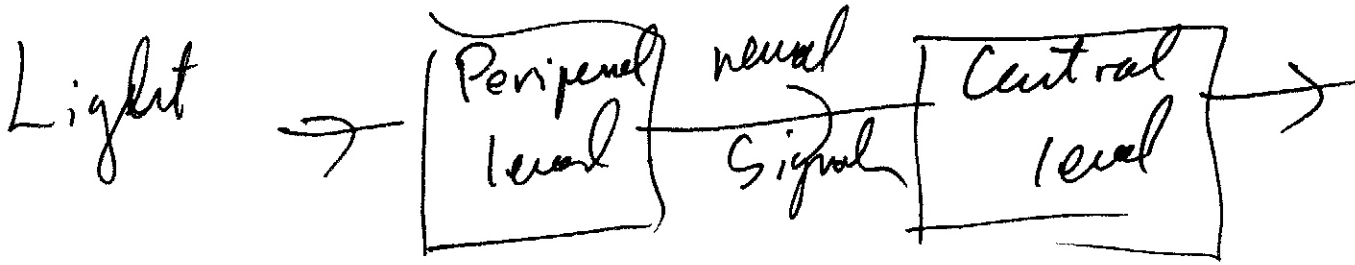
Human Visual System

3/01/06



Central level ⟶ not well understood.

Peripheral level ⟶ Better understood.

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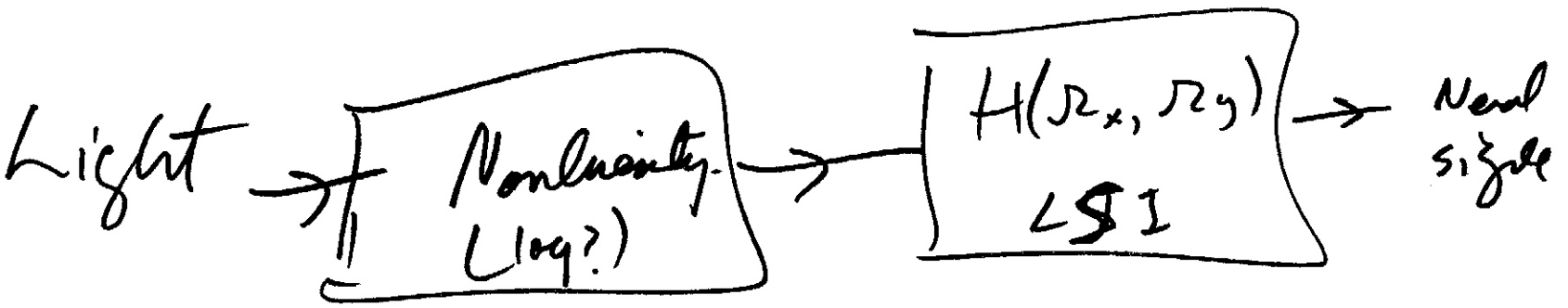
1. physiological studies
2. psychophysical studies

One simple model for Peripheral level.



