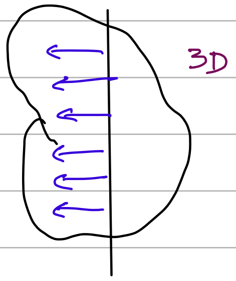
EE702: Lec-5 (22 Jan)

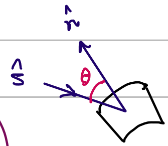
22/01/2025

No lecture on 24th (Friday)!

Just a heads up: We are still on Lambertian surface only!



Assumpt$_n$: $\hat{S}$ known

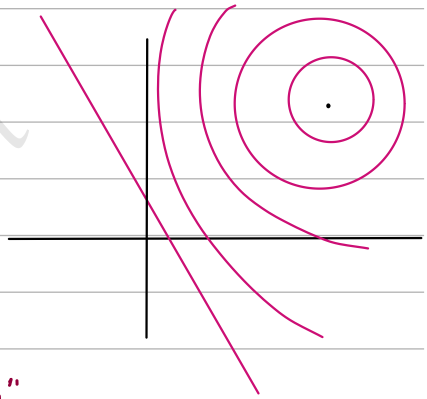


$$E(x,y) = \cancel{\text{const}} \cdot \cos\theta$$
$$= \hat{n}(x,y)\cdot\hat{s}$$

$$\hat{s} = \frac{(1,0,p_s)\times(0,1,q_s)}{} = \frac{(-p_s,-q_s,1)}{\sqrt{1+p_s^2+q_s^2}}$$

Assume
$c = 1$

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



$$\Rightarrow c^2(1+p_s^2+q_s^2)(1+p^2+q^2) = (1+pp_s+qq_s)^2$$

Some inherent, obvious constraints

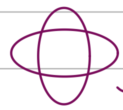
"Photogrametry"

$\hat{z}$ = viewing direct$_n$

i) $\hat{n}\cdot\hat{s} \geq 0$

ii) $\hat{n}\cdot\hat{z} \geq 0$

$\hat{s}_1, \hat{s}_2$



→ MAX: 4

min: 0

$\hat{s}_1, \hat{s}_2, \hat{s}_3$

$$\rho(\hat{n},\hat{s}_1) = c_1$$
$$\rho(\hat{n},\hat{s}_2) = c_2$$
$$\rho(\hat{n},\hat{s}_3) = c_3$$

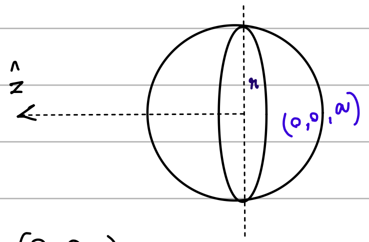
$$\underbrace{\begin{bmatrix} s_{11} & s_{12} & s_{13} \\ s_{21} & s_{22} & s_{23} \\ s_{31} & s_{32} & s_{33} \end{bmatrix}}_{S} \cdot \rho\hat{n} = \underbrace{\begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix}}_{C}$$

$\rho(x,y) \rightarrow$ Albedo

"Photometric stereo"

$$\Rightarrow \rho_{\hat{n}} = S^{-1}C = \frac{1}{[s_1\ s_2\ s_3]}\left[c_1(\hat{s}_2\times\hat{s}_3) + c_2(\hat{s}_3\times\hat{s}_1) + c_3(\hat{s}_1\times\hat{s}_2)\right]$$

Sravan K Suresh
22B3936



$$(z-a)^2 + x^2 + y^2 = r^2$$

$$z = \sqrt{r^2 - x^2 - y^2} + a$$

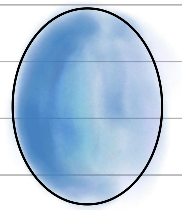
$\hat{s} = (0,0,1)$

Now,

$$p = \frac{\partial z}{\partial x} = \frac{-x}{z-a} \qquad q = \frac{\partial z}{\partial y} = \frac{-y}{z-a}$$

$$E(x,y) = \hat{n} \cdot \hat{s} = \frac{1}{\sqrt{1+p^2+q^2}}$$

$$= \frac{z-a}{r} = \sqrt{\frac{r^2-x^2-y^2}{r}} = \sqrt{1 - \frac{x^2+y^2}{r^2}}$$



"Shaded image"

Sravan K Suresh
22B3936