CV HW #2

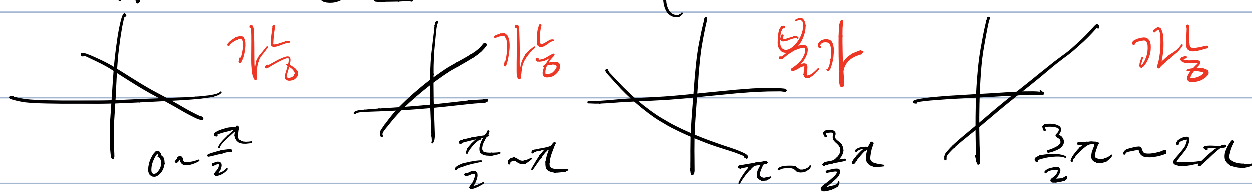
기계항공공학부
2015-15284 문주혁

1. Hough Transform Line Parameterization

1. $\rho = x\cos\theta + y\sin\theta = \sqrt{x^2+y^2}\,\sin(\theta+\phi)$

where $\cos\phi = y/\sqrt{x^2+y^2}$
$\sin\phi = x/\sqrt{x^2+y^2}$

2. $|\rho| \leq \sqrt{W^2+H^2}$ $\quad 0 \leq \theta \leq 2\pi$ (사실 $\pi \leq \theta \leq \frac{3}{2}\pi$는 안됨



2. Lambertian Reflectance Properties

1. $\int_{\text{hemisphere}} \frac{\rho}{\pi}\cos\theta_r\, d\omega_r \leq 1$ $\quad$ ($\because$ conservation of energy)

$$LHS = \int_0^{\frac{\pi}{2}}\int_0^{2\pi} \frac{\rho}{\pi}\cdot \cos\theta_r \underbrace{\sin\theta_r\, d\phi_r\, d\theta_r}_{d\omega_r} = \rho$$

$\therefore \rho \leq 1$

2. $Ef = L\dfrac{d^2\phi_r}{(dA\cos\theta_r)\,d\omega_r} \Rightarrow Ef\cos\theta_r = \dfrac{d^2\phi_r}{dA\, d\omega_r}$

it should be uniform

$\Rightarrow f = \dfrac{k}{\cos\theta_r}$ $\quad (k = \text{const})$

Conservation of E

$$\int_{\text{hemisphere}} \frac{k}{\cos\theta_r} \cdot \cos\theta_r \cdot d\omega_r = \int_0^{\frac{\pi}{2}} \int_0^{2\pi} k \sin\theta_r \, d\phi_r \, d\theta_r$$

$$= 2\pi k = \rho$$

$$\therefore k = \frac{\rho}{2\pi} \qquad f = \frac{\rho}{2\pi\cos\theta_r}$$

$$R = \frac{\cos\theta_i \text{ (surface normal과 incident direction)}}{\cos\theta_r \text{ (surface normal과 view direction)}}$$

$$\cos\theta_r = 1/\sqrt{1+p^2+q^2} \qquad \cos\theta_i = \frac{1+p_s p + q_s q}{\sqrt{1+p^2+q^2}\sqrt{1+p_s^2+q_s^2}}$$

$$R(p,q) = \frac{1+p_s p + q_s q}{\sqrt{1+p_s^2+q_s^2}}$$

3. Camera Calibration

V의 column 들이 R^n의 orthonormal basis

$\Rightarrow p = a_1 v_1 + \cdots + a_n v_n$

where $a_1^2 + \cdots + a_n^2 = 1$, $v_1, v_2, \ldots, v_n$ are column of V.

$$Ap = a_1\sigma_1 v_1 + \cdots + a_n \sigma_n v_n$$

$$\|Ap\|^2 = a_1^2\sigma_1^2 + \cdots + a_n^2\sigma_n^2$$

$$\geq a_1^2\sigma_n^2 + \cdots + a_n^2\sigma_n^2 = \sigma_n^2$$

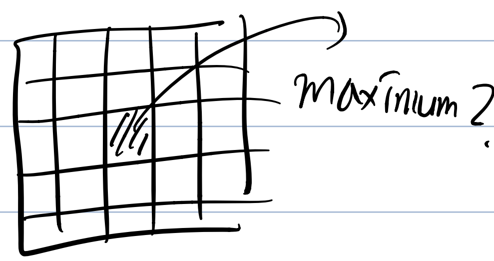
등호는 $a_1 = \cdots = a_{n-1} = 0$, $a_n = 1$ 일 때,

