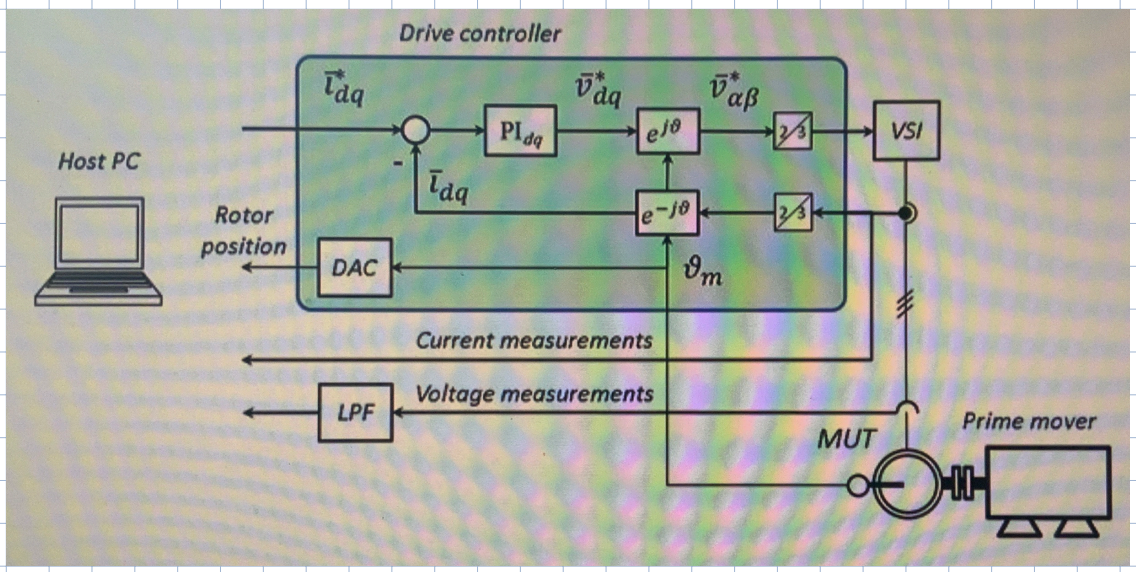
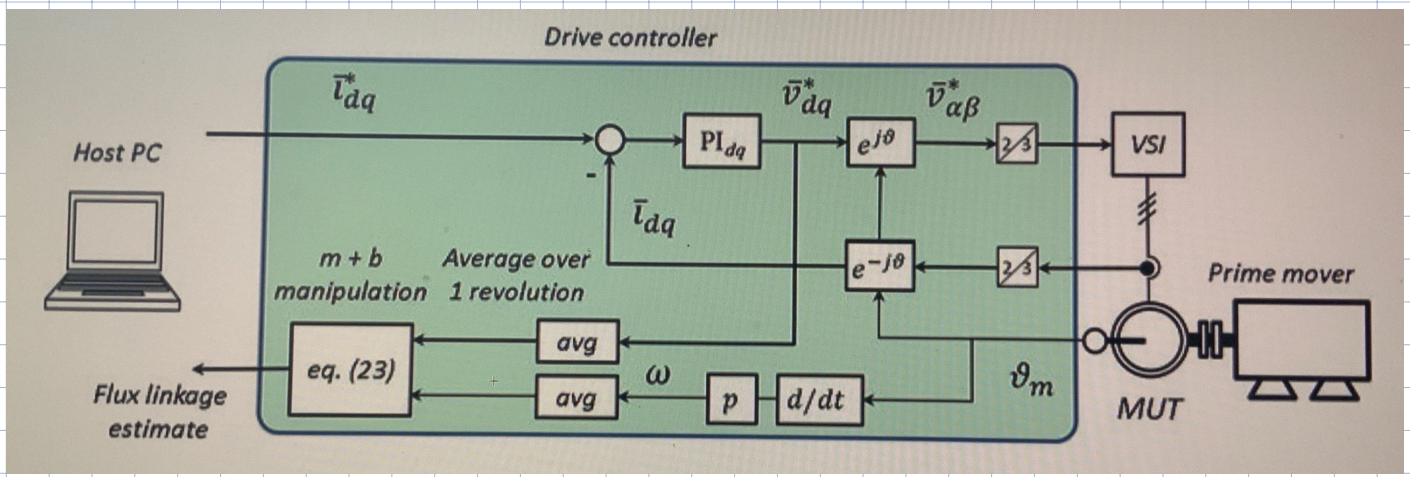




$\lambda_d(I_d, I_q^+) = \lambda_d(I_d, I_q^-)$ $\quad$ $\lambda_q(I_d, I_q^+) = -\lambda_q(I_d, I_q^-)$

