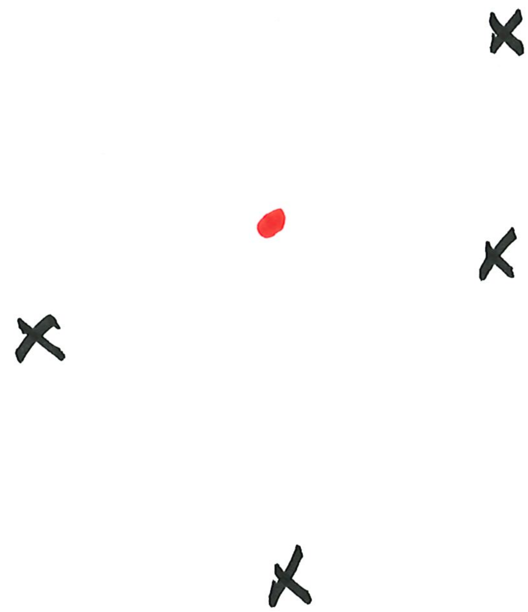
12/4/23

- Het. analysis
- Variogram

  ↓

- Kriging



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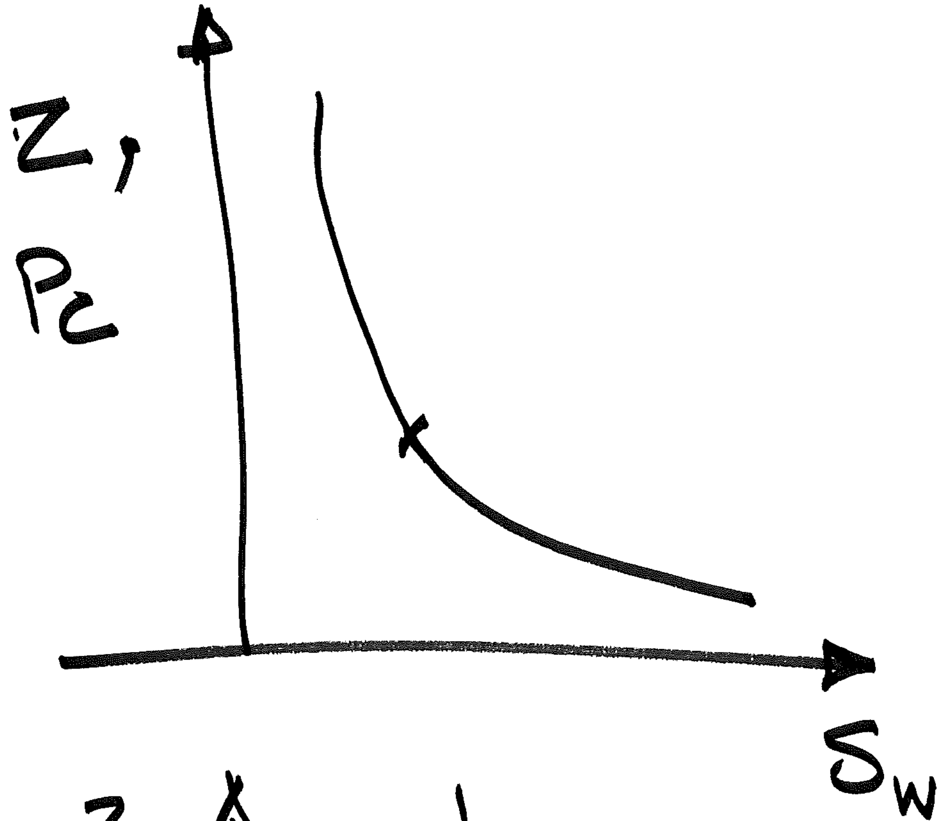
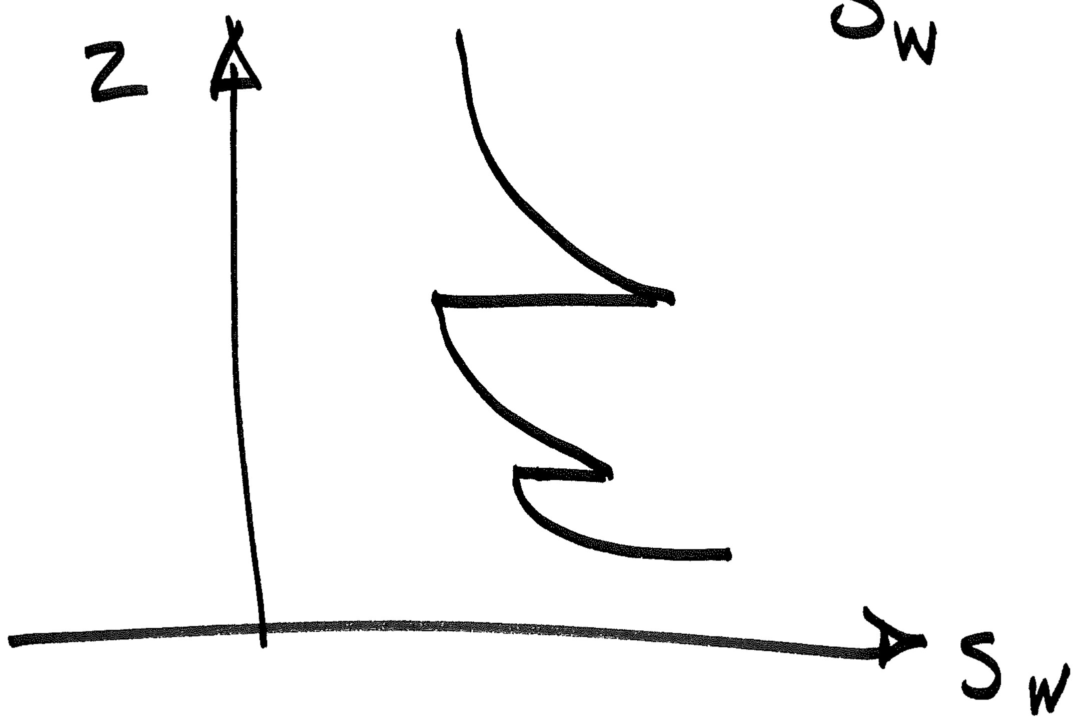
* Solid - Fluid Interfacial Int.

