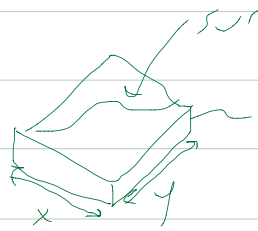
Office hour 3:00 – 5:00 PM

final paper 20 – 30 pages inc. figures.

DL2510 — Tutorial to help with assignment

High Dynamic Range (HDR) Imaging

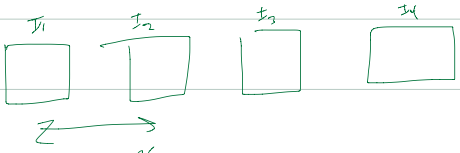


value (0 ... 255)

8 pts

12 pts

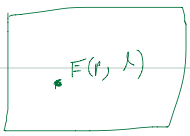
Welding



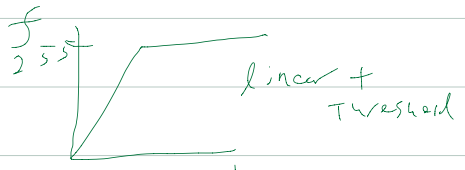
3 stops

$2^3 = 8$

CCD / CMOS

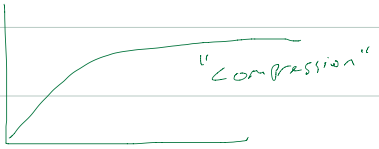


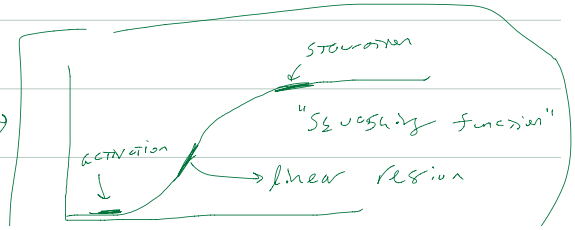
E = irradiance (W/m^2)