즉 $p = v_n$ 일 때 성립

4. Hough Transform for Line Detection

2. non maximum suppression은
nonMaximumSuppression 함수에 구현되어 있다.
Im, Io를 input으로 넣으면
Im의 픽셀값을 Io 방향 양쪽의 픽셀 값과
비교하여 (외삽을 통해) 둘 중 하나라도
해당 픽셀값보다 크다면 해당 픽셀값을 0으로
바꾼다.
사용되는 곳은
Im = nonMaximumSuppression (Im, Io)
Im을 Hough Transform에 input으로 주기 전에
Edge Detection에서 나온 Im, Io 값을 통해
NMS 실행함.

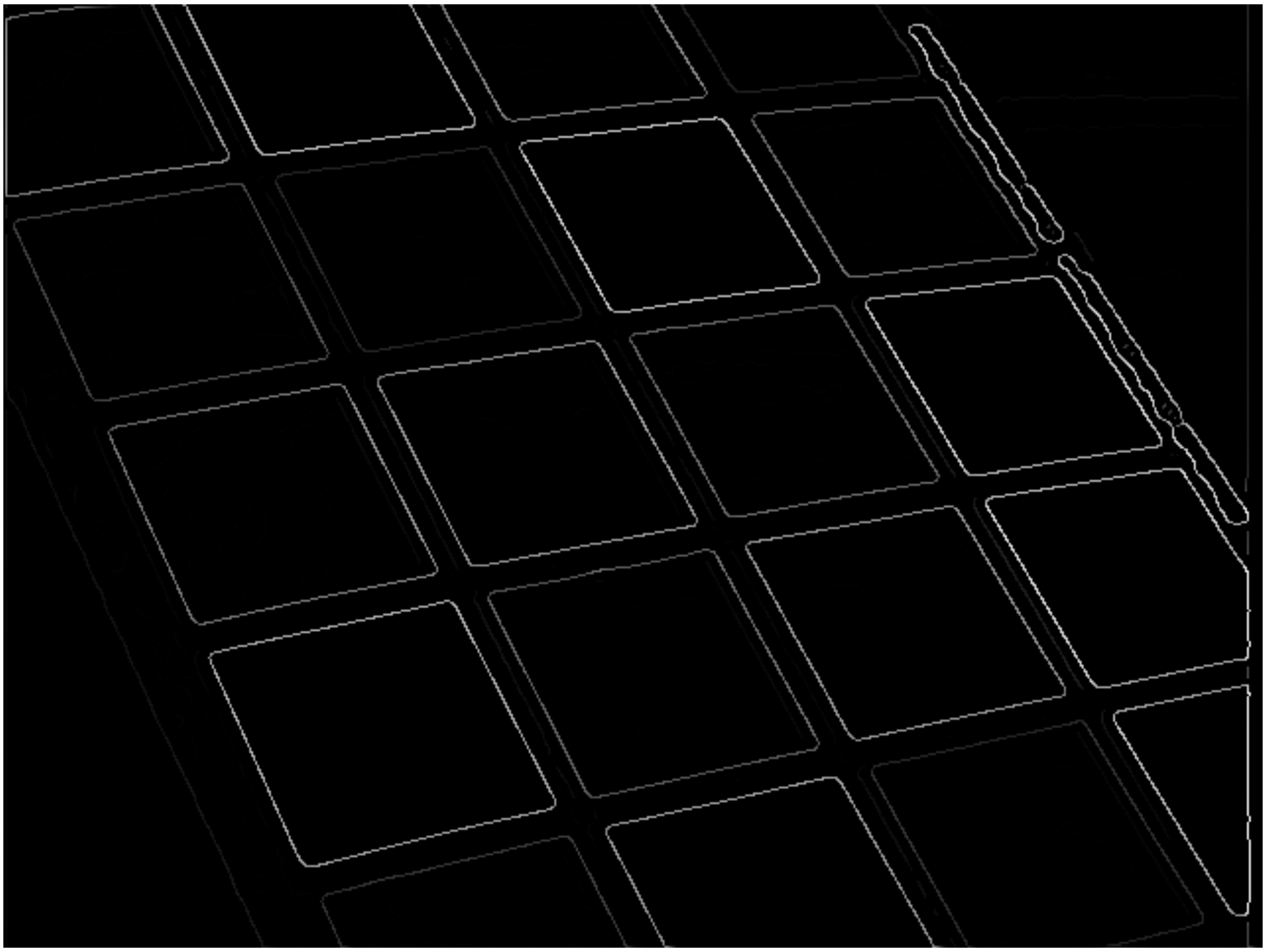
3. sigma = 2
threshold = 0.1
rhoRes = 2
thetaRes = π/180
nLines = 20