* $\underline{P_c}$

  ↳ 

  ↳ sat. - Height analysis





* K_r

Example:

$K_r \propto$ cross-sec. area for flow of each phase

$$K_{rw} = \frac{\int_0^{S_w} [r(S_w')]^2 \, dS_w'}{\int_0^1 [r(S_w)']^2 \, dS_w'} = \frac{\int_0^{S_w} \frac{dS_w'}{[P_c(S_w')]^2}}{\int_0^1 \frac{dS_w'}{[P_c(S_w')]^2}}$$

$$\tau = F\phi = \frac{1}{\phi}$$

$m = 2$ for $S_w = 1$

$$S_w < 1 \rightsquigarrow \tau(S_w) = \frac{1}{\phi S_w}$$

$$k \propto \frac{r^2}{\tau^2} \rightsquigarrow k \propto r^2 \phi^2 S_w^2$$

if $S_w \to S_{w,irr} \rightsquigarrow \tau \to \infty$

$$k \propto r^2 \phi^2 S_w^{*\,2}$$

$$S_w^* = \frac{S_w - S_{wirr}}{1 - S_{wirr}}$$

$$\Rightarrow \bar{k}_{rw} = \frac{k_{rw}(S_w^*)}{k_{rw}(S_w^* = 1)}$$

$$\bar{k}_{rw} = \frac{\int_0^{S_w^*} \left[r(S_w^{*\prime}) \right]^2 \phi^2 S_w^{*2} \, dS_w^{*\prime}}{\int_0^1 \cdots}$$

$$\rightarrow \quad \bar{k}_{rw} = S_w^{*2} \frac{\int_0^{S_w^*} \frac{dS_w^{*\prime}}{\left[P_c(S_w^*) \right]^2}}{\int_0^1 \frac{dS_w^{*\prime}}{\left[P_c(S_w^*) \right]^2}}$$

Example:

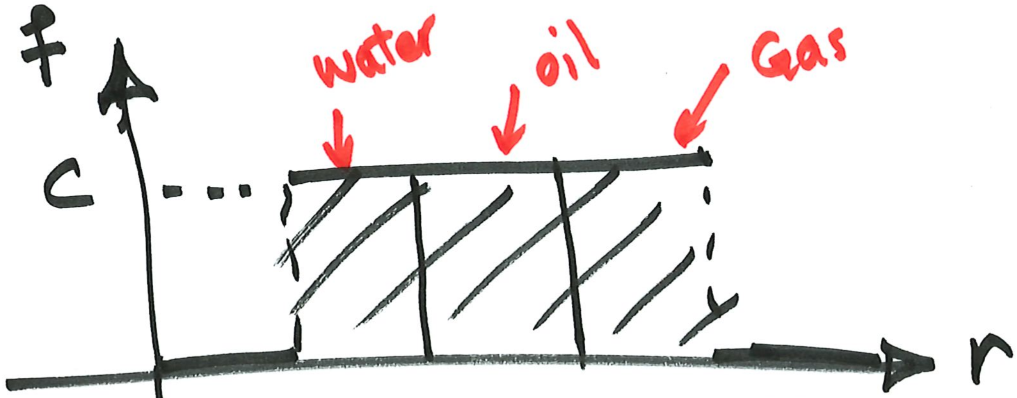
$f_{pv} = 0 \qquad r < 1\,\mu m$

$f_{pv} = C \qquad 1 < r < 21\,\mu m$

$f_{pv} = 0 \qquad r > 21\,\mu m$

water oil Gas

water-wet



$$\int_1^{21} f(r)\,dr = 1 \rightarrow \int_1^{21} C\,dr = 1$$

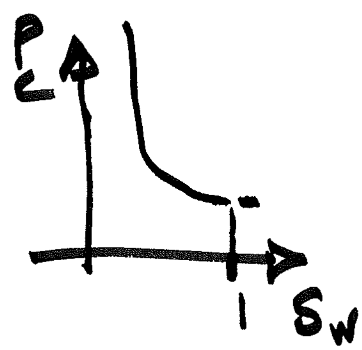
$$\rightarrow C(21-1) = 1 \rightarrow C = \frac{1}{20}\ (1/\mu m)$$

6

$$f(R) = -\frac{dS_{nw}}{dR} = \frac{P_c}{R}\,\frac{dS_{nw}}{dP_c}$$

$$\begin{cases} 500 = \dfrac{P_c}{r}\,\dfrac{dS_{nw}}{dP_c} \\[2ex] P_c = \dfrac{2\sigma\cos\theta}{r} \rightarrow r = \dfrac{2\sigma\cos\theta}{P_c} \end{cases}$$

$$\rightarrow \cancel{500 =}$$



$$\int \frac{dP_c}{(P_c)^2} = \int \frac{dS_{nw}}{(500)\,2\sigma\cos\theta}$$

$$\Rightarrow -\frac{1}{P_c} = \frac{1}{10500} S_{nw} + \underline{\underline{K}}$$

$$@\, S_{nw} = 0 \rightarrow P_c = P_d$$

$$\rightarrow K = -\frac{1}{P_d}$$

$$P_c = \frac{10500\, P_d}{10500 - P_d\, S_{nw}}$$

$$P_d = ? \qquad \frac{2\sigma \cos\theta}{r}$$

$r_{max} = 21\ \mu m$

$$\rightsquigarrow P_d = \frac{21 \text{ dynes/cm}}{21\times10^{-4}\ \text{[redacted]}} = 10000 \text{ dynes/cm}^2$$

$$\rightarrow P_c = \frac{105\times10^{6}}{10500 - 10000\, S_{nw}} \text{ dynes/cm}^2$$

