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Lec-19
Date-

Standard Parameter based Models - I

- States: ω $\psi_d, \psi_q, \psi_f', \psi_h', \psi_G, \psi_K$
- Assumptions: $L_{fh}' = M_{df}'$ ψ_h ψ_g, ψ_K
- Back Calculation – How ? ✓
- What we cannot get ?
- Inputs T_m , E_{fd}.

$$\frac{\Psi_d(s)}{I_d(s)} = \frac{L_d(1+sT_d')(1+sT_d'')}{(1+sT_{do}')(1+sT_{do}'')}$$

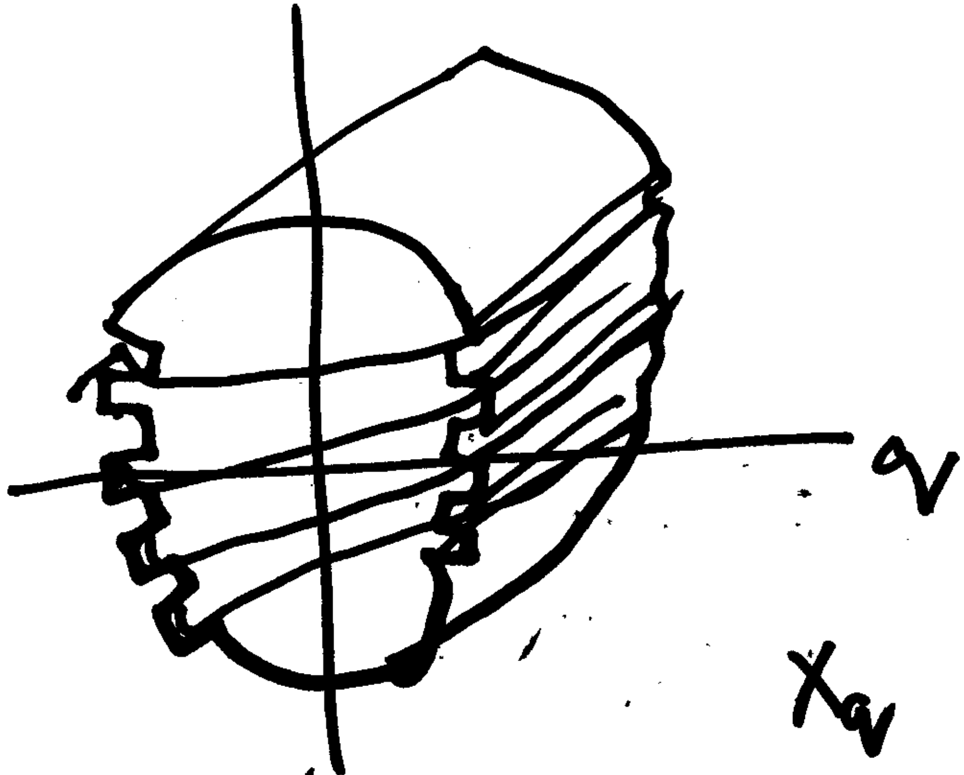
$$= \frac{(1+sB_N+s^2A_N)\,L_d}{(1+sB_D+s^2A_D)}$$

$$B_N = T_d' + T_d'', \quad A_N = T_d' T_d''$$

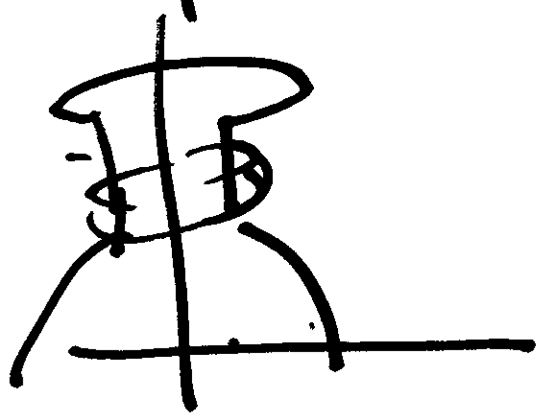
Standard Parameter based Model - II

- States: $4d$, $4q$, $4F$, $4G$, $4K$, $4H$
- Assumptions: $T_{dc}'' = T_d''$
- Back Calculation – No need
- What we cannot get ?
- Inputs

