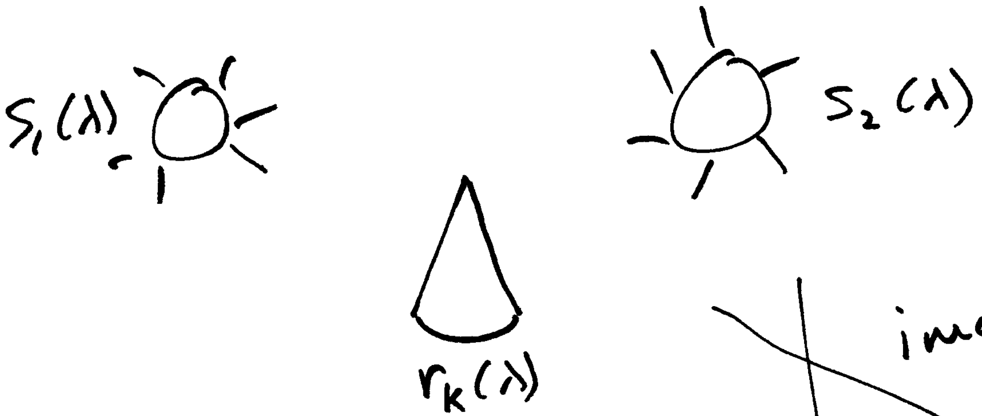
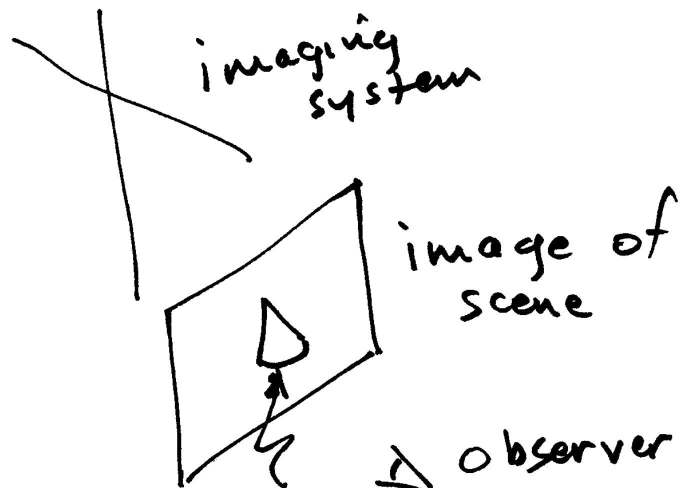
Michael Brill's extension of Nikolaev's framework.

Nikolaev's framework:



K – object index



Rank of image field – no. of lights

Healy simplification $F_k(\lambda, x, y)$

$$F_k(\lambda, x, y) = \underbrace{g_1^k(x,y)}_{} \, r_k(\lambda) \, S_1(\lambda) + g_2^k(x,y) \, r_k(\lambda) \, S_2(\lambda)$$

no dichromatic reflection model

sensor response for j-th channel

$$Q_j^k(x,y) = \cancel{g} \int F_k(\lambda; x, y)\, q_j(\lambda)\, d\lambda$$

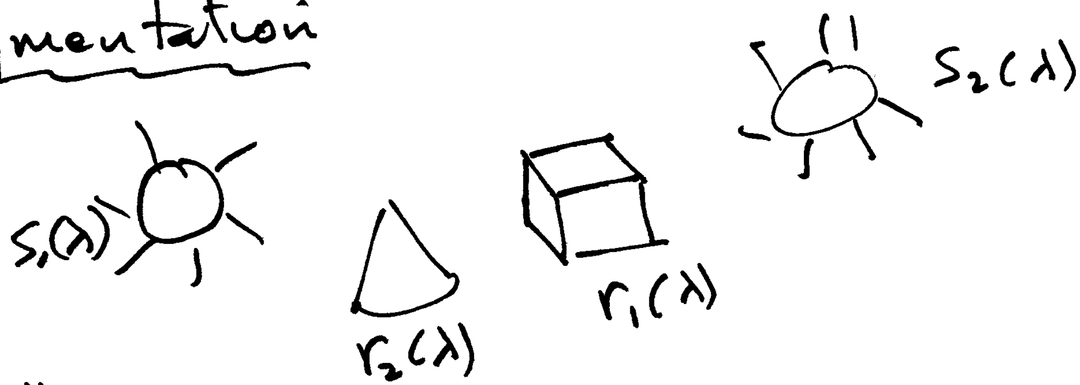
$$= g_1^k(x,y) \int S_1(\lambda)\, r_k(\lambda)\, q_j(\lambda)\, d\lambda$$

$$+ g_2^k(x,y) \int S_2(\lambda)\, r_k(\lambda)\, q_j(\lambda)\, d\lambda$$

k - object index

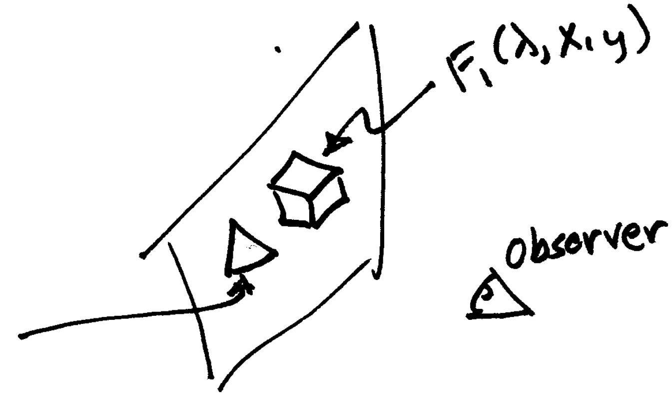
$j = 1, 2, 3$

Segmentation



Problem

Find a discrimination function $D(x,y)$ that is constant within an object & changes from object to object



$$\vec{c}_k = \begin{bmatrix} Q_1^k(x,y) \\ Q_2^k(x,y) \\ Q_3^k(x,y) \end{bmatrix} = g_1^k(x,y)\,\vec{c}_k^{\,1} + g_2^k(x,y)\,\vec{c}_k^{\,2}$$

