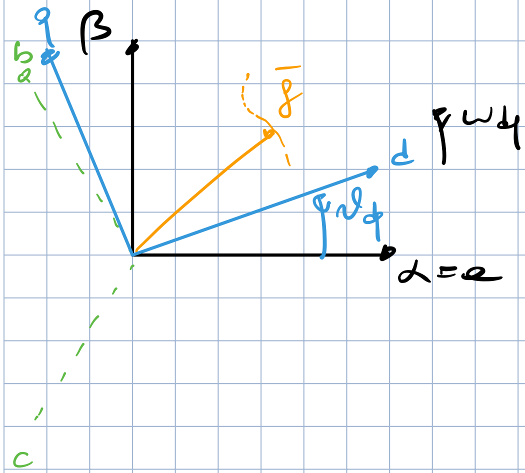
VETTORI SPAZIALI 2



$$\bar{g} = \frac{2}{3}\left[g_a + g_b e^{j\frac{2}{3}\pi} + g_c e^{j\frac{4}{3}\pi} \right]$$

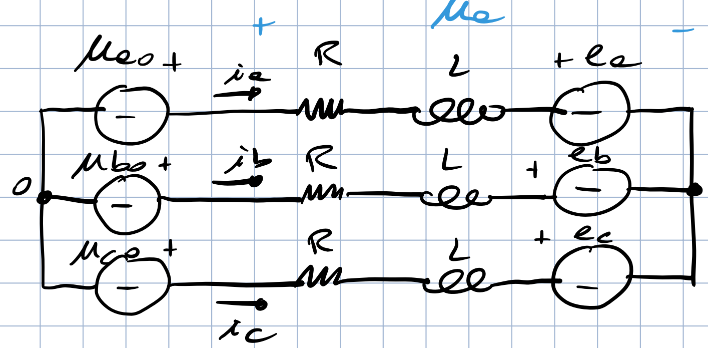
$$= g_\alpha + j g_\beta$$

$$\vartheta_{dq} = \int_0^t \omega_{dq}\, dt$$

$$\bar{g}_{dq} = \bar{g}_{\alpha\beta}\, e^{-j\vartheta_{dq}}$$

$$\bar{g}_{\alpha\beta} = \bar{g}_{dq}\, e^{j\vartheta_{dq}}$$

CIRCUITO RLE TRIFASE



$$\bar{g} = \frac{2}{3}\left[g_a + g_b e^{j\frac{2}{3}\pi} + g_c e^{j\frac{4}{3}\pi} \right]$$

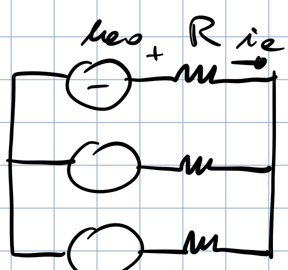
$$u_a = R i_a + L\frac{di_a}{dt} + e_a = u_{a0} - u_{N0}$$

$$u_b = R i_b + L\frac{di_b}{dt} + e_b = u_{b0} - u_{N0}$$

$$u_c = R i_c + L\frac{di_c}{dt} + e_c = u_{c0} - u_{N0}$$

$$\bar{u} = R\bar{i} + L\frac{d\bar{i}}{dt} + \bar{e} = \bar{u}_{x0} - \bar{0}$$

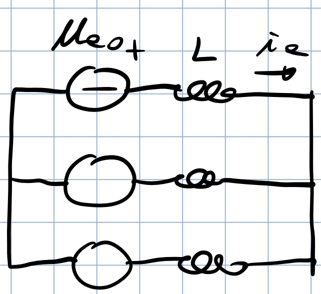
(1) $L = 0$ $\quad \bar{e} = 0$



$$\bar{u} = R\bar{i}$$

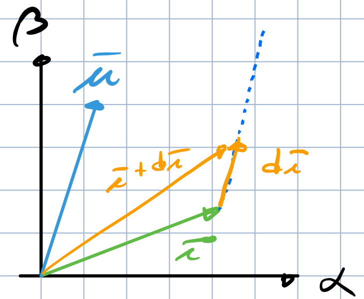
$$\bar{i} = \frac{\bar{u}}{R}$$

② $R=0 \qquad \bar{e}=0$



$$\bar{u} = L\frac{d\bar{i}}{dt}$$

$$d\bar{i} = \frac{1}{L}\bar{u}\,dt$$



In TRANSITORIO

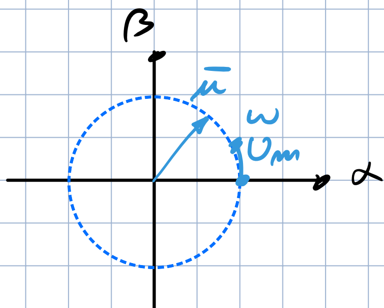
Caso particolare $\quad \bar{u} = U_m e^{j\omega t}$

