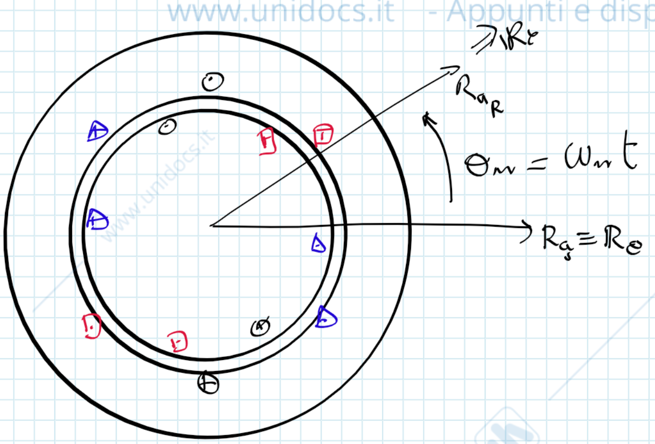


$$\bar{\varphi}_s^s = \frac{3}{2} L_s \bar{i}_s^s + \frac{3}{2} L_m e^{j\theta_m} \bar{i}_R^R$$

$$\bar{\varphi}_R^R = \underbrace{\frac{3}{2} L_R \bar{i}_R^R}_{\text{"auto" indutt.}} + \underbrace{\frac{3}{2} L_m e^{-j\theta_m} \bar{i}_s^s}_{\text{"mutua" indutt}}$$

$$\begin{cases} \bar{v}_s^s = R_s \bar{i}_s^s + \dfrac{d\bar{\varphi}_s^s}{dt} \\ \bar{v}_R^R = R_R \bar{i}_R^R + \dfrac{d\bar{\varphi}_R^R}{dt} \end{cases}$$

OB: ARRIVARE MODELLO CIRCUITALE

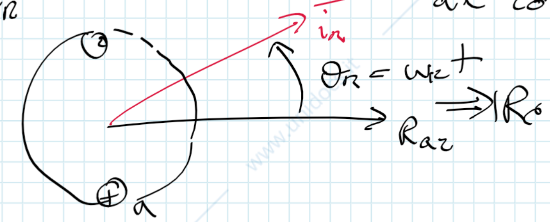
ω = puls. alim. statore → vel. campo rot.

ω_m = velocità rotore

ω_R = velocità fasore $\bar{i}_R$ rispetto al rotore

1. Verificare che $\omega_R = \omega - \omega_m$

$\bar{v}_R^R = V_R e^{j\omega_R t}$ $\quad \bar{\varphi}_R^R$, $\bar{i}_R^R$

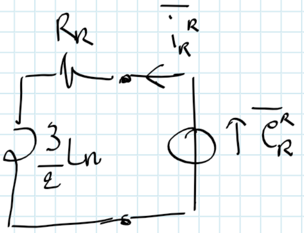


analizz. la f.e.m. quando il rotore è aperto ($i_R = 0$)

$$\bar{\varphi}_R^R = \frac{3}{2} L_m e^{-j\omega_m t} \underbrace{\sqrt{\frac{3}{2}} I_M e^{j\omega t}}_{\bar{i}_s^s} \Rightarrow \bar{\varphi}_R^R = \varphi_R e^{j\omega_R t} = \frac{3}{2} L_m \sqrt{\frac{3}{2}} I_s e^{j(\omega-\omega_m)t}$$

$$\bar{e}_R^R = j(\omega-\omega_m) \cdot \frac{3}{2} L_m \sqrt{\frac{3}{2}} I_s e^{j(\omega-\omega_m)t}$$

$$\Downarrow$$



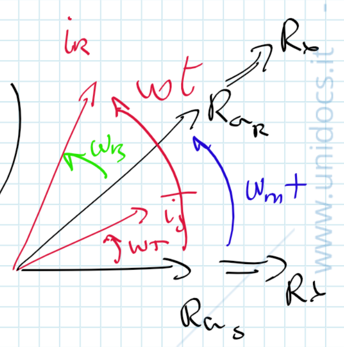
$\bar{i}_R^R$ = la stessa pulsazione di $\bar{e}_R^R \Rightarrow \bar{i}_R^R = I_R e^{j\omega_R}$