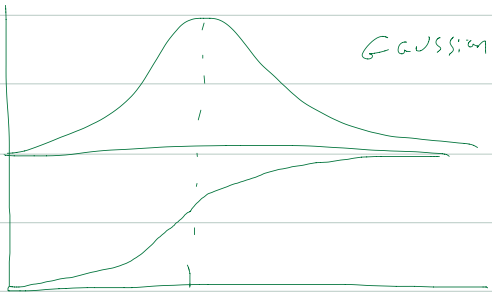


$$I(p) = f\left[\int_0^{\Delta T} E(P,T)\,dT\right]$$

↳ unknown fn

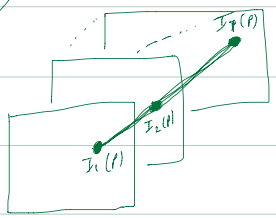


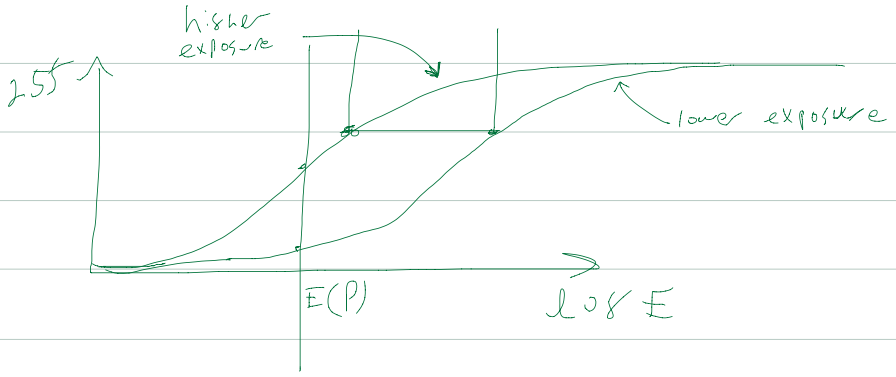




$I_1(p) = f(E(p)\Delta T_1)$ — Exposure

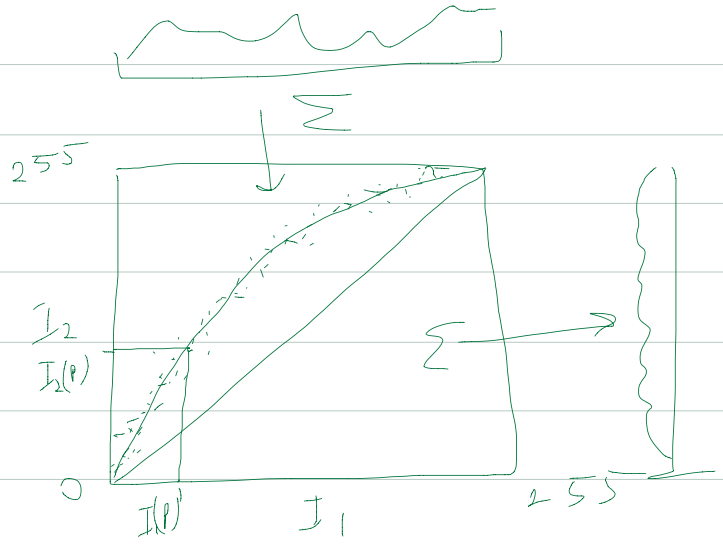
$I_2(p) = f(E(p)\Delta T_2)$





$\Delta T_2 > \Delta T_1$

$I_2(p) > I_1(p)$



Method (Debevec)

$$I_{ij} = f(E_i \Delta t_j)$$

E_i → pixel i

Δt_j → exposure j

$j = 1 \dots P$ # pictures

$i = 1 \dots N$ # pixels

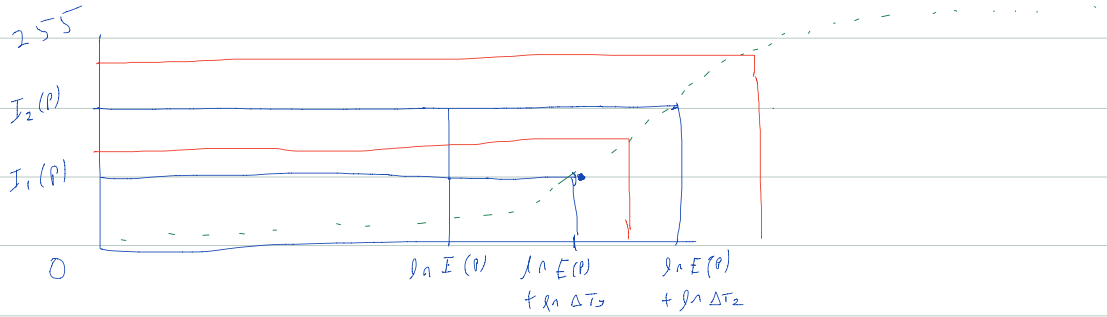
Let $g() = \ln f^{-1}()$ apply g to both sides

$$g(I_{ij}) = g(f(E_i \Delta t_j))$$

$$\boxed{g(I_{ij}) = \ln(E_i) + \ln \Delta t_j}$$

$g(I_{ij}) = \ln(E_i) + \ln \Delta t_j$ (inverse mapping of pixel to actual Brightness.)

$g(I_j(p)) = \ln E(p) + \ln \Delta t_i$



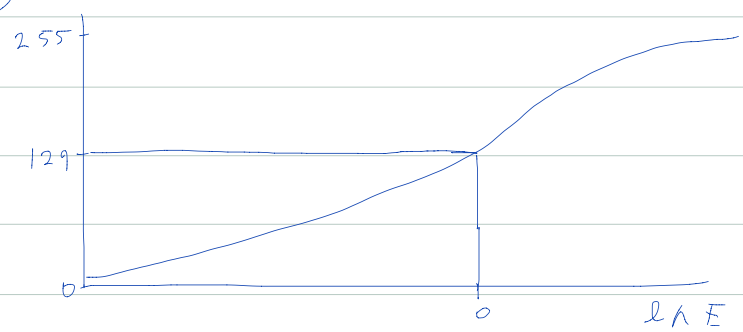
$$g(I_1(p)) = \ln(E(p)) + \ln(\Delta t_1)$$