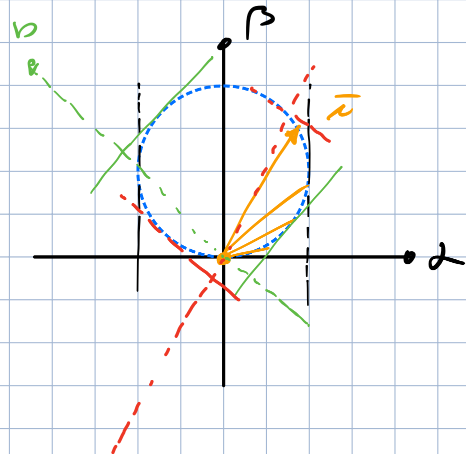
$$\bar{i} = \cancel{\bar{i}(0)} + \int_0^t \frac{1}{L}\bar{u}\,dt \qquad i(0)=0$$

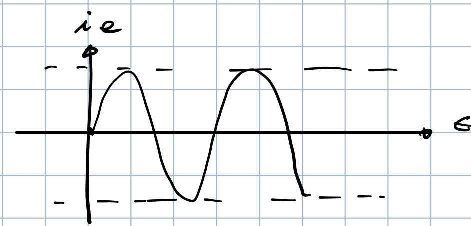
$$= \int_0^t \frac{1}{L} U_m e^{j\omega t}\,dt = \frac{U_m}{L}\int_0^t e^{j\omega t}\,dt = \frac{U_m}{j\omega L}\left[e^{j\omega t} - 1\right]$$

$$= \frac{U_m e^{j\omega t}}{j\omega L} - \frac{U_m}{j\omega L}$$

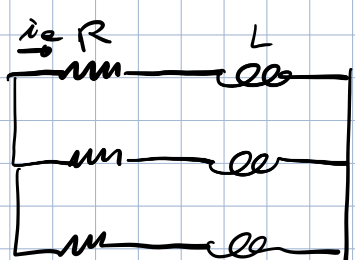
$$= \frac{\bar{u}}{j\omega L} - \frac{U_m}{j\omega L} = \frac{\bar{u} - U_m}{j\omega L} = \frac{\bar{u} - U_m}{\omega L}e^{-j\pi/2} = \bar{i}$$







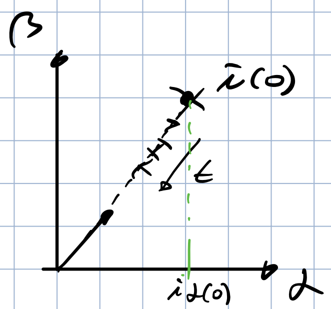
③ $\bar{e}=0 \qquad \bar{u}=0$

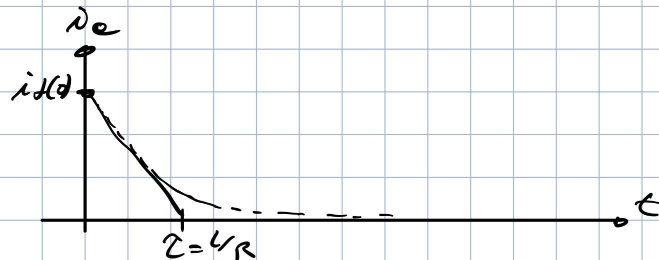


$$R\bar{i} + L\frac{d\bar{i}}{dt} = 0$$

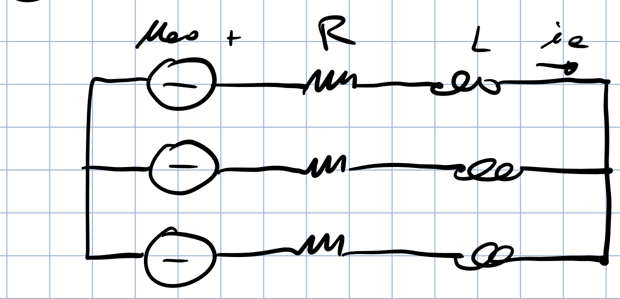
Ho solo evoluzione libera

$$\bar{i} = \bar{i}(0)\,e^{-t/\tau} \qquad \tau = L/R \qquad \bar{i}(0) \in \mathbb{C}$$





(4) $\bar e = 0$



$$\bar u = R\bar i + L\frac{d\bar i}{dt} \qquad \bar u = U_m e^{j\omega t}$$

$$\bar i = \bar i_o + \bar i_p$$

REGIME PERMANENTE

SOLUZIONE LIBERA

$\bar i_o = \bar A e^{-t/\tau}$ $\qquad \bar A \in \mathbb{C}$ costante da calcolare