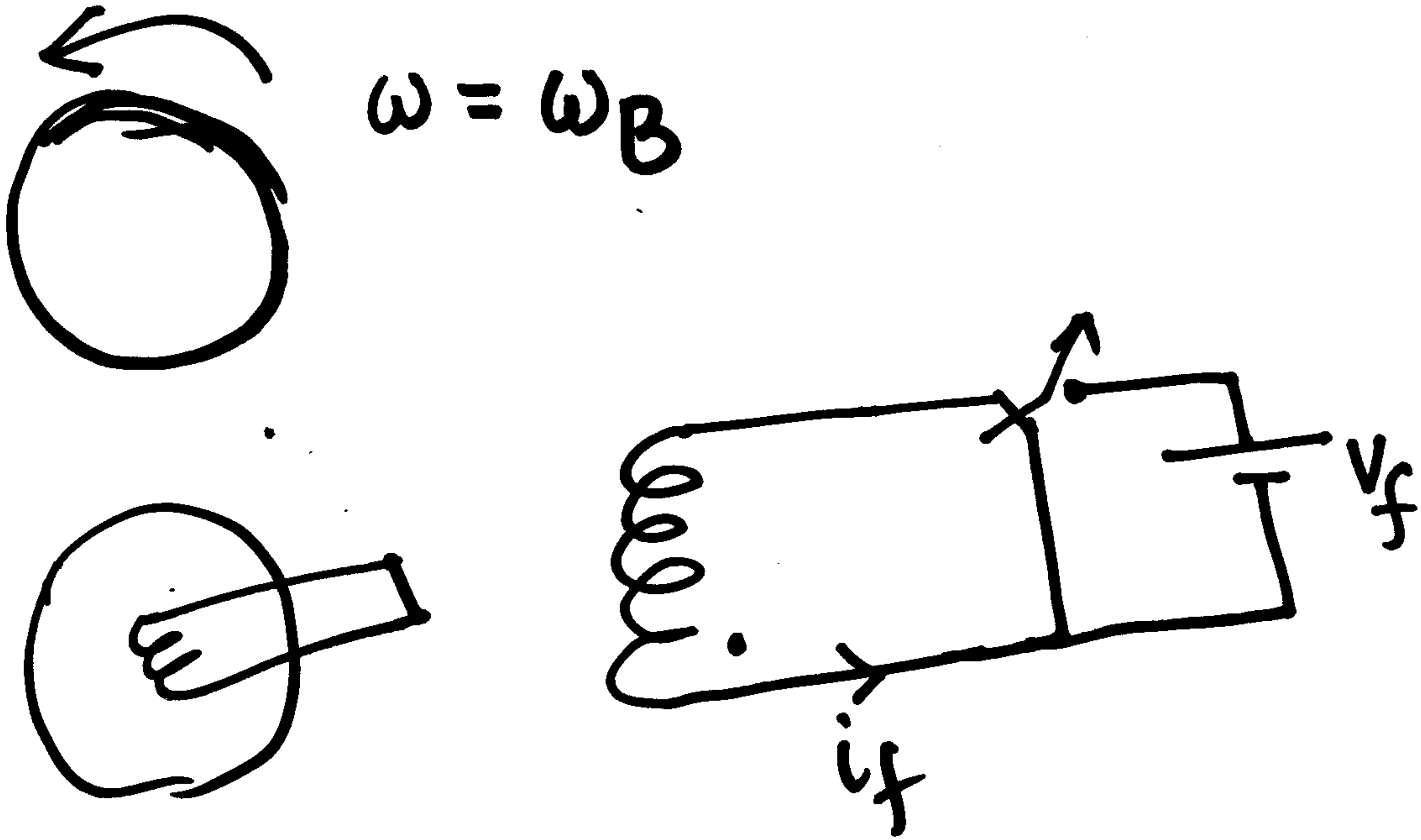
same as in Model-I



$X_q \quad X_d$



$X_q < X_d.$

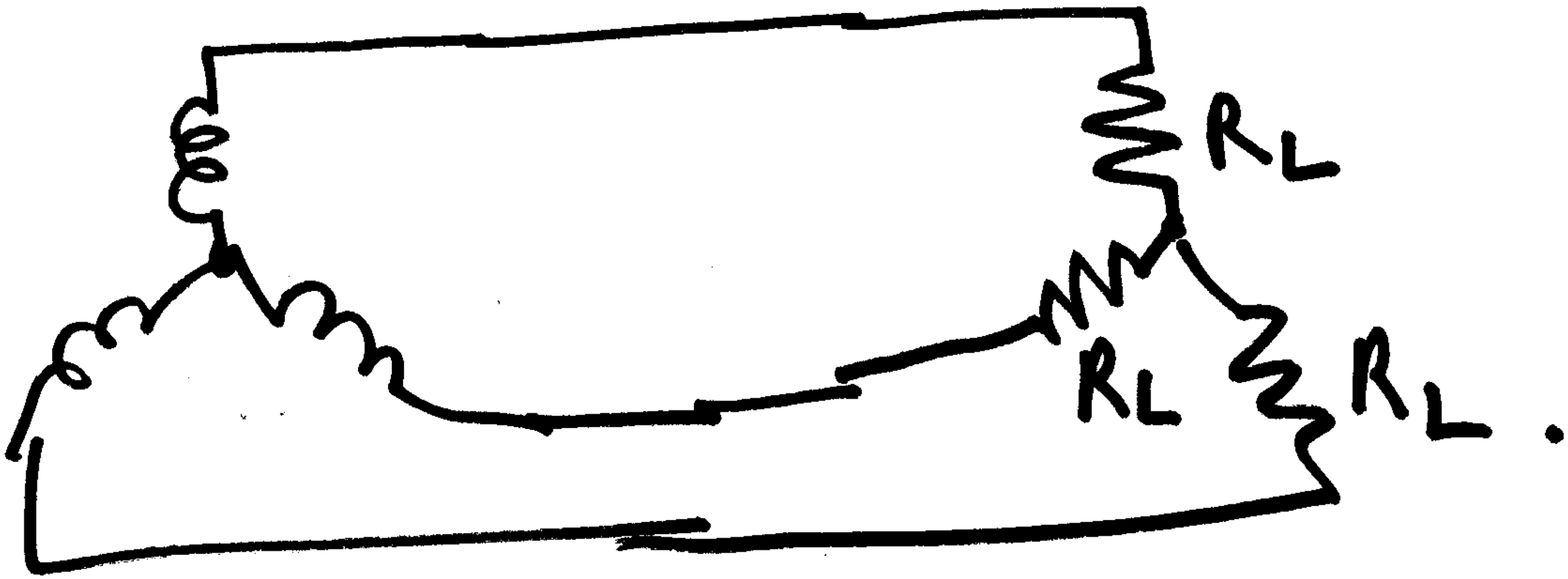


STATOR OPEN

$$v_{d_{oc}} = 0$$

$$V_{q_{oc}} = \omega_B \cdot \frac{M_{df}}{R_f} \cdot V_f \cdot$$

E_{fd}



$R_L \rightarrow$ LARGE

$= 0$ SHORT

$$\begin{bmatrix} \dot{\psi}_d \\ \dot{\psi}_q \\ \dot{\psi}_F \\ \dot{\psi}_H \\ \dot{\psi}_G \\ \dot{\psi}_K \end{bmatrix} = A_1 \begin{bmatrix} \psi_d \\ \psi_q \\ \psi_F \\ \psi_H \\ \psi_G \\ \psi_K \end{bmatrix} + A_2 \begin{bmatrix} i_d \\ i_q \end{bmatrix} + B \begin{bmatrix} v_d \\ v_q \\ E_{fd} \end{bmatrix}$$