$$\boxed{\omega_R = \omega - \omega_m}$$

$$\frac{d\bar{\varphi}_s^s}{dt} = \frac{3}{2} L_s \bar{i}_s + \frac{3}{2} L_m e^{j\theta_m} \bar{i}_R^R$$

$$\bar{v}_s = R_s \bar{i}_s + \overbrace{j\omega \frac{3}{2} L_s \bar{i}_s + \frac{d}{dt}\left(\frac{3}{2} L_m \cancel{e^{j\omega_m t}} \sqrt{\frac{3}{2}} I_R e^{j(\omega - \cancel{\omega_m})t}\right)}$$

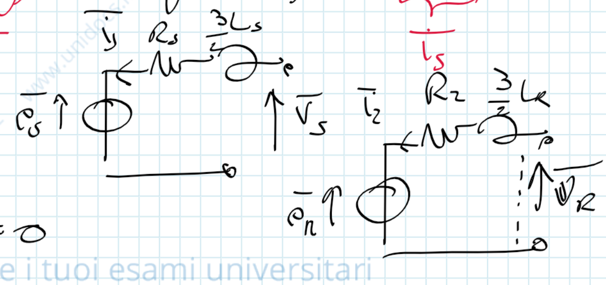
$$= R_s \bar{i}_s + j\omega \frac{3}{2} L_s \bar{i}_s + j\omega \frac{3}{2} L_m \underbrace{\sqrt{\frac{3}{2}} I_R e^{j\omega t}}_{\bar{i}_R}$$



$$\bar{v}_R^R = V_R e^{j\omega t} e^{-j\omega_m t} = R_R i_R e^{j\omega t} e^{-j\omega_m t} + j(\omega-\omega_m)\frac{3}{2} L_R i_R e^{j\omega t} e^{-j\omega_m t} + \frac{d}{dt}\left(\frac{3}{2} L_m e^{-j\omega_m t} \cdot i_s e^{j\omega t}\right)$$

$$\underbrace{V_R e^{j\omega t}}_{\bar{v}_R} \cancel{e^{-j\omega_m t}} = R_R \underbrace{i_R e^{j\omega t}}_{\bar{i}_R} \cancel{e^{-j\omega_m t}} + j(\omega-\omega_m)\frac{3}{2} L_R \underbrace{i_R e^{j\omega t}}_{\bar{i}_R} \cancel{e^{-j\omega_m t}} + j(\omega-\omega_m)\frac{3}{2} L_m \underbrace{i_s e^{j\omega t}}_{\bar{i}_s} \cancel{e^{-j\omega_m t}}$$

$$\begin{cases} \bar{v}_s = R_s \bar{i}_s + j\omega \frac{3}{2} L_s \bar{i}_s + \overbrace{j\omega \frac{3}{2} L_m \bar{i}_R}^{\bar{e}_s} \\ \bar{v}_R = R_R \bar{i}_R + j(\omega-\omega_m)\frac{3}{2} L_R \bar{i}_R + \underbrace{j(\omega-\omega_m)\frac{3}{2} L_m \bar{i}_s}_{\bar{e}_R} = 0 \end{cases}$$



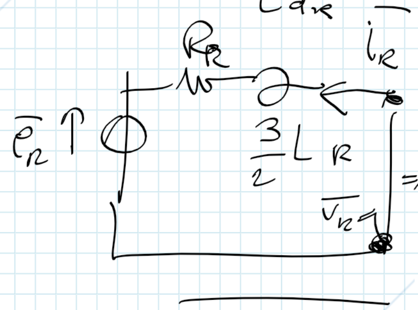
$$\begin{cases}\bar v_s = R_s \bar i_s + j\omega \frac{3}{2} L_s \bar i_s + j\omega\frac{3}{2} L_m \bar i_R \\ 0 = \bar v_R = R_R \bar i_R + j(\omega-\omega_m)\frac{3}{2} L_R \bar i_R + j(\omega-\omega_m)\frac{3}{2} L_m \bar i_s\end{cases} \Leftarrow \quad \bar i_s,\ \bar i_R,\ \bar v_R \text{ a } \omega$$