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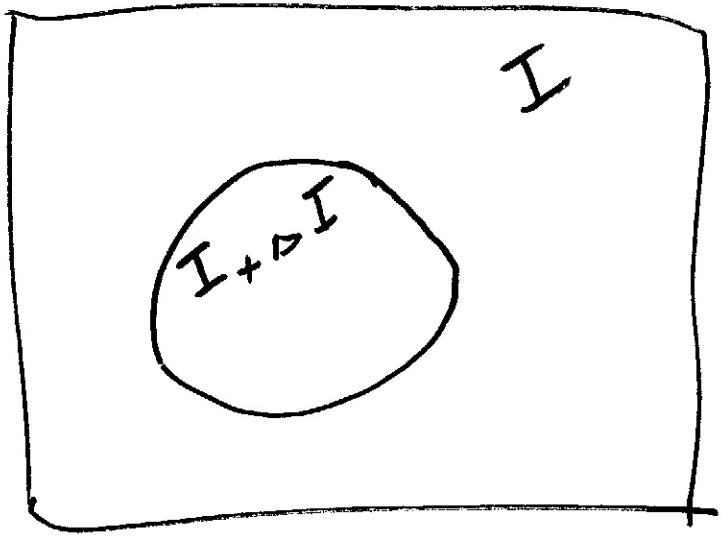
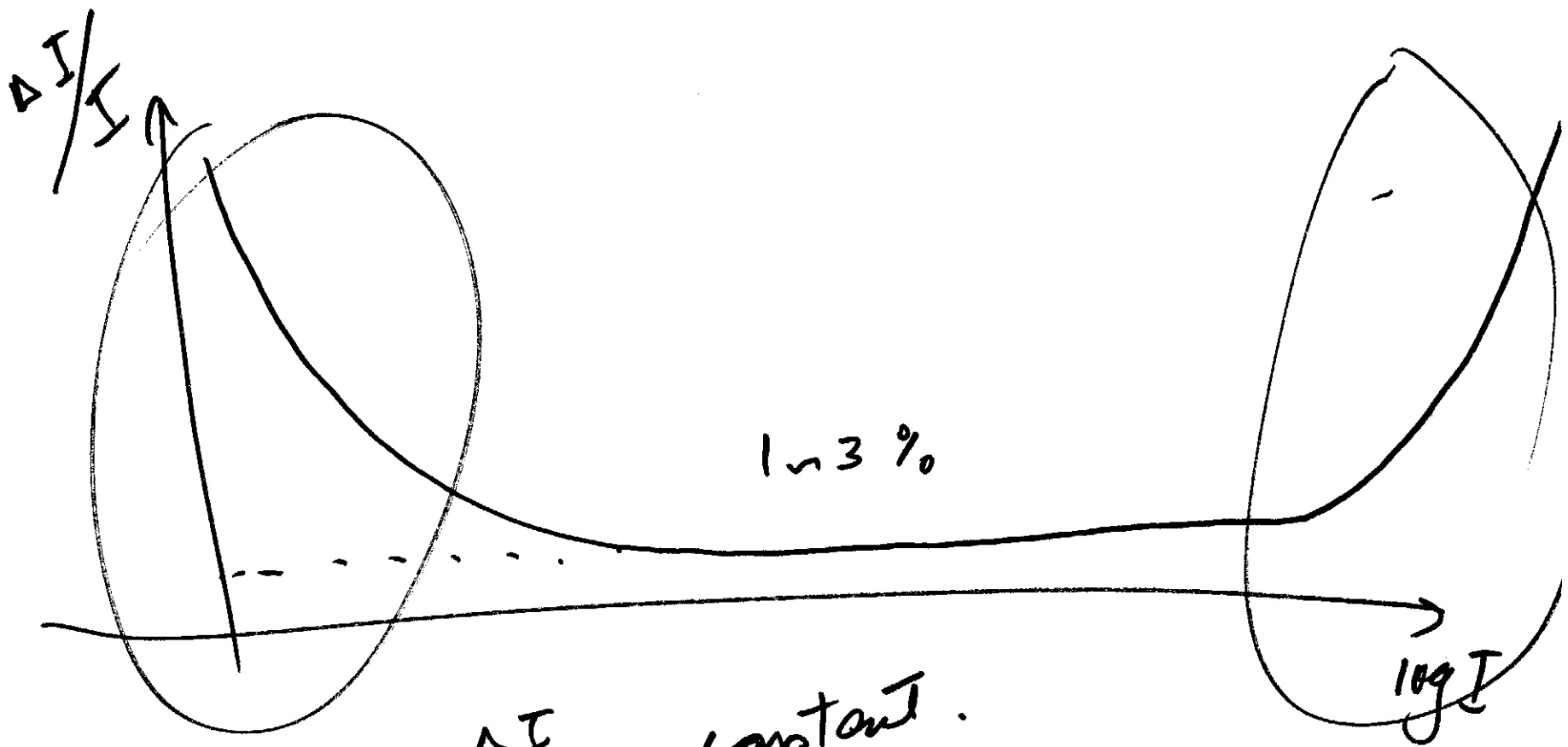
Freq. Response $H(\Omega_x, \Omega_y)$

Visual Phenomena

(1) Weber's Law. jnd = just noticeable difference.