4. H에서의 픽셀의 값이 상하좌우 2개보다 큰지
판별, 그렇지 않다면 0으로 값 바꿈. ↳ optimal

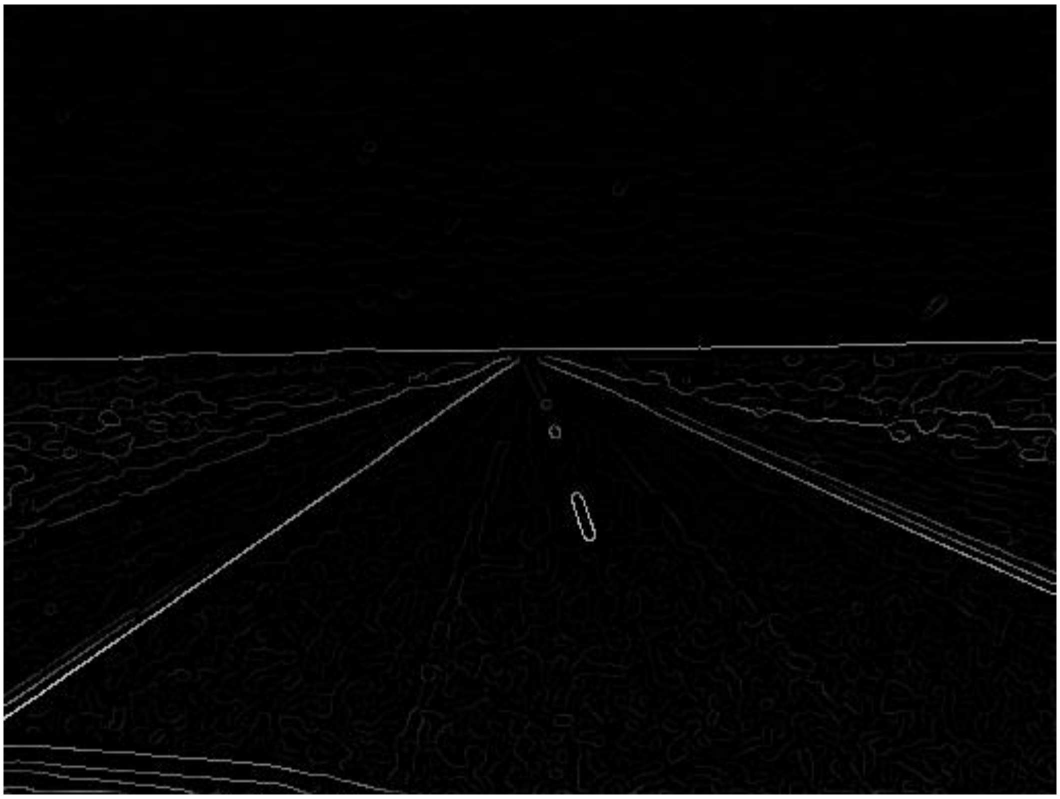
I_m

img01

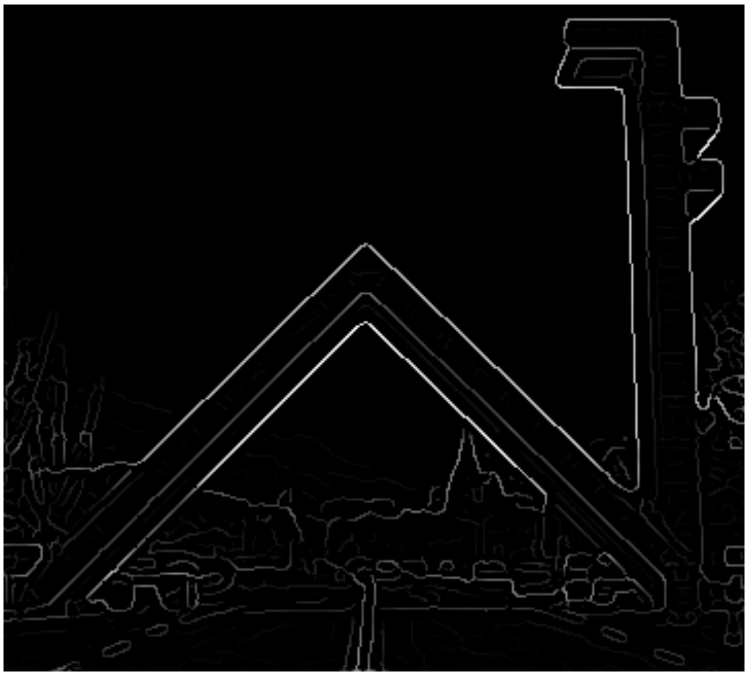


img02

img03

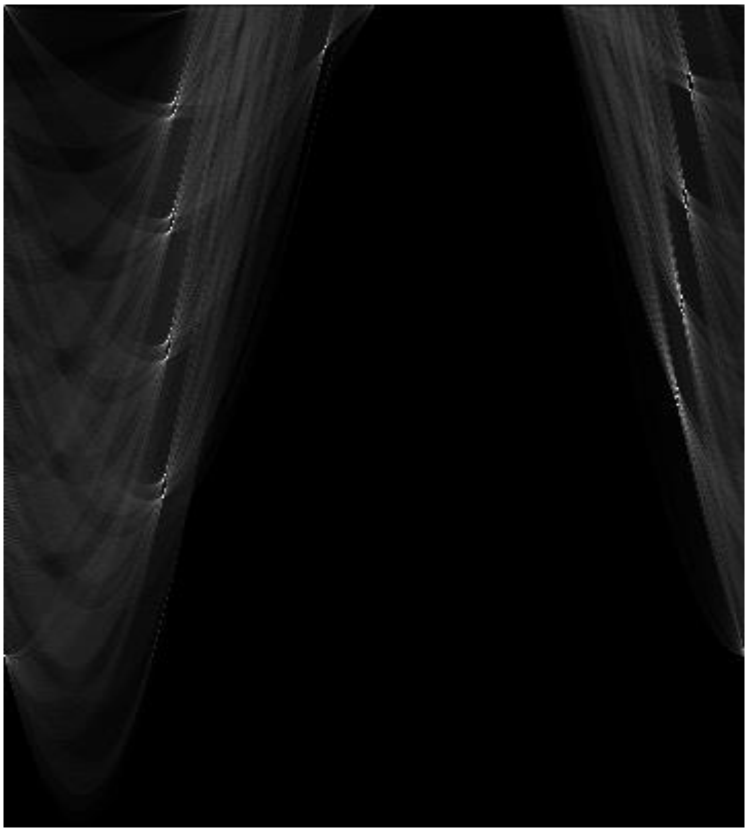