$I_q^+ = -I_q^-$

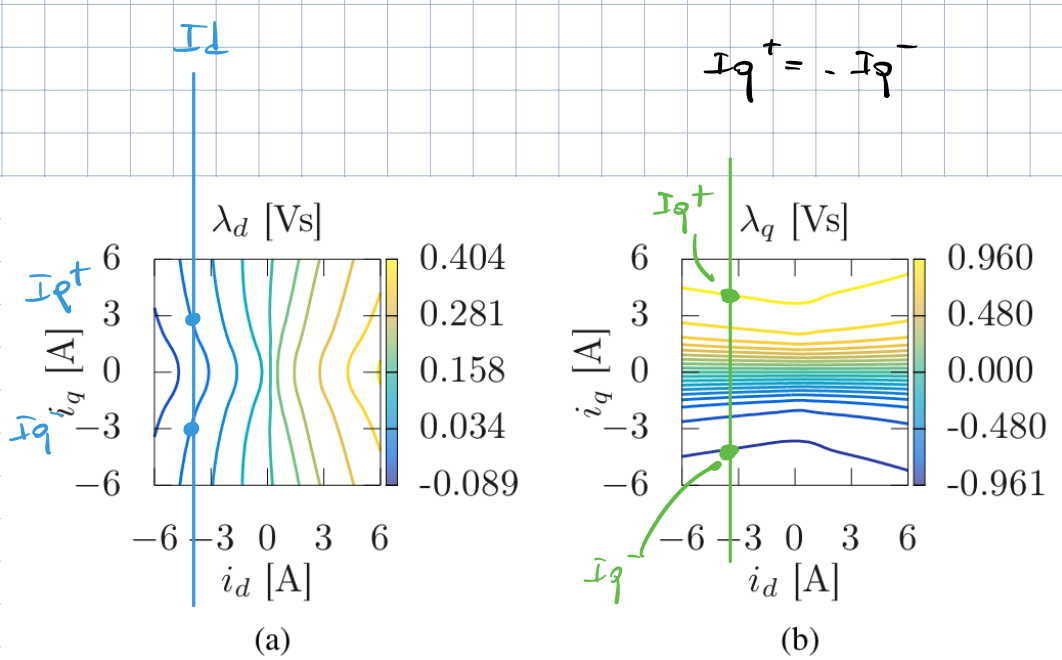


Fig. 4: PMA-SynRM flux-linkages maps (finite element analysis). (a) $\lambda_d(i_d, i_q)$ (b) $\lambda_q(i_d, i_q)$

$$\begin{cases} V_d = R I_d - \omega_m^e \lambda_q \\ V_q = R I_q + \omega_m^e \lambda_d \end{cases}$$

$$\begin{cases} V_d^+ = R I_d - \omega_m^e \lambda_q^+ \\ V_q^+ = R I_q^+ + \omega_m^e \lambda_d^+ \end{cases} \qquad I_d \; I_q^+$$

$$\begin{cases} V_d^- = R I_d - \omega_m^e \lambda_q^- \\ V_q^- = R I_q^- + \omega_m^e \lambda_d^- \end{cases} \qquad I_d \; I_q^-$$

$I_q^+ = -I_q^-$

I_q^+ → MOTORE

I_q^- → GENERATORE

$$\left.\begin{aligned} \lambda_d^+ &= \lambda_d^- \\ \lambda_q^+ &= -\lambda_q^- \end{aligned}\right\} \text{Vale x simmetria di flusso}$$

Se combino le equazioni ottengo:

$$V_d^- - V_d^+ = \cancel{R I_d} - \omega_m^e \lambda_q^- - \cancel{R I_d} + \omega_m^e \lambda_q^+$$

$$= 2 \omega_m^e \lambda_q^+$$

$$V_q^+ + V_q^- = \cancel{R I_q^+} + \omega_m^e \lambda_d^+ + \cancel{R I_q^-} + \omega_m^e \lambda_d^-$$

$$= 2 \omega_m^e \lambda_d^+$$

Da cui:

$$\lambda_d^+ (I_d, I_q^+) = \frac{V_q^+ + V_q^-}{2 \omega_m^e}$$

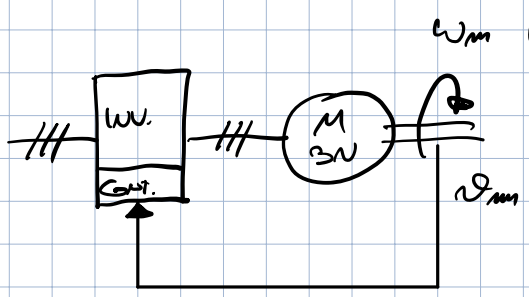
$$\lambda_q^+ (I_d, I_q^+) = \frac{V_d^- - V_d^+}{2 \omega_m^e}$$

- Ho ancora R !
- Compenso non idealità inverter e uso i riferimenti
- Si possono usare anche tecniche evolute di SCCF - COMPENSAZIONE Dell'inverter.