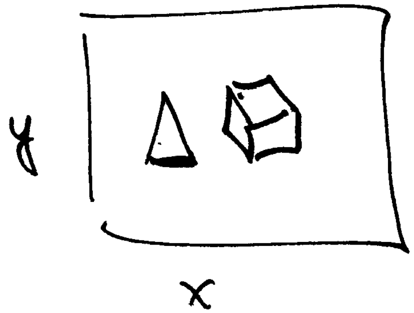
$$\left[c_k^i\right]_j = \int S_i(\lambda)\, r_k(\lambda)\, q_j(\lambda)\, d\lambda \qquad \vec{c}_k^{\,i} = \begin{bmatrix} [c_k^i]_1 \\ [c_k^i]_2 \\ [c_k^i]_3 \end{bmatrix}$$

i – illuminant index

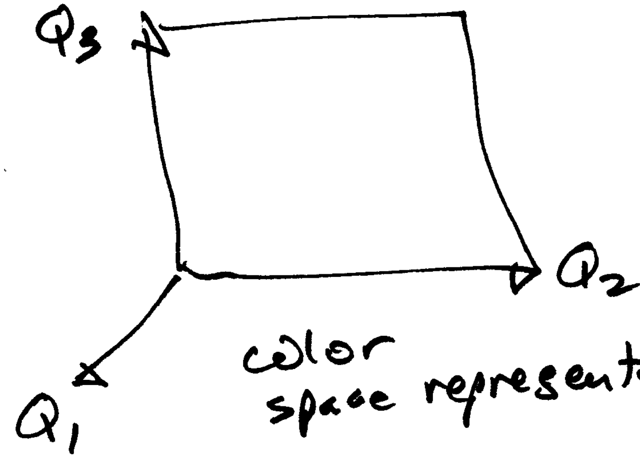
j - sensor channel index
q_j(lambda) - response of
j-th channel

$$\vec{c}_k^{\,(x,y)} = g_1^k(x,y)\,\vec{c}_k^{\,1} + g_2^k(x,y)\,\vec{c}_k^{\,2}$$

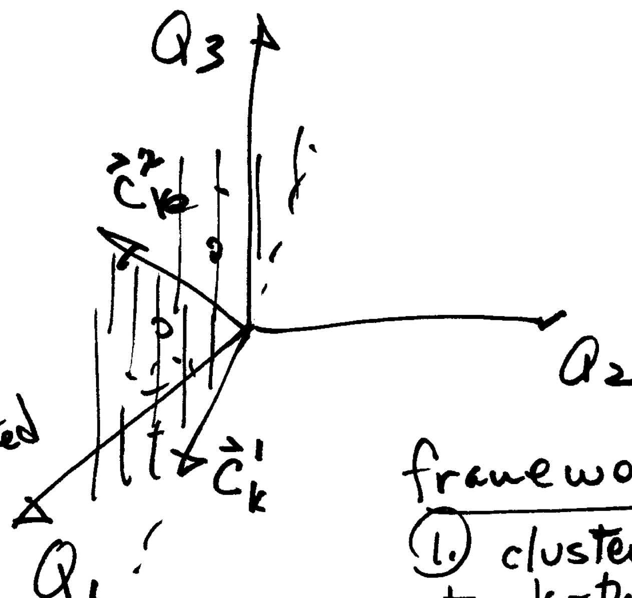
Within a fixed object $\vec{c}_k(x,y)$ is a linear combination of two fixed vectors $\vec{c}_k^{\,1}$ & $\vec{c}_k^{\,2}$ with spatially varying weights $g_1^k(x,y)$ & $g_2^k(x,y)$



spatial representation



color space representation



$$\vec{c}_k(x,y) = g_1^k(x,y)\,\vec{c}_k^{\,1} + g_2^k(x,y)\,\vec{c}_k^{\,2}$$

Analysis tells that pts from two objects will be well-separated except at intersection of two planes

framework

1. cluster points corresponding to k-th plane ~ $\vec{c}$
2. Find normal to plane
3. Recluster based on estimated normal

~~[illegible]~~
Comparison to Maloney & Wandell:

1. One illuminant
2. Single surface
3. ~~[illegible]~~ Also had two components:
    a. specular reflection
    b. body reflection

wanted to find illuminant

Shoji Tominaga & Brian Wandell

Use dichromatic reflection model

$$Y(\theta, \lambda) = c_I(\theta)\, S_I(\lambda)\, E(\lambda) + c_S(\theta)\, S_S(\lambda)\, E(\lambda)$$

spectral power distribution of an object in scene

θ - spatial coordinates, geometry factors
λ - wavelength

I - "interior" body reflection term (266)

S - "surface" - specular reflection term

assumptions

1. additivity
2. separability
3. $S_S(\lambda) = \text{constant}$

$E(\lambda)$ - illuminant

$S_I(\lambda)$ - body spectral reflectance

$S_S(\lambda)$ - surface spectral reflectance