img04



H

img01



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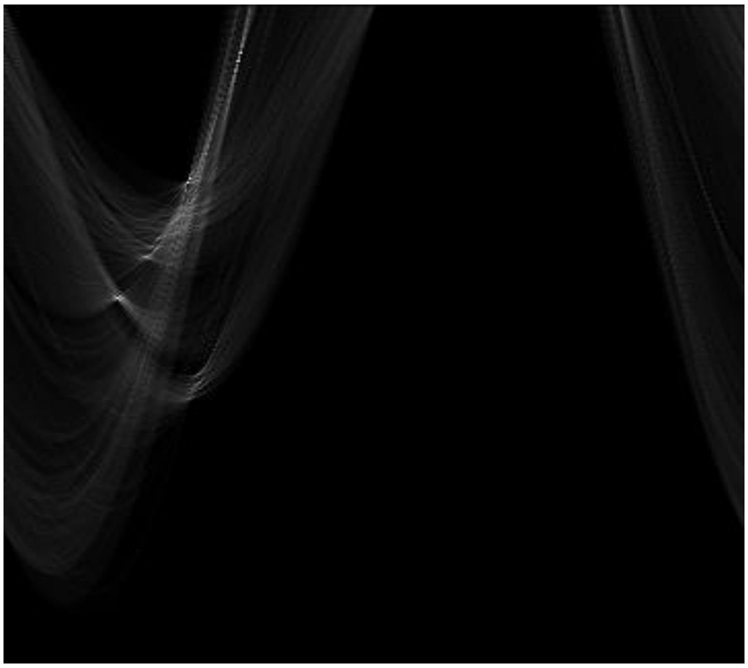

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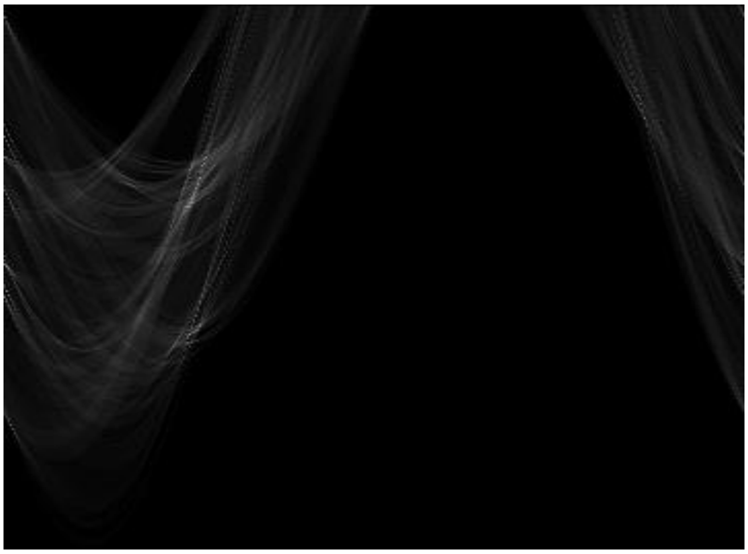

