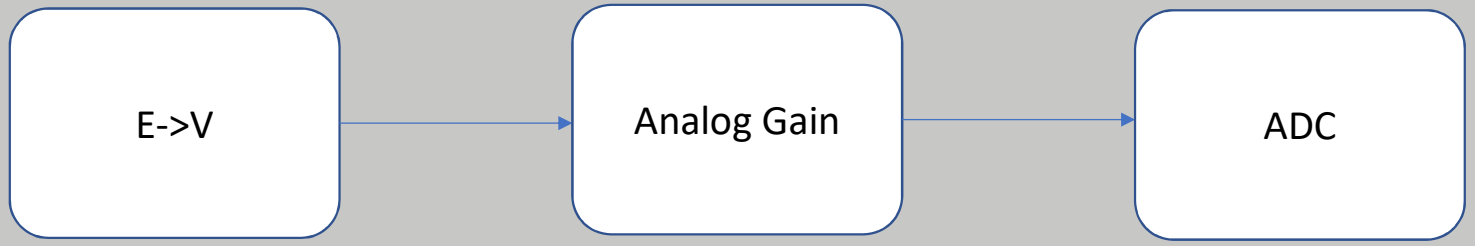
ΔV = ΔQ/C

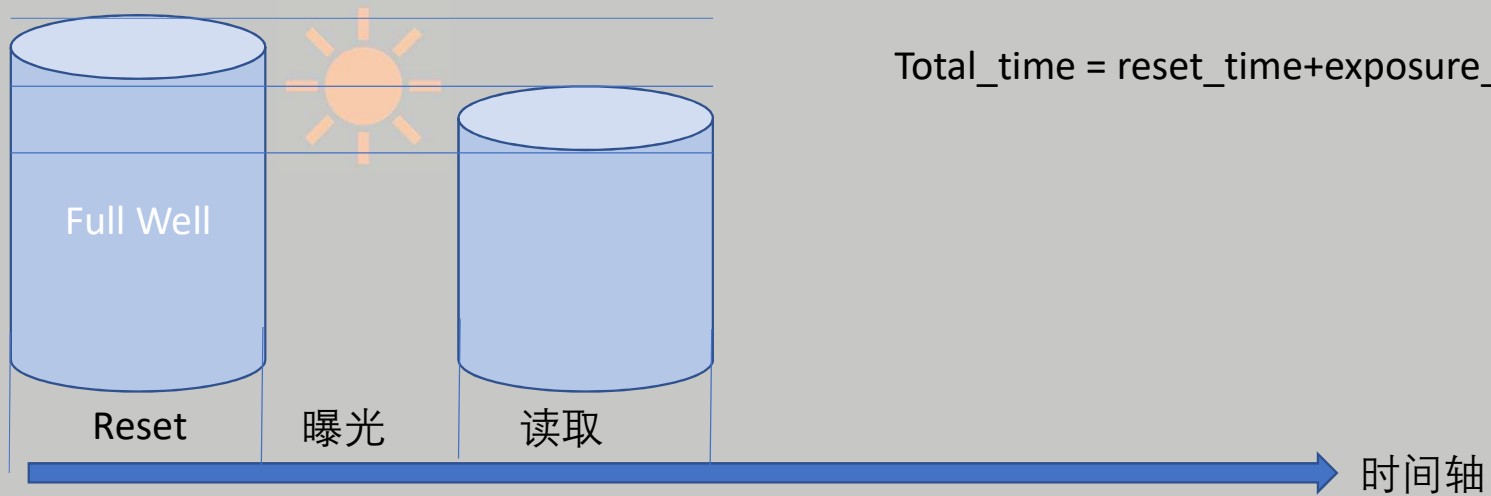
e

V

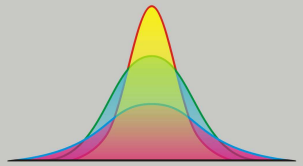


读取过程

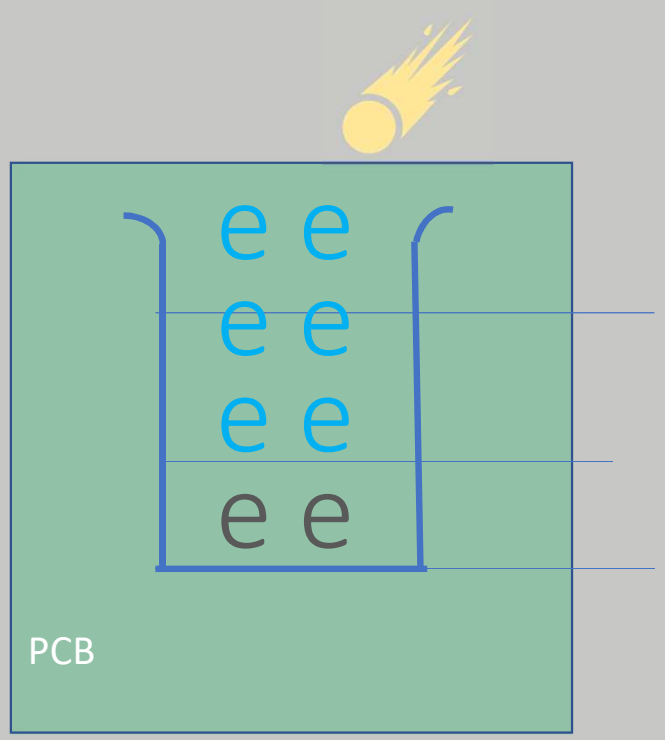




Total_time = reset_time+exposure_time+readout_time

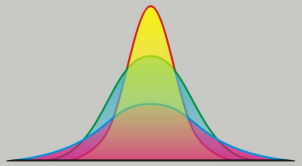


Sensor动态范围



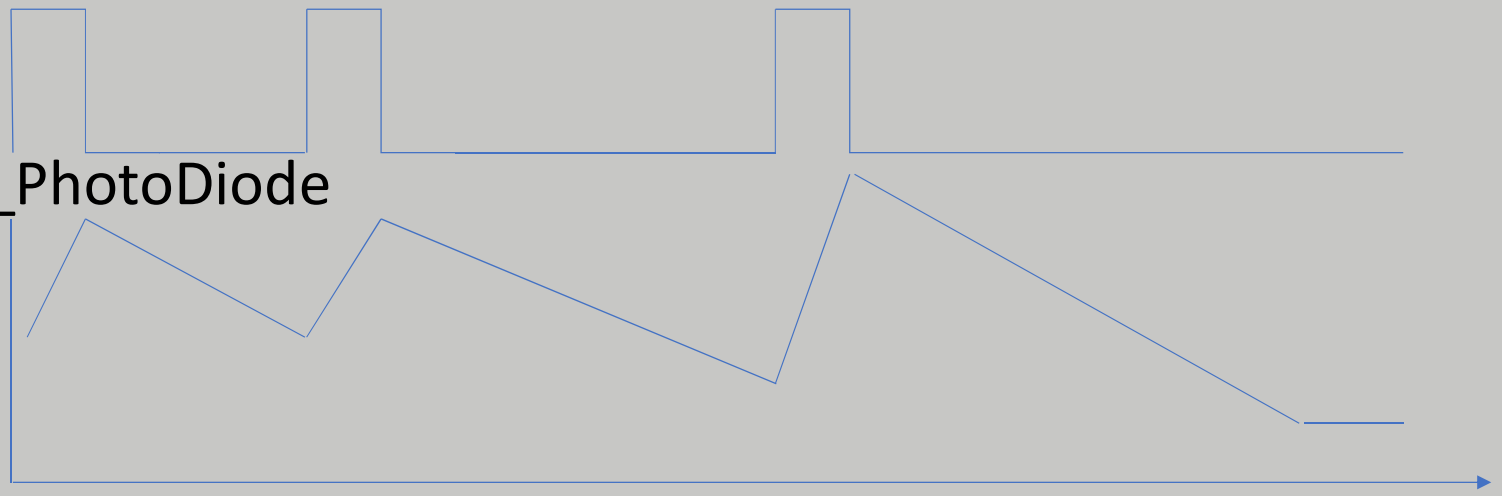
1：Full well Capacity
2：Dark Current
3：Fill Factor

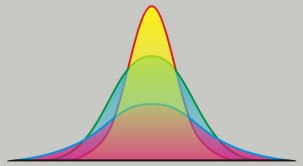
Dynamic Range = Saturation / Noise floor → 简化算法 Dynamic Range = Saturation/ black level



Sensor 时序

- Reset
- V_PhotoDiode





Noise in Sensor

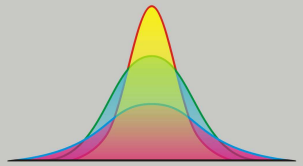
- 时域噪声与空域噪声

时域噪声----

KTC Noise(readout),PhotonShotNoise,DarkCurrentNoise,PowerNoise

- 空域噪声

空域噪声----DefectPixel,Row/ColumnNoise,PRNU,DSNU



Crosstalk 对 noise的影响

$$\begin{bmatrix} R' \\ G' \\ B' \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

R‘ =a11×R + a12xG+a13xB

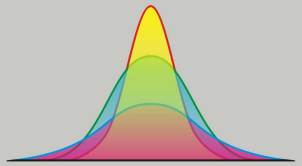
加模型的噪声计算：

ADD（N1,N2) =(N1^2+N2^2) ^0.5

N‘ =(a11×R)^2 + (a12xG)^2+(a13xB)^2

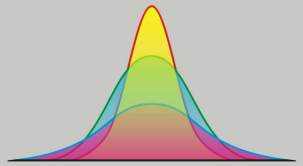
负的系数越大SNR越低

http://www.ericfossum.com/Publications/Papers/2015%20JOSAA%20Color%20Filters.pdf



THANKS

本课程由 Maver Jiang提供



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