$S_w = 1 - S_{nw}$

$$\rightarrow P_c = \frac{15223.24}{500 + 10000\, S_w}$$

psi

$$K = \frac{(\sigma \cos \theta)^2}{2} F_1 \int_0^1 \frac{dS}{P_c^2}$$

$$K_{rw} = \frac{\int_0^{0.3} \frac{dS}{P_c^2}}{\int_0^1 \frac{dS}{P_c^2}}$$

$$K_{ro} = \frac{\int_{0.3}^{0.7} \frac{dS}{P_c^2}}{\int_0^1 \frac{dS}{P_c^2}}$$

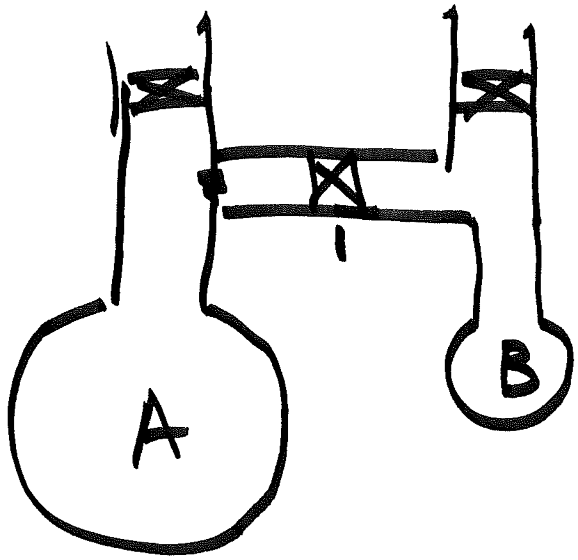
$$K_{rg} = \frac{\int_{0.7}^{1} dS/P_c^2}{\int_0^1 dS/P_c^2}$$

$S_w = 30\%$

$S_o = 40\%$

$S_g = 30\%$

Example:



rad A $= 4R$

rad B $= R$

σ

P_a

$$P_{CA} = \frac{4\sigma}{r_A} = \frac{\sigma}{R}$$

$$P_{CB} = \frac{4\sigma}{r_B} = \frac{4\sigma}{R}$$

$$P_A = P_0 + \frac{\sigma}{R}$$

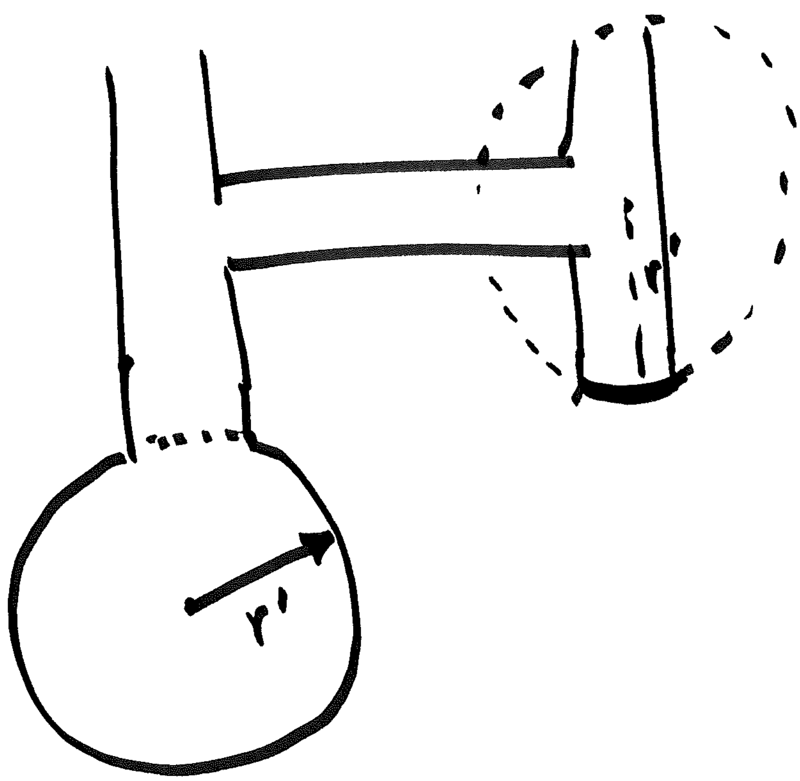
$$P_B = P_0 + \frac{4\sigma}{R}$$

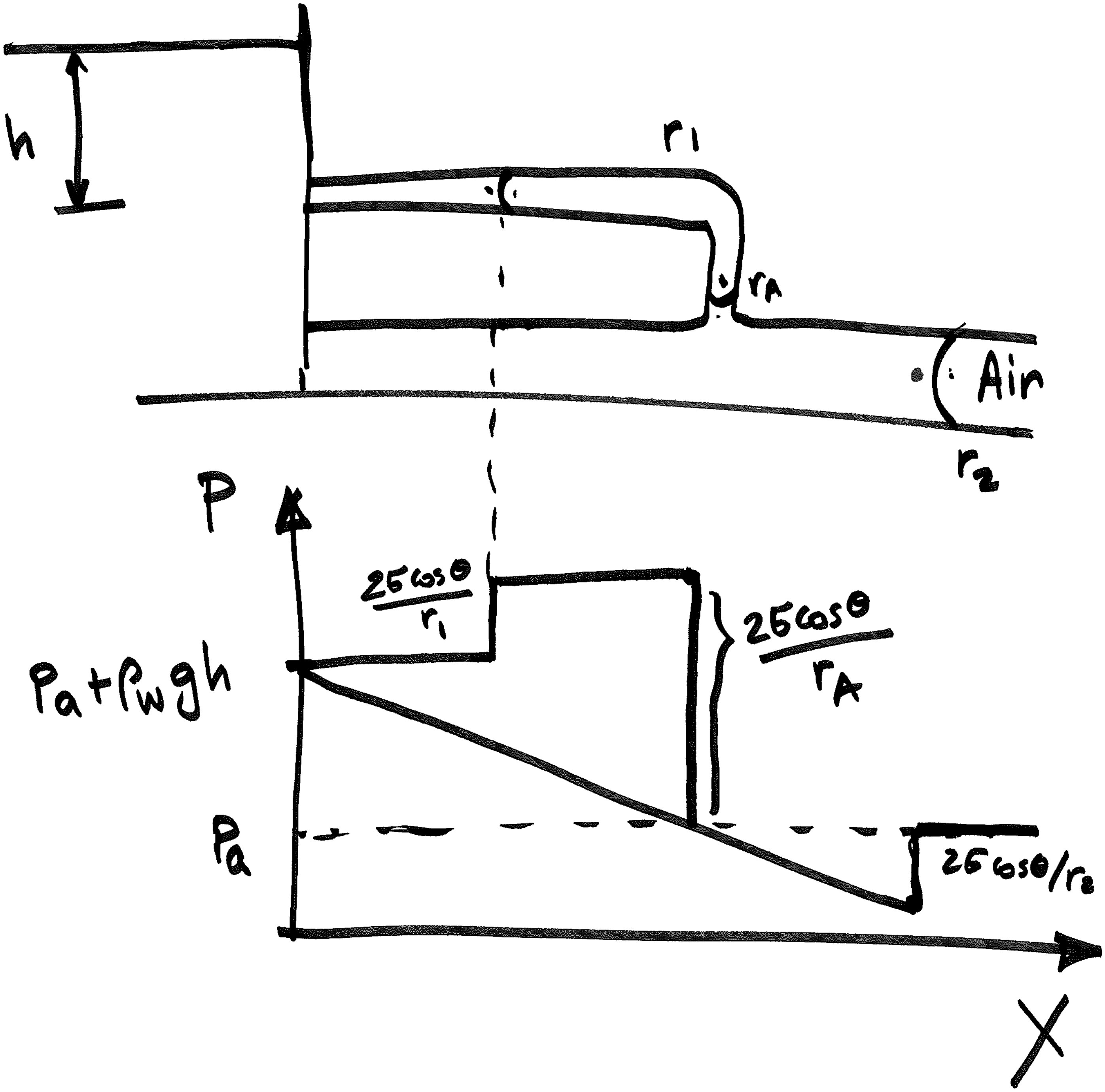
$$P_B > P_A$$

flow from B to A

$$P_0 + \frac{4\delta}{r'_A} = P_0 + \frac{4\delta}{r'_B}$$

$$\rightarrow r'_A = r'_B$$




h
r1
rA
Air
r2
P
2σcosθ / r1
2σcosθ / rA
Pa+ρwgh
Pa
2σcosθ/r2
X