TD N° 04

MSAP M/S1 2021/2022

TD

Soit le modèle de la MSAP suivant :

$$\overline{V}_s = R_s \overline{I}_s + \frac{d\phi_s}{dt} + j\omega_s \phi_s$$

1. donner une projection sur les deux axes (d, q).
2. Développer un modèle avec les flux.
3. Donner le schéma de simulation de ce modèle.

Réponse :

$$V_{sd} + jV_{sq} = R_s(I_{sd} + jI_{sq}) + \frac{d}{dt}(\phi_{sd} + j\phi_{sq}) + j\omega_s(\phi_{sd} + j\phi_{sq})$$

$$= R_s I_{sd} + \frac{d\phi_{sd}}{dt} - \omega_s \phi_{sq} + j\left(R_s I_{sq} + \frac{d\phi_{sq}}{dt} + \omega_s \phi_{sd}\right)$$

$$\begin{cases} V_{sd} = R_s I_{sd} + \frac{d\phi_{sd}}{dt} - \omega_s \phi_{sq} \\ V_{sq} = R_s I_{sq} + \frac{d\phi_{sq}}{dt} + \omega_s \phi_{sd} \end{cases} \Rightarrow \begin{cases} \cancel{\frac{d\phi_{sd}}{dt} = R_s I_{sd} - \frac{d\phi_{sd}}{dt}} \\ \end{cases}$$

$$\begin{cases} \frac{d\phi_{sd}}{dt} = V_{sd} - R_s I_{sd} + \omega_s \phi_{sq} \\ \frac{d\phi_{sq}}{dt} = V_{sq} - R_s I_{sq} - \omega_s \phi_{sd} \end{cases} \qquad \begin{cases} \phi_{sd} = L_s I_{sd} + \phi_F \\ \phi_{sq} = L_s I_{sq} \end{cases}$$

$$I_{sd} = \frac{\phi_{sd} - \phi_F}{L_s}, \qquad I_{sq} = \frac{\phi_{sq}}{L_s}$$

$$I \Rightarrow \begin{cases} \frac{d\phi_{sd}}{dt} = V_{sd} - R_s \frac{\phi_{sd} - \phi_F}{L_s} + \omega_s \phi_{sq} \\ \frac{d\phi_{sq}}{dt} = V_{sq} - R_s \cdot \frac{\phi_{sq}}{L_s} - \omega_s \phi_{sd} \end{cases}$$

$$\begin{cases} \frac{d\phi_{sd}}{dt} = V_{sd} - \frac{R_s}{L_s} \cdot \phi_{sd} - \frac{R_s}{L_s} \phi_F + \omega_s \phi_{sq} \\ \frac{d\phi_{sq}}{dt} = V_{sq} - \frac{R_s}{L_s} \cdot \phi_{sq} - \omega_s \phi_{sd} \end{cases}$$

Le Couple : $C_e = p\,\mathrm{Im}(\bar{I}_s \cdot \bar{\Phi}_s^*)$

$$C_e = p\,\mathrm{Im}\left[(I_{sd} + j I_{sq})(\Phi_{sd} - j\Phi_{sq})\right]$$

$$= p\,\mathrm{Im}\left[I_{sd}\Phi_{sd} + I_{sq}\cdot\Phi_{sq} + j(\Phi_{sd}\cdot I_{sq} - I_{sd}\Phi_{sq})\right]$$

$$= p(\Phi_{sd}\cdot I_{sq} - I_{sd}\Phi_{sq})$$

$$= p\left(\Phi_{sd}\cdot\frac{\Phi_{sq}}{L_s} - \frac{\Phi_{sd} - \Phi_F}{L_s}\cdot\Phi_{sq}\right)$$

$$= \frac{p}{L_s}\left(\cancel{\Phi_{sd}\,\Phi_{sq}} - \cancel{\Phi_{sd}\cdot\Phi_{sq}} + \Phi_F\cdot\Phi_{sq}\right) = \frac{p}{L_s}\cdot\Phi_F\cdot\Phi_{sq}$$

l'éq. mécanique : $C_e - C_r = J\frac{d\Omega}{dt} + f\Omega$

$$\Rightarrow C_e - C_r = (Js + f)\Omega \Rightarrow \Omega = \frac{C_e - C_r}{Js + f}$$

Schéma de Simulation :