i_0, v_0

$\psi_0 = 0$ ✓

$$\begin{bmatrix} V_d \\ V_q \end{bmatrix} = \begin{bmatrix} R_L & 0 \\ 0 & R_L \end{bmatrix} \begin{bmatrix} i_d \\ i_q \end{bmatrix} \quad — \quad \checkmark$$

$$\begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} R_L & 0 & 0 \\ 0 & R_L & 0 \\ 0 & 0 & R_L \end{bmatrix} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix}$$

$$\begin{bmatrix} i_d \\ i_q \end{bmatrix} = A_3^{B} \begin{bmatrix} \psi_d \\ \psi_q \\ \psi_F \\ \psi_H \\ \psi_G \\ \psi_K \end{bmatrix}$$

$$A_2 = \begin{bmatrix} -R_a - R_L & 0 \\ 0 & -R_a - R_L \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} * \omega_B .$$

$$A_1 = \begin{bmatrix} 0 & -\omega & 0 & 0 & 0 & 0 \\ \omega & 0 & 0 & 0 & 0 & 0 \\ 1/T_d'' & 0 & -\frac{1}{T_d''} & 0 & 0 & 0 \\ 1/T_d' & 0 & 0 & -\frac{1}{T_d'} & 0 & 0 \\ 0 & \frac{1}{T_q''} & 0 & 0 & -\frac{1}{T_q''} & 0 \\ 0 & 1/T_q' & 0 & 0 & 0 & \frac{1}{T_q'} \end{bmatrix}$$

$$\begin{bmatrix} \psi_d \\ \psi_q \\ \psi_H \\ \psi_F \\ \psi_G \\ \psi_K \end{bmatrix}$$

$$\begin{bmatrix} i_d \\ i_q \end{bmatrix} = A_3 \psi = \begin{bmatrix} A_{31} & A_{32} \end{bmatrix}$$

$$A_{31} = \begin{bmatrix} 1/x_d'' & 0 & -(x_d' - x_d'')/x_d' \cdot \frac{1}{x_d''} \\ 0 & \frac{1}{x_q''} & 0 \end{bmatrix}$$

$$A_{32} \begin{bmatrix} -(x_d - x_d')/x_d' \cdot \frac{1}{x_d''} & 0 & 0 \\ 0 & -\frac{(x_q' - x_q'')}{x_q' \cdot x_q''} & -\frac{(x_q - x_q')}{x_q \cdot x_q'} \end{bmatrix}$$

$$B2 = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1/T'_d \cdot \dfrac{x'_d}{x_d - x'_d} \\ 0 \\ 0 \end{bmatrix}$$

$\psi \rightarrow E_{fd}$

$$e^{\Lambda t} = \begin{bmatrix} e^{\lambda_1 t} & & \\ & \ddots & \\ & & e^{\lambda_n t} \end{bmatrix}$$

$$\psi(t) = e^{At}\,\psi(0) - A^{-1}\left[I_{6\times 6} - e^{At}\right] B_2$$

$$e^{At} = P\,e^{\Lambda t}\,P^{-1}$$

$P \rightarrow e\,v$

$$\Lambda \rightarrow \begin{bmatrix} \lambda_1 & & 0 \\ & \lambda_2 & \\ 0 & & \ddots\ \lambda_3 \end{bmatrix}$$

$$\dot{\psi} = A\psi + B_2 E_{fd}.$$

$$\psi(t) = e^{At} \cdot \psi(0) + \int_0^t e^{A(t-\tau)} \cdot B_2 E_{fd} \, d\tau$$

$$=$$

$$\dot{\psi} = A_1 \psi + A_2 \dot{i}$$

$$+ B_2 \cdot E_{fd}.$$

$$= A \psi + B_2 E_{fd}$$

$$A = A_1 + A_2 \times A_3.$$