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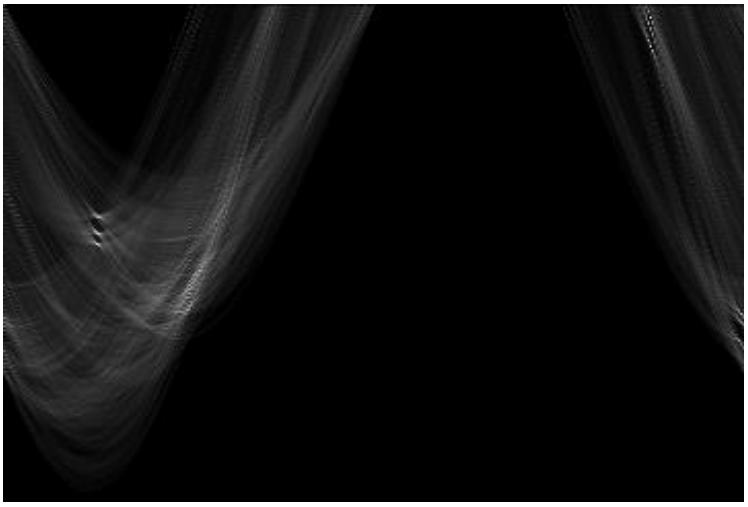
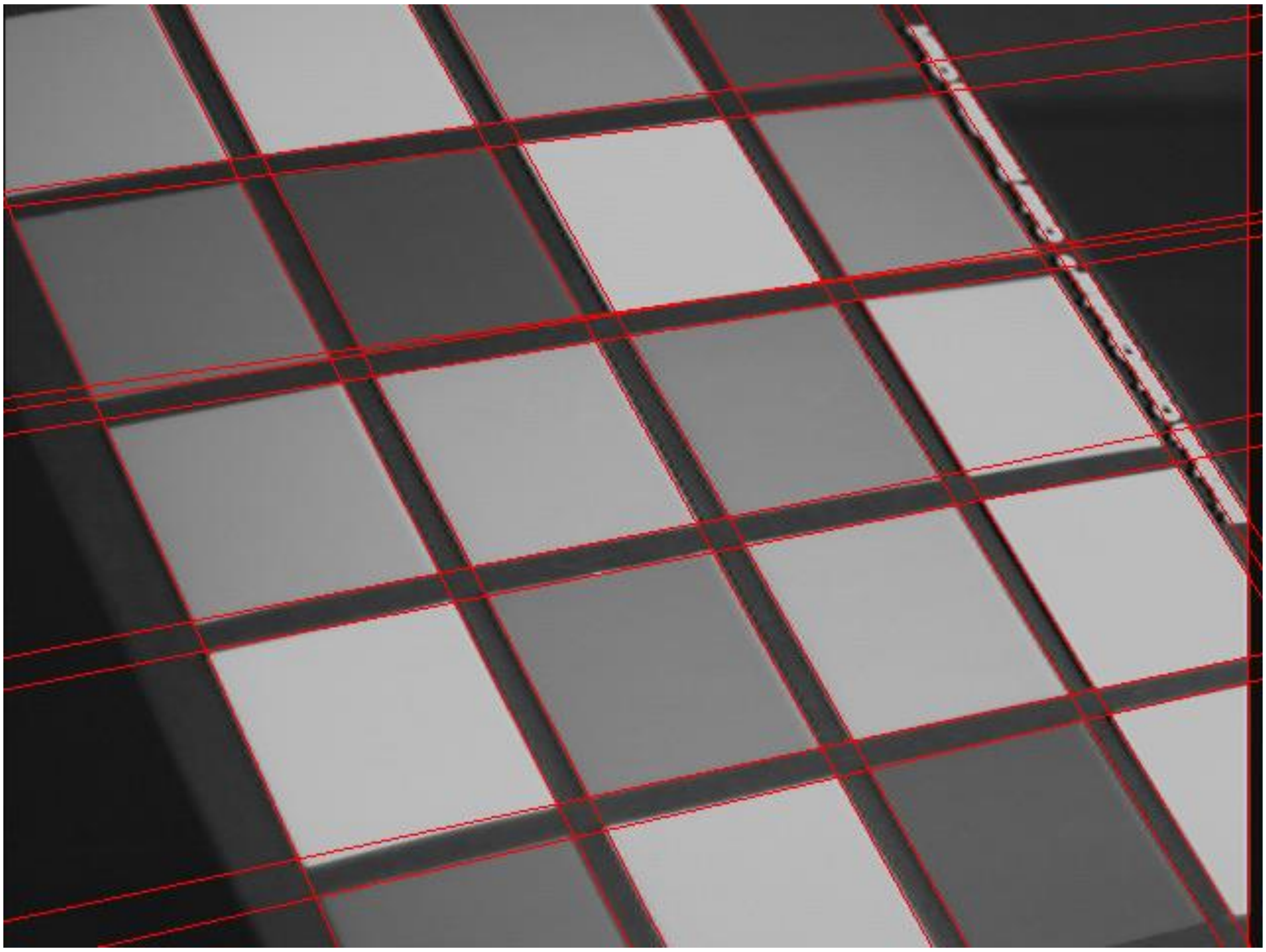