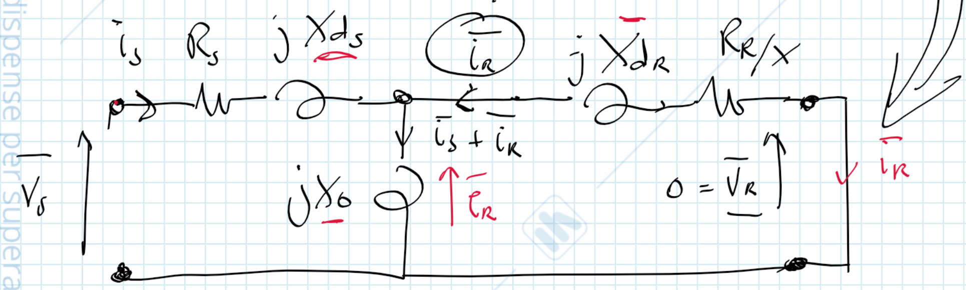
$$x = \frac{\omega-\omega_m}{\omega} = \text{scorrimento} \qquad x \neq 0 \qquad (\omega=\omega_m) \Rightarrow (\bar i_R = 0)$$

$$0 = \frac{R_R}{x}\bar i_R + j\omega\frac{3}{2} L_R \bar i_R + j\omega \frac{3}{2} L_m \bar i_s \pm j\omega\frac{3}{2} L_m \bar i_R \qquad \overbrace{\frac{3}{2} L_s - \frac{3}{2} L_m}^{L_{ds}}$$

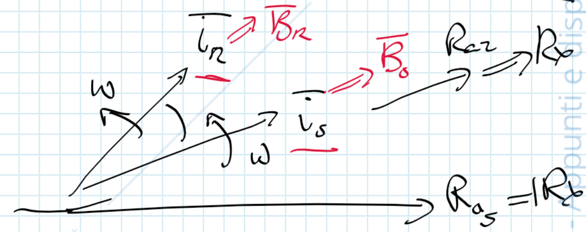
$$\bar v_s = R_s\bar i_s + j\underbrace{\omega\frac{3}{2} L_s}_{x_{ds}} \bar i_s + j\omega\frac{3}{2} L_m\bar i_R \pm j\omega \frac{3}{2} L_m \bar i_s \qquad \underbrace{\frac{3}{2} L_R - \frac{3}{2} L_m}_{L_{dR}}$$

$$\begin{cases}\bar v_s = R_s\bar i_s + j\omega \overbrace{L_{ds}}^{x_{ds}} \bar i_s + j\omega\frac{3}{2} L_m(\bar i_s+\bar i_R) \\ 0 = \frac{R_R}{x}\bar i_R + j\underbrace{\omega L_{dR}}_{X_{dR}}\bar i_R + j\underbrace{\omega\frac{3}{2} L_m}_{X_0}(\bar i_s+\bar i_R)\end{cases}$$





CIRCUITO TRASFORMATORICO



MODELLI RIDOTTI

$$\frac{\bar v_R^*}{\bar v_R} = \frac{\bar i_R}{\bar i_R^*} = H \qquad \underline{\bar v_R\cdot\bar i_R = \bar v_R^*\cdot\bar i_R^*} \Leftarrow \text{ mantengo eff. energetica}$$

$$\omega\frac{3}{2} L_s = X_s \qquad \omega\frac{3}{2} L_m = X_0 \qquad \omega\frac{3}{2} L_R = X_R$$

$$\begin{cases}\bar v_s = R_s\bar i_s + jX_s\bar i_s + jX_0\bar i_R \\ 0 = \bar v_R = \frac{R_R}{x}\bar i_R + jX_R\bar i_R + jX_0\bar i_s\end{cases}$$

