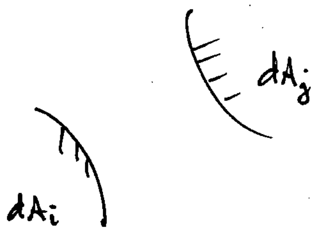
LAST LECTURE :



$$dF_{dA_i-dA_j} = \frac{\cos\theta_i \cos\theta_j}{\pi S^2}\, dA_j \quad \left(\text{NORMALIZED TO } dA_i\right)$$

$\int$ FOR ONLY ONE SIDE

$\iint$ FOR BOTH SIDES

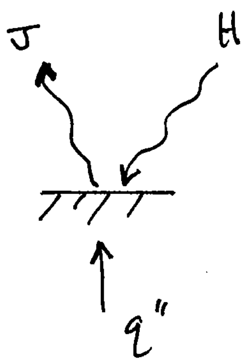
RECIPROCITY: $dA_i\, dF_{dA_i-dA_j} - dA_j\, dF_{dA_j-dA_i}$

$$A_i F_{ij} = A_j F_{ji} \qquad \text{(DETAILED BALANCE, 2}^{\text{nd}}\text{ LAW)}$$

$$F_{i(k+j)} = F_{ik} + F_{ij}$$ (BUT CANNOT DO THE REVERSE! DUE TO AREA NORMALIZATION)

ENERGY CONS. :

$$\sum_{j=1}^{N} F_{ij} = 1$$



NRG-BAL :

$$q'' = J - H = \varepsilon E_b - \alpha H$$ VALID AT ALL POINTS IN ENCLOSURE

see next page

RADIOSITY :

$$J = \varepsilon E_b + \rho H$$

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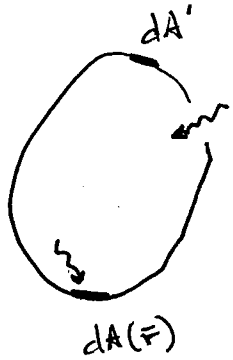
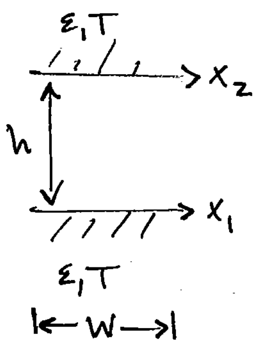


$$H(\vec{r}) = \int J(\vec{r}\,')\, dF_{dA-dA'} + H_o(\vec{r})$$



$$J_2(x_2) = \varepsilon\sigma T^4 + \frac{(1-\varepsilon)h^2}{2}\int_0^W \frac{J_1(x_1)\,dx_1}{\left[h^2+(x_2-x_1)^2\right]^{3/2}}$$

x_1 IS DUMMY VAR.

$$\phi(x) = f(x) + \int_0^\infty \underbrace{K(x,x')}_{\text{KERNEL}}\,\phi(x')\,dx'$$

GAUSS-LEGENDRE QUADRATURE

$$\int_0^W K(x,x')\,\phi(x')\,dx' = \sum_{i=1}^N w_i\, K(x,x_i)\,\phi(x_i)$$

(TYPICALLY NORMALIZE KERNAL LIMITS TO +1 AND -1.)

$$\phi(x) = f(x) + \sum_{i=1}^N w_i\, K(x,x_i)\,\phi(x_i)$$

THE KERNEL: • WHEN $x = x'$, THE KERNEL CAN "BLOW-UP"

• SOMETIMES NOT WELL BEHAVED

TO AVOID THIS PROB.

$$\phi(x) = f(x) + \int_0^W K(x,x')\left[\phi(x') - \phi(x)\right]dx' + \int_0^W \phi(x)\,K(x,x')\,dx'$$

CAN PULLOUT &

INT. ANALYTICALLY OR NUMERICALL

$$\sum_{i=1}^N K(x,x_i)\left[\phi(x_i) - \phi(x)\right]w_i$$

∴ WILL RESULT IN "N" ALGEBRAIC EQNS

THE ABOVE CAN BE SOLVED USING MATRICES, WHICH ARE TYPICALLY FULL MATRICES.

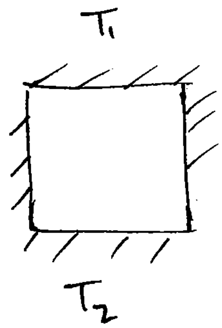
(SO, TAKES LONGER)

c.f. FINITE DIFFERENCE, WHICH TYPICALLY HAS SPARCE MATRICES

$$\text{e.g., } \nabla^2\phi = 0 \Rightarrow \begin{pmatrix} \ddots & & 0 \\ & \ddots & \\ 0 & & \ddots \end{pmatrix}\begin{pmatrix} \\ \\ \\ \end{pmatrix} = \begin{pmatrix} \\ \\ \\ \end{pmatrix}$$

TRIDIAGONAL

MORE CRUDELY



"TEMPERATURE AND RADIOSITY UNIFORM"

IF HAS OPENING

$$H_i = \sum_{i=1}^{N} J_j F_{ij} + H_{o_i}$$

INCOMING RADIATION TO ANY ΔA_i

(SO, CAN FIND FOR ANY SURFACE)