$$g(I_2(p)) = \ln(E(p)) + \ln(\Delta t_2)$$

$$g(I_1(p)) - g(I_2(p)) = \ln(\Delta t_1) - \ln(\Delta t_2)$$

$$= \ln\left(\frac{\Delta t_1}{\Delta t_2}\right) \quad \text{K}$$

Let $g(129) = 0$



LSQ formulation

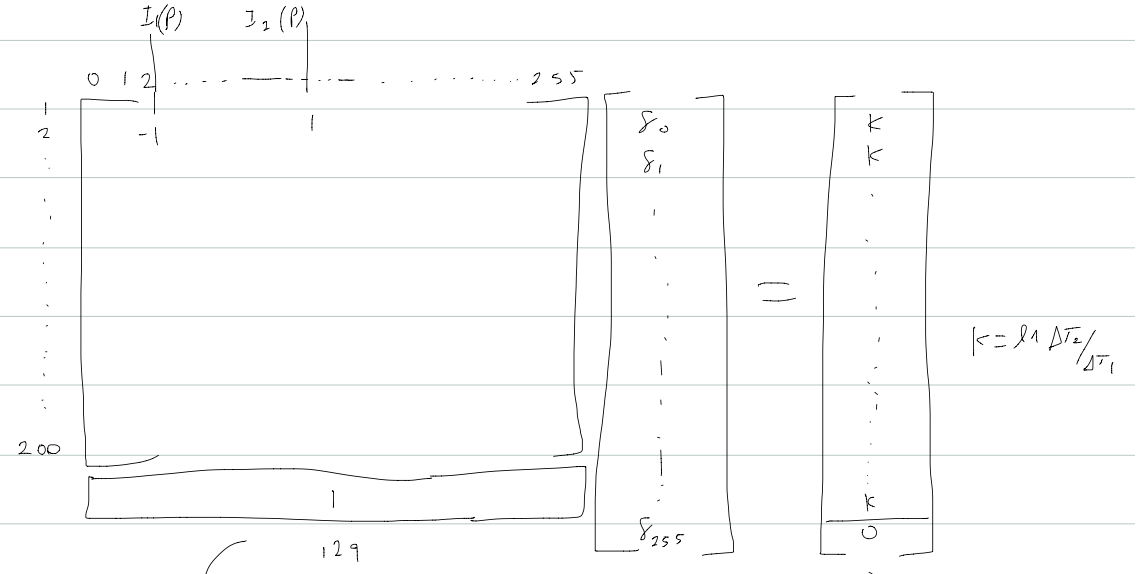
$$0 = \sum_{p=1}^{P} \sum_{j=1}^{N} \left[g(I_j(p)) - \ln E(p) - \ln \Delta t_j \right]^2$$

P: pixels (200 points) — 2 frames — N: frames

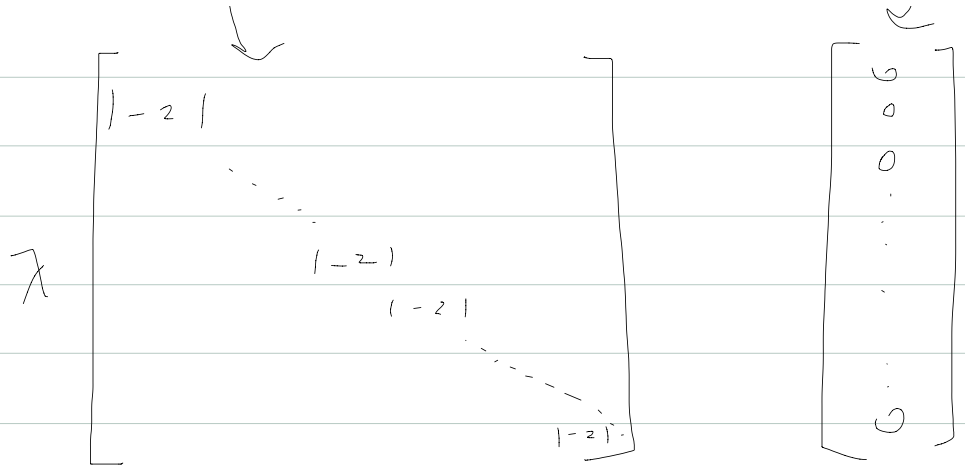
$g()$ Takes pixels to $\ln E(p)$

$$g(I_j(p)) \simeq \ln E(p) + \ln(\Delta t_j) + \underbrace{n}_{\text{noise}}$$

Gaussian error in $\ln E(p)$



for every pixel $g(I_2(p)) - g(I_1(p)) = k$ $\quad g(129) = 0$


1 -2 1
1 -2 1
1 -2 1
1 -2 1
0
0
0