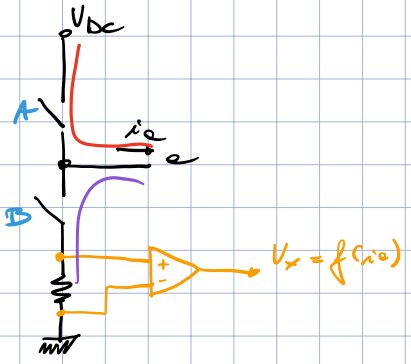
BRUSH-LESS

SENSOR-LESS

- COSTO
- MINOR INGOMBRO / PESO
- FAULT-TOLERANT



MISURA DI CORRENTE

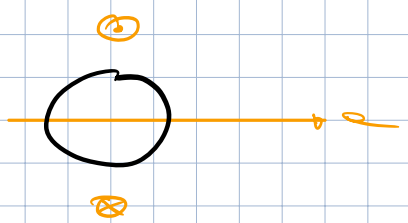


MISURA DI TENSIONE

PWM ?

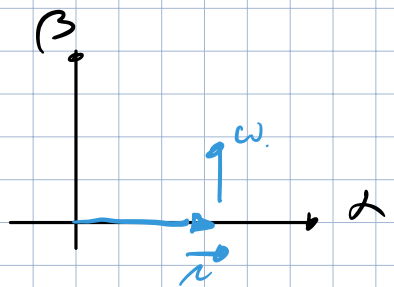
Usare i Riferimenti!

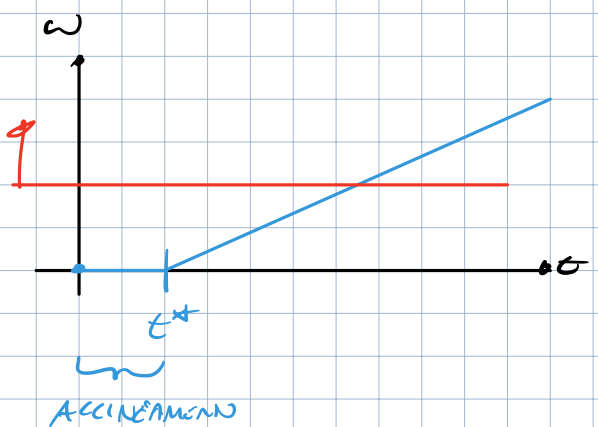
	BASSA VELOCITÀ	ALTA VELOCITÀ
MACCHINA ISOTROPA	Molto difficile/impossibile	$J_m \frac{d\omega_m}{dt}$
MACCHINA ANISOTROPA	Ricorrere all'anisotropia	per stimare l'angolo



VELOCITÀ MOLTO BASSE $\omega_m^e \geq 0{,}2\,\omega_B$

COME PARTO?





$$\vartheta_m^e = \int_0^t \omega_m^e \, dt$$

STIMATORE A CATENA APERTA DEL FLUSSO DEI MAGNETI $\alpha\beta$

$$\vec{v} = R\vec{i} + \frac{d\vec{\lambda}}{dt} \qquad \vec{\lambda} = L\vec{i} + \vec{\lambda}_m$$