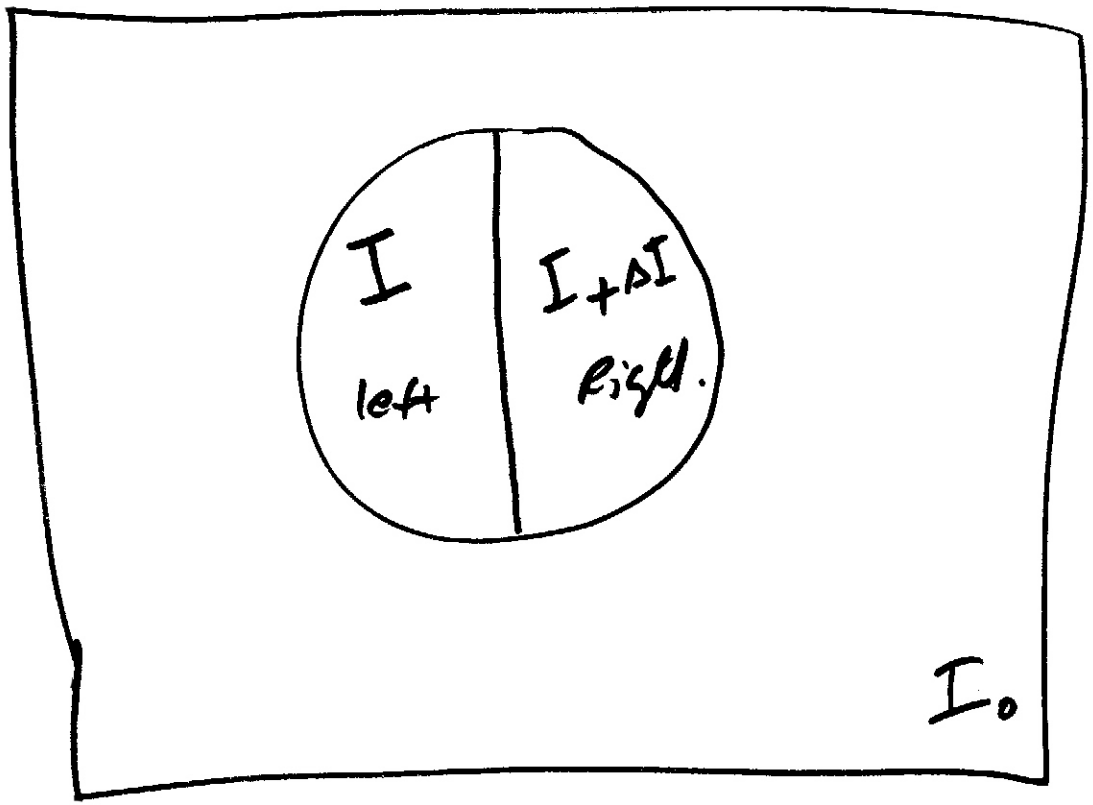


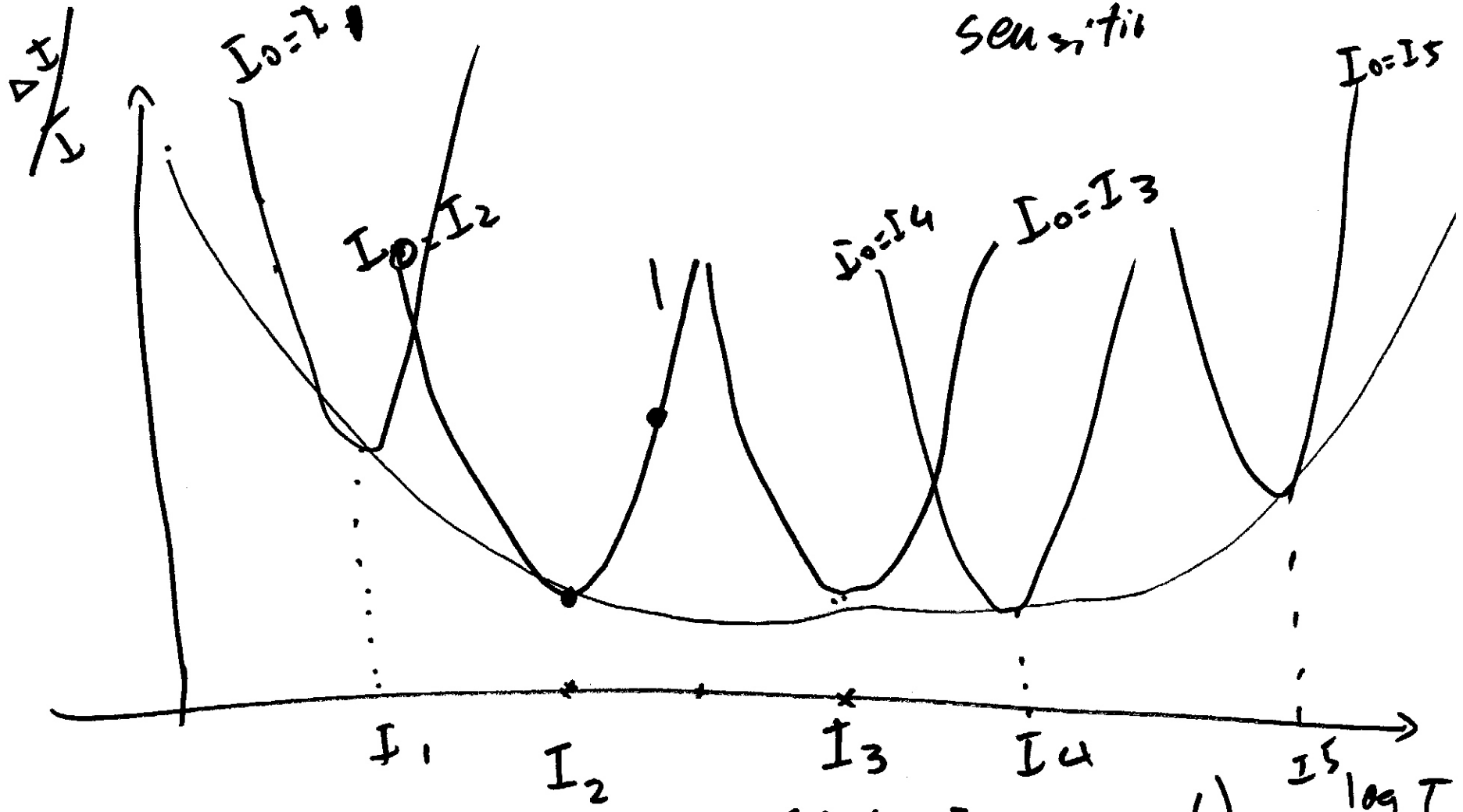


$$\frac{\Delta I}{I} \simeq \text{constant}.$$

$$\Delta I \to 0 \qquad \frac{dI}{I} \simeq \text{constant} = d(\log I)$$

Adaptation Experiment





Sensitivity to intensity is highest ($\frac{\Delta I}{I}$ is lowest) near the level that the observer is adapted to.

Spatial Freq. Response

$$I(x,y) = I_0(y)\cos\left(\omega(x)\, x\right) + \text{constant}$$

constant → ensure I is always positive.

plot → 7.22.