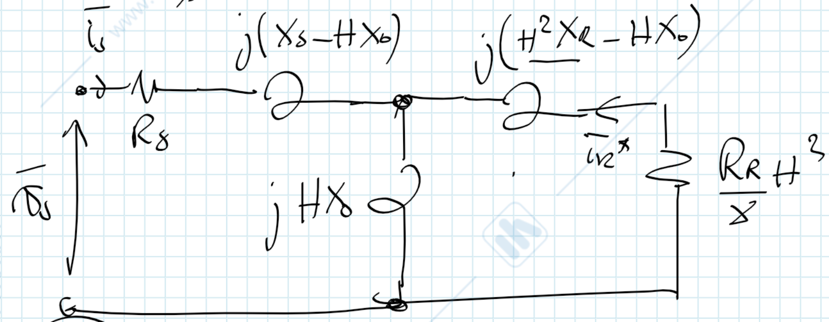
$$\bar i_R \Rightarrow i_R^* \qquad \boxed{\begin{aligned}\bar i_R &= H i_R^* \\ \bar v_R &= \bar v_R^*/H\end{aligned}}$$

$$\bar v_R^* = 0$$

$$\begin{cases}\bar v_s = R_s\bar i_s + jX_s\bar i_s + jX_0 H i_R^* \\ \frac{\bar v_R^*}{H} = \frac{R}{x}H i_R^* + jX_R H i_R^* + jX_0\bar i_s\end{cases} \Rightarrow \bar v_R^* = \frac{R}{x}H^2 i_R^* + jX_R H^2 i_R^* + jX_0 H\bar i_s = 0$$

$$\begin{cases} \bar{v}_S = R_S\,\bar{i}_S + jX_S\,\bar{i}_S + jHX_0\,\bar{i}_R^* \pm jHX_0\,\bar{i}_S \\ \bar{v}_R^* = \dfrac{R_R}{x}\,H^2\,\bar{i}_R^* + jH^2X_R\,\bar{i}_R^* + jHX_0\,\bar{i}_S \pm jHX_0\,\bar{i}_R^* = 0 \end{cases}$$