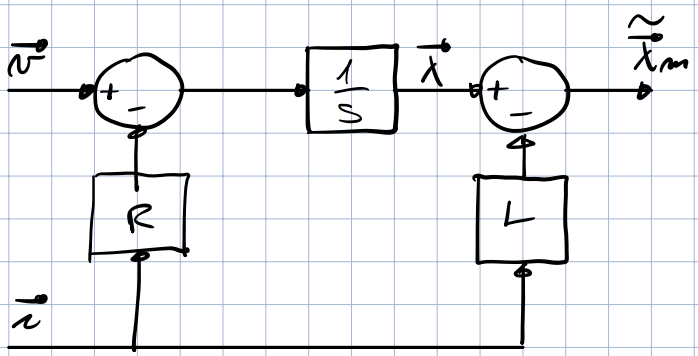
$\alpha\beta$ MACCHINA ISOTROPA

$\vec{\lambda}$ contiene info su ϑ_m^e

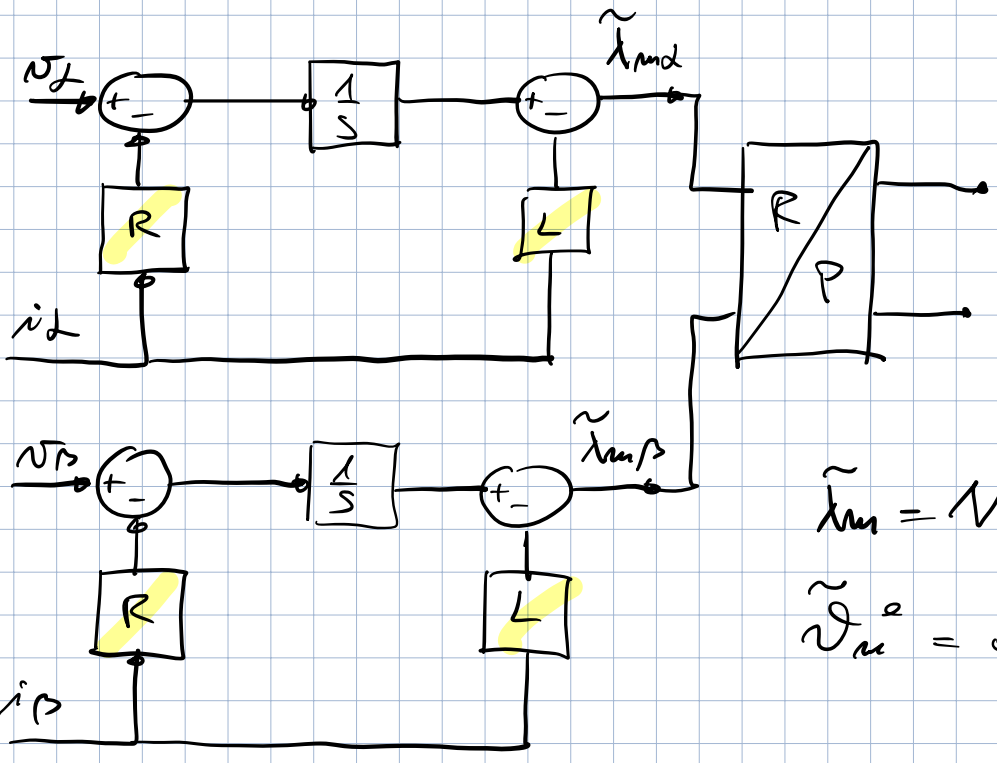
$$\vec{\lambda} = \int \vec{v} - R\vec{i}\,dt \qquad \vec{\lambda} = \vec{\lambda}(0) + \int_0^t \vec{v} - R\vec{i}\,dt$$

$$\vec{\lambda}_m = \vec{\lambda} - L\vec{i}$$

$$\tilde{\vec{\lambda}}_m = \int_0^t \vec{v} - R\vec{i}\,dt - L\vec{i}$$



$$\vec{\lambda}_m = \lambda_m e^{j\vartheta_m^e}$$



$$\tilde{\lambda}_m = \sqrt{\tilde{\lambda}_{m\alpha}^2 + \tilde{\lambda}_{m\beta}^2}$$

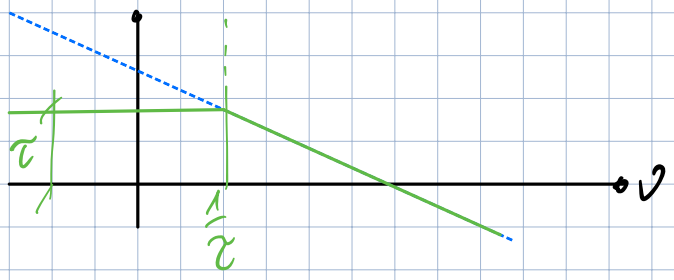
$$\tilde{\vartheta}_m^e = \operatorname{atan}\frac{\tilde{\lambda}_{m\beta}}{\tilde{\lambda}_{m\alpha}}$$

$$\cos\vartheta_m^e = \frac{\tilde{\lambda}_{m\alpha}}{\tilde{\lambda}_m}$$

$$\sin\vartheta_m^e = \frac{\tilde{\lambda}_{m\beta}}{\tilde{\lambda}_m}$$

$$\tilde{\omega}_m^e = \frac{d\vartheta_m^e}{dt}$$

Sostituzione $\frac{1}{s} \cong \frac{\tau}{1+s\tau}$ Filtro Passa Basso



Parametri: R la cadute $|\vec{I}_m|$ modulo

L la cadute su ϑ_m^i angolo

$$\vec{v} - R\vec{i}$$

$$v_m(t) = A \operatorname{sen}\omega t + B \operatorname{sen}(100\omega t)$$

$$\frac{dv_m}{dt} = \omega A \cos\omega t + 100\omega B \cos(100\omega t)$$

STIMATORE DI FCEM

$$\vec{v} = R\vec{i} + L\frac{d\vec{i}}{dt} + \frac{d\vec{\imath}_m}{dt}$$

$$= R\vec{i} + L\frac{d\vec{i}}{dt} + \vec{e}$$

$$\vec{e} = \vec{v} - R\vec{i} - L\frac{d\vec{i}}{dt}$$

oppure