HoughLines

img01



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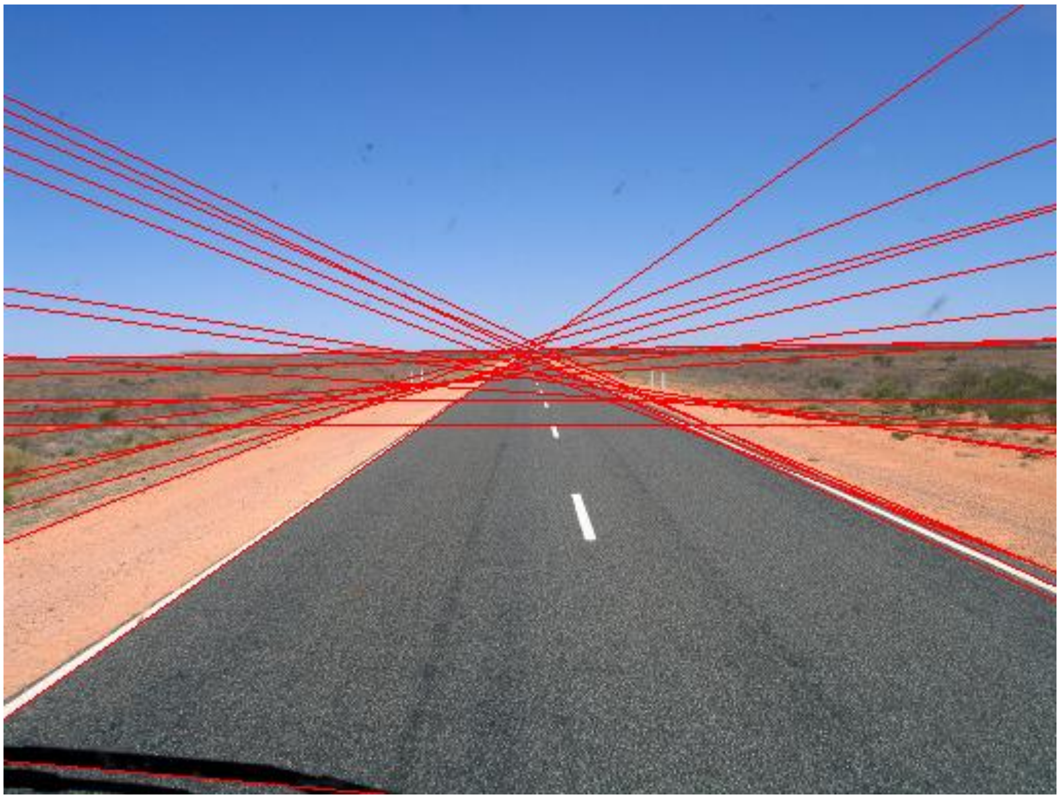