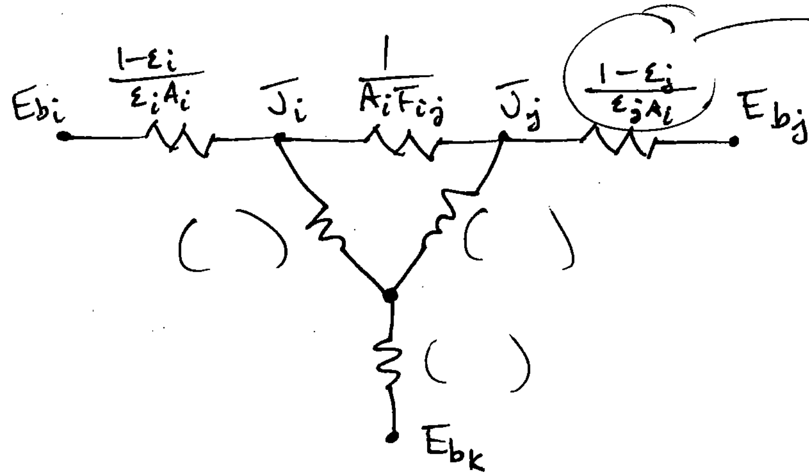
★ <u>RADIATION NETWORK METHOD</u>

$$q_i = \frac{E_{b_i} - J_i}{\left(\frac{1-\varepsilon_i}{\varepsilon_i}\right)} \Rightarrow \dot{Q}_i = \frac{E_{b_i} - J_i}{\frac{1-\varepsilon_i}{\varepsilon_i A_i}} = \frac{E_{b_i} - J_i}{R_i}$$

$$\dot{Q}_{i\to j} = A_i J_i F_{ij}$$

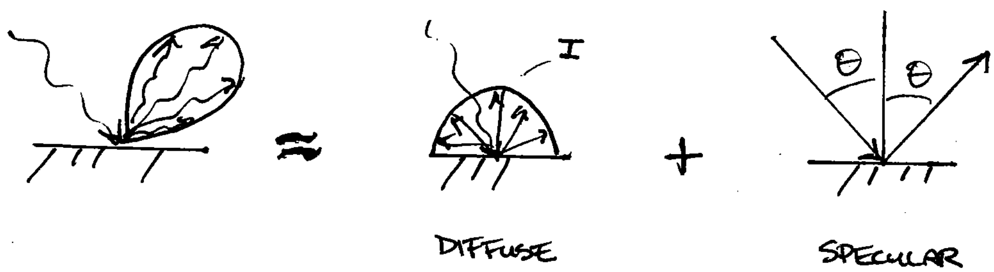
reciprocity

$$\underset{\text{"NET"}}{\dot{Q}_{ij}} = A_i J_i F_{ij} - A_j F_{ji} J_j = \frac{J_i - J_j}{\frac{1}{A_i F_{ij}}} = \frac{J_i - J_j}{R_{ij}}$$



(ANALOGOUS TO A CONTACT RESISTANCE)

DIFFUSE – SPECULAR SURFACES



$$\rho'' \Rightarrow \rho^{\frown\frown} \Rightarrow \rho \equiv \rho^d + \rho^s$$

$$\rho^d + \rho^s + \alpha = 1$$

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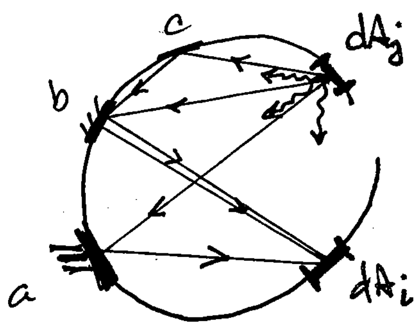
FOR GRAY SURFACES (SPECULAR & DIFFUSE COMPONENT EXIST SIMULTANEOUSLY)



"SPECULAR"

$$dF^s_{dA_i - dA_j} = \frac{\text{INTERCEPTED BY } dA_j \left\{ \begin{array}{l} \text{DIRECT +} \\ \text{SPECULAR} \\ \text{REFLECTION} \end{array} \right.}{\text{TOTAL DIFFUSE POWER LEAVING } dA_i}$$

$$dF^s_{dA_i - dA_j} = dF_{dA_i - dA_j} + \rho^s_a \, dF_{dA_i(a) - dA_j} + \rho^s_b \rho^s_c \, dF_{dA_i(bc) dA_j}$$

$\hookrightarrow$ $dA_i \, dF^s_{dA_i - dA_j} = dA_j \, dF^s_{dA_j - dA_i}$ (RECIPROCITY STILL HOLDS)

$$q(\bar{r}) = \varepsilon E_b(\bar{r}) - \alpha H(\bar{r})$$

$$J^{tot} = \rho^d H(\bar{r}) + \rho^s H(\bar{r}) + \varepsilon(\bar{r}) E_b(\bar{r})$$

$$= J(\bar{r}) + \rho^s H(\bar{r})$$

$$\Rightarrow H(\bar{r}) = \int J(\bar{r}) \, dF^s_{dA - dA'} + H_o(\bar{r})$$