Image Sensing Acquisition

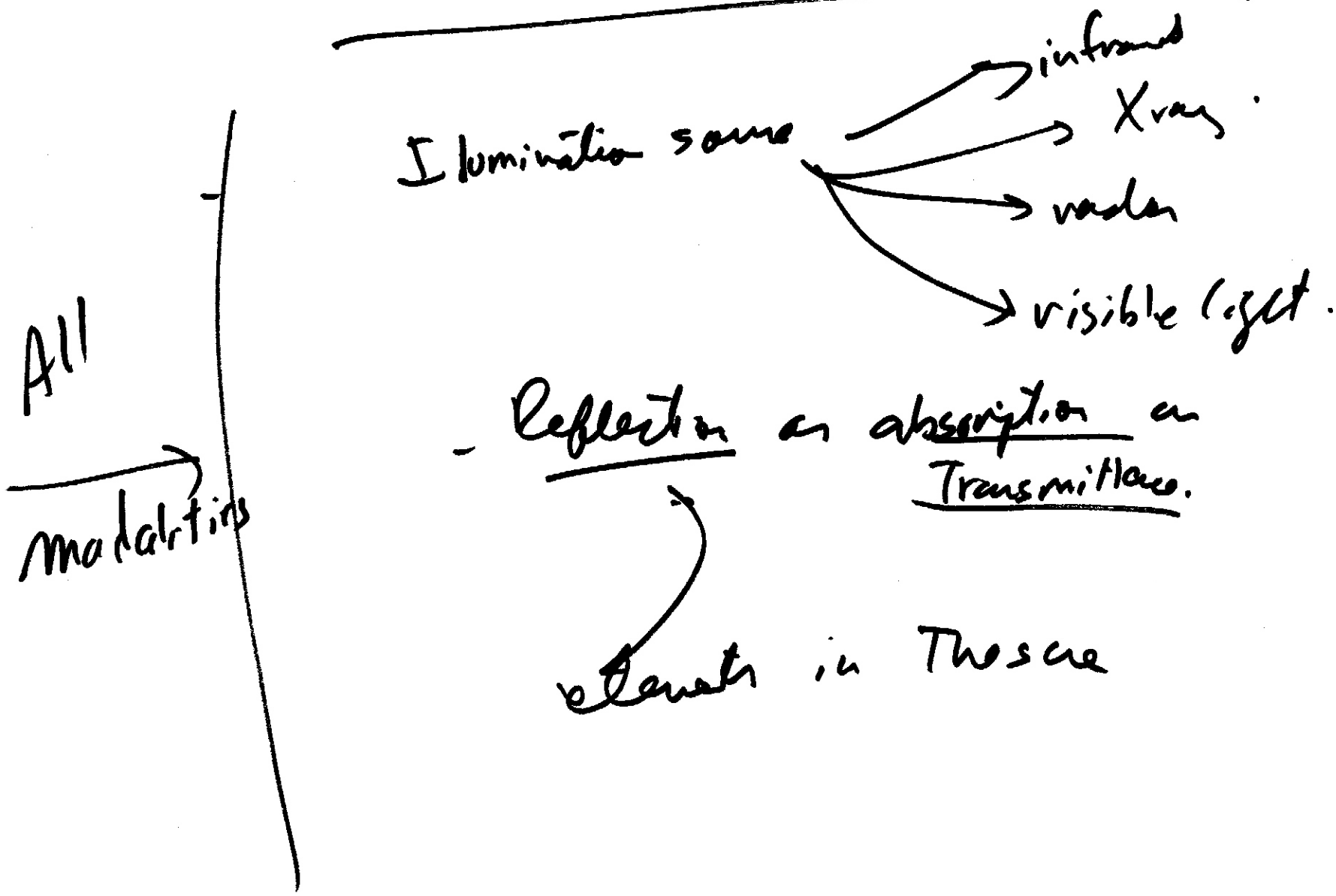


Image formation

Characterized by 2 components.

(a) amount of source illumination incident on scene.

(b) amount that is reflected.

$$f(x,y) = i(x,y)\, r(x,y)$$

$f(x,y)$ → sensed img.

$i(x,y)$ → illumination.

$r(x,y)$ → reflectance.

$$0 < i(x,y) < \infty$$

Sunny clear day	90,000	lm/m²
clear evening	0.1	lm/m²

show complex words & pictures

$0 < r(x,y) < 1$

0.01	black velvet
0.15	stainless steel.
0.80	flat white wall
0.9	silver plated metal.
0.95	snow

Empirical observation Exploited in Image Processing Systems

1. Sharper image looks better.
2. Same noise in uniform background region is more visible than noise in ~~edge~~ Textured region.
3. Same noise in dark areas are more noticeable than in bright areas.

7.18 J. Lim

4. Same amt of artificial noise looks a lot worse than natural noise
5. Images with unnatural aspect ratios attract viewer attention.

11