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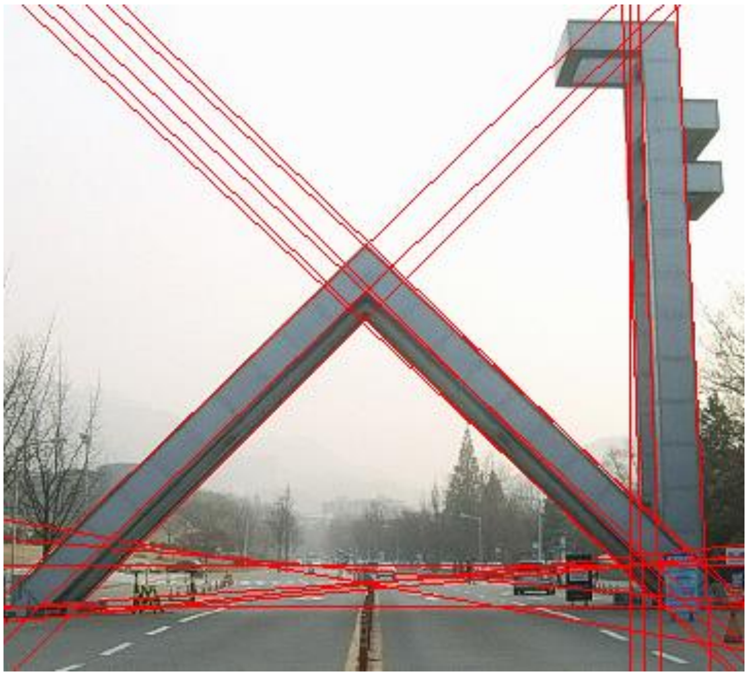