$\bar i_p = \bar I_p e^{j\omega t}$

$$\bar u = R\bar i_p + L\frac{d\bar i_p}{dt} = U_m e^{j\omega t}$$

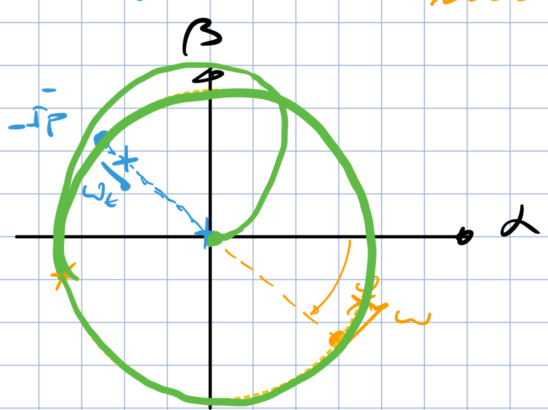
$$R\bar I_p \cancel{e^{j\omega t}} + L\bar I_p \cancel{e^{j\omega t}}(j\omega) = U_m \cancel{e^{j\omega t}}$$

$$\bar I_p(R+j\omega L) = U_m \qquad \bar I_p = \frac{U_m}{R+j\omega L}$$

$\bar i = \bar A e^{-t/\tau} + \frac{U_m}{R+j\omega L} e^{j\omega t}$ $\qquad$ SOLUZIONE GENERALE

$$\bar i(0) = 0 = \bar A \cdot 1 + \frac{U_m}{R+j\omega t}\cdot 1 \Rightarrow \bar A = -\frac{U_m}{R+j\omega L} = -\bar I_p$$

$$\bar i = -\frac{U_m}{R+j\omega L} e^{-t/\tau} + \frac{U_m}{R+j\omega L} e^{j\omega t}$$



$\varphi = \arctan\frac{\omega L}{R}$

Come risolvere in dq?

$$\bar u_{\alpha\beta} = R\,\bar i_{\alpha\beta} + L\,\frac{d\bar i_{\alpha\beta}}{dt}$$

$$\bar u_{\alpha\beta} = \bar u_{dq}\, e^{j\vartheta_{dq}}$$

$$\bar i_{\alpha\beta} = \bar i_{dq}\, e^{j\vartheta_{dq}}$$

$$\bar u_{dq}\, e^{j\vartheta_{dq}} = R\,\bar i_{dq}\, e^{j\vartheta_{dq}} + L\,\frac{d}{dt}\left(\bar i_{dq}\, e^{j\vartheta_{dq}}\right) \qquad \frac{d\vartheta_{dq}}{dt} = \omega_{dq} \overset{!}{=} \omega$$

$$\bar u_{dq}\,\cancel{e^{j\vartheta_{dq}}} = R\,\bar i_{dq}\,\cancel{e^{j\vartheta_{dq}}} + L\,\frac{d\bar i_{dq}}{dt}\,\cancel{e^{j\vartheta_{dq}}} + L\,\bar i_{dq}\, j\omega\,\cancel{e^{j\vartheta_{dq}}}$$

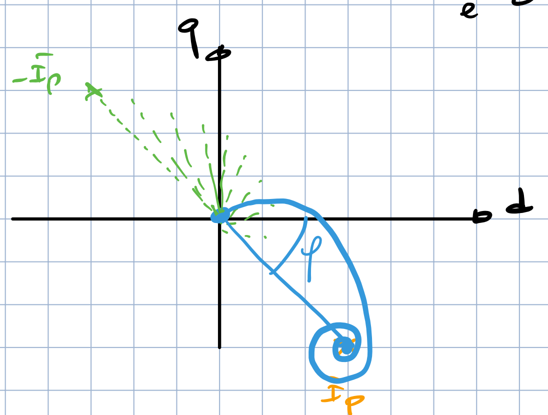
$$\bar u_{dq} = R\,\bar i_{dq} + L\,\frac{d\bar i_{dq}}{dt} + j\omega L\,\bar i_{dq}$$

$$\bar u_{dq} = U_m = R\,\bar i_{dq} + L\,\frac{d\bar i_{dq}}{dt} + j\omega L\, i_{dq} = (R + j\omega L)\,\bar i_{dq} + L\,\frac{d\bar i_{dq}}{dt} \qquad \bar i_{dq} = \bar i_{dq0} + \bar i_{dqp}$$

$$\left.\begin{array}{l} \bar i_{dq0} = \bar A\, e^{-\frac{R+j\omega L}{L}t} \\[2em] \bar i_{dqp} = cost = \bar I_p = \dfrac{U_m}{R+j\omega L} \end{array}\right\} \bar i_{dq} = \bar A\, e^{-\frac{R+j\omega L}{L}t} + \frac{U_m}{R+j\omega L}$$

$$\bar i_{dq}(0) = 0 = \bar A\cdot 1 + \frac{U_m}{R+j\omega L} \Rightarrow \bar A = \frac{-U_m}{R+j\omega L}$$

$$\bar i_{dq} = -\frac{U_m}{R+j\omega L}\, e^{-\frac{R+j\omega L}{L}t} + \frac{U_m}{R+j\omega L} = \frac{U_m}{R+j\omega L} - \frac{U_m}{R+j\omega L}\,\underbrace{e^{-\frac{R}{L}t}}_{e^{-t/\tau}}\, e^{-j\omega t} \qquad \tau = L/R$$



$$\bar I_p = \frac{U_m}{R+j\omega L}$$