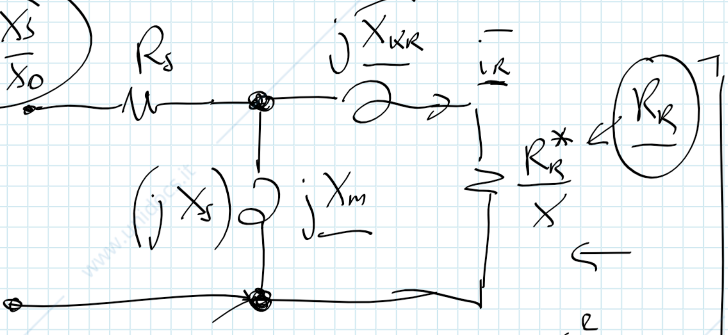
$\rightarrow \bar{v}_R, \bar{i}_R$



$\boxed{H = \frac{X_S}{X_0}}$ sparisce il termine $X_S - HX_0 = X_{dS}$

$\boxed{H = \frac{X_0}{X_R}}$ sparisce X_{dR}

$H = \frac{X_S}{X_0}$

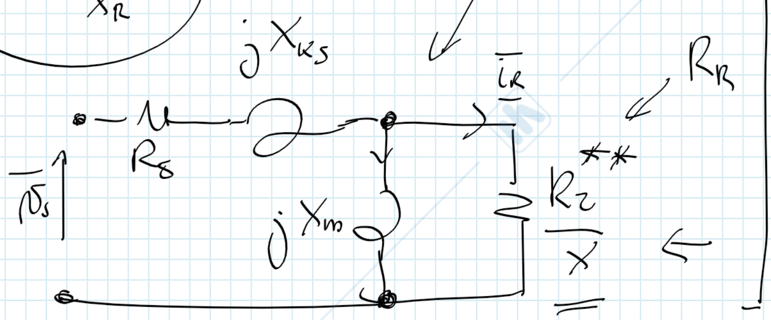


X_{KR} = REATT. DI C.C. ROTORICA

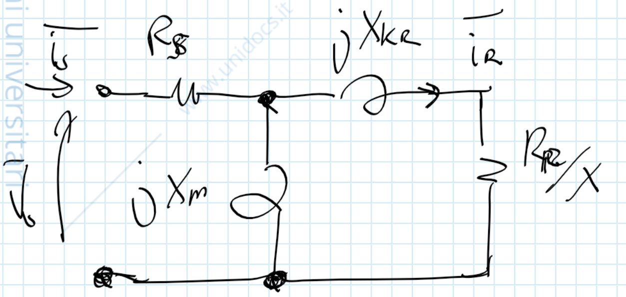
RIDOTTI NON APPROX !!

$X_m = \frac{X_0^2}{X_R}$

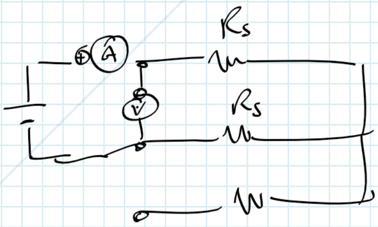
$H = \frac{X_0}{X_R}$



X_{KS} = REATT. DI C.C STATORICA



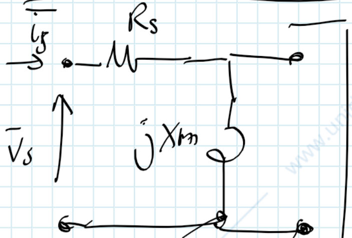
R_S = misurata



R_S è nota o misurata

PROVA "A VUOTO" — PROVA "CORTO CIRCUITO"

$\boxed{\text{PROVA "A VUOTO"}}$ → SENZA CARICO → MECCANICO → $\omega = \omega_m \Rightarrow x = 0$, $\bar{I}_R = 0$



⇒

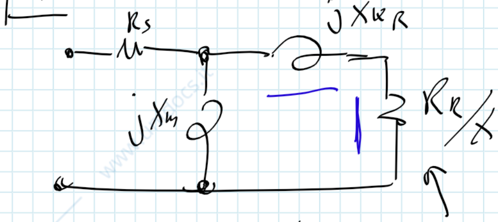
R_S misurata $\quad \bar{i}_S, \bar{V}_S$

fas. spaz.

$$\begin{cases} P_{attiva} \Rightarrow R_S = R_S\,i_S^2 = P_{TOT} = 3P_{fase} \\ Q_{REATTIVA} \Rightarrow X_m = X_m\,i_S^2 = Q_{TOT} = 3Q_{fase} \end{cases}$$

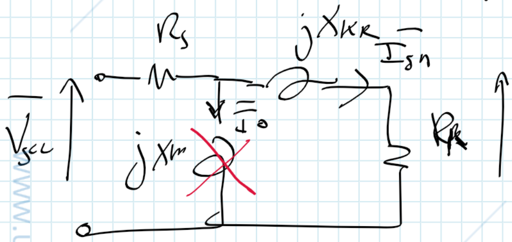
$(i_S = \sqrt{3}\ i_{eff\ fase})$

PROVA DI "CORTO - CIRCUITO" (ROTORE BLOCCATO)



$X = \frac{\omega - \omega_m}{\omega}$ $\quad X \to 0$

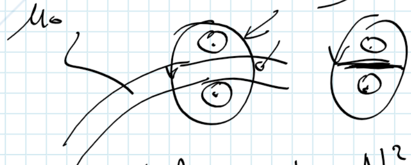
$X = 1 \Rightarrow \omega_m = 0$ ROTORE BLOCCATO



GENERA ALTE CORR. ⇒ $\bar{V}_{scc}$ opp. ridotta

$\bar{I}_s$ nominale.

$\bar{I}_0$ (corr. che passa in X_m è trasc.)



$\Theta = \frac{1}{\mu_0}\frac{l}{A} \Rightarrow L = \frac{N^2}{\Theta}$

Pattiva ⇒ $R_s + R_R$

Qreattiva ⇒ X_{KR} (X_m trascurabile)