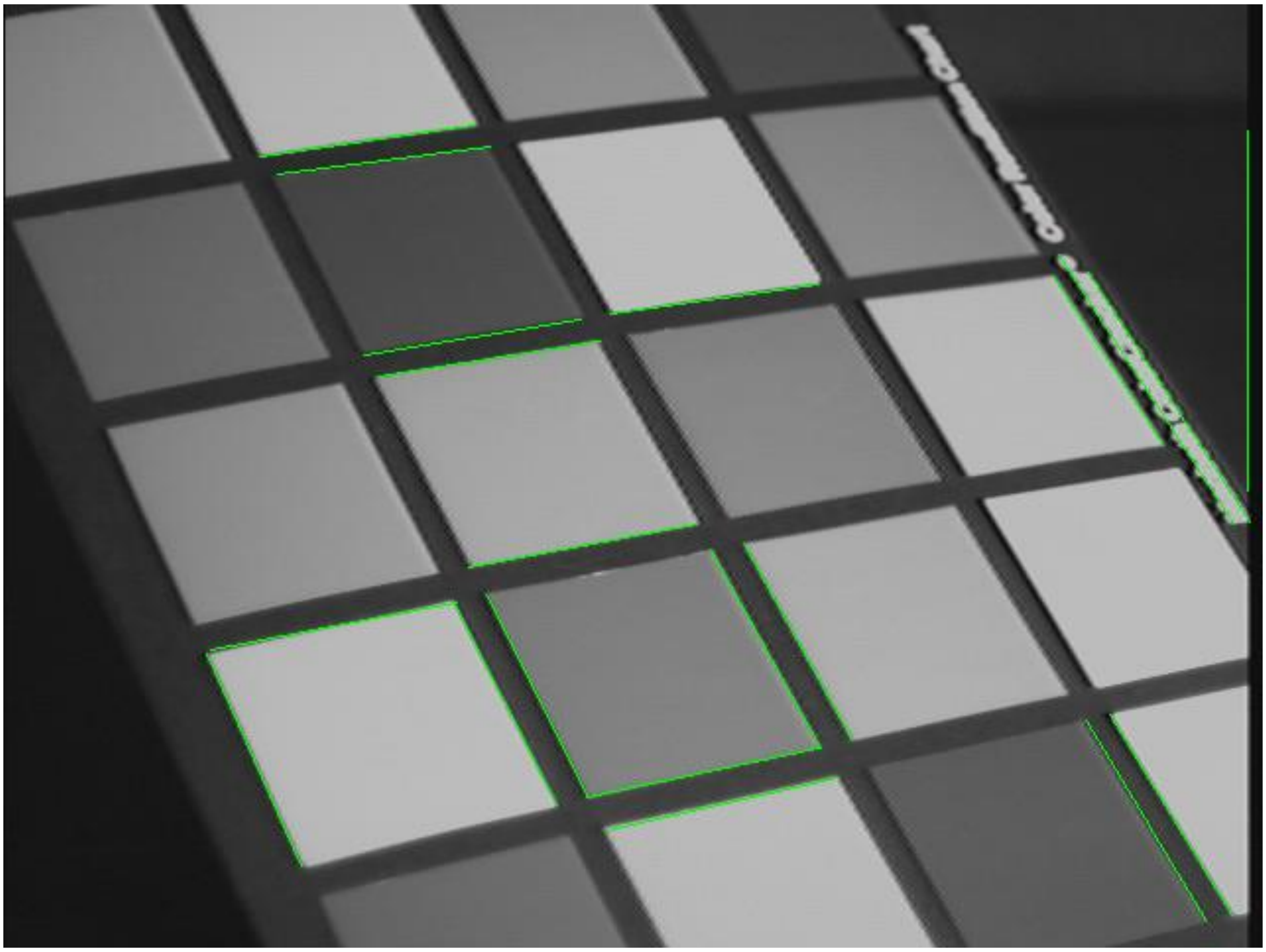


HoughLineSegments

img01



img02

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