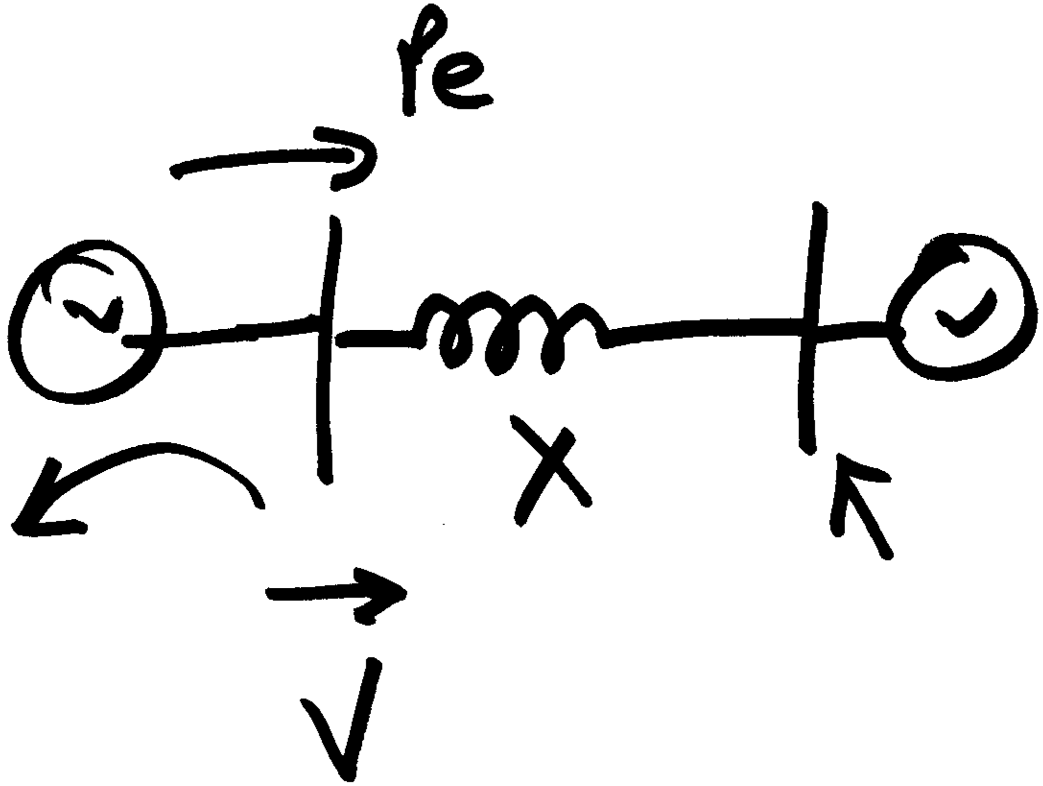
Prof. A.M. Kulkarni
Date: 14/07/10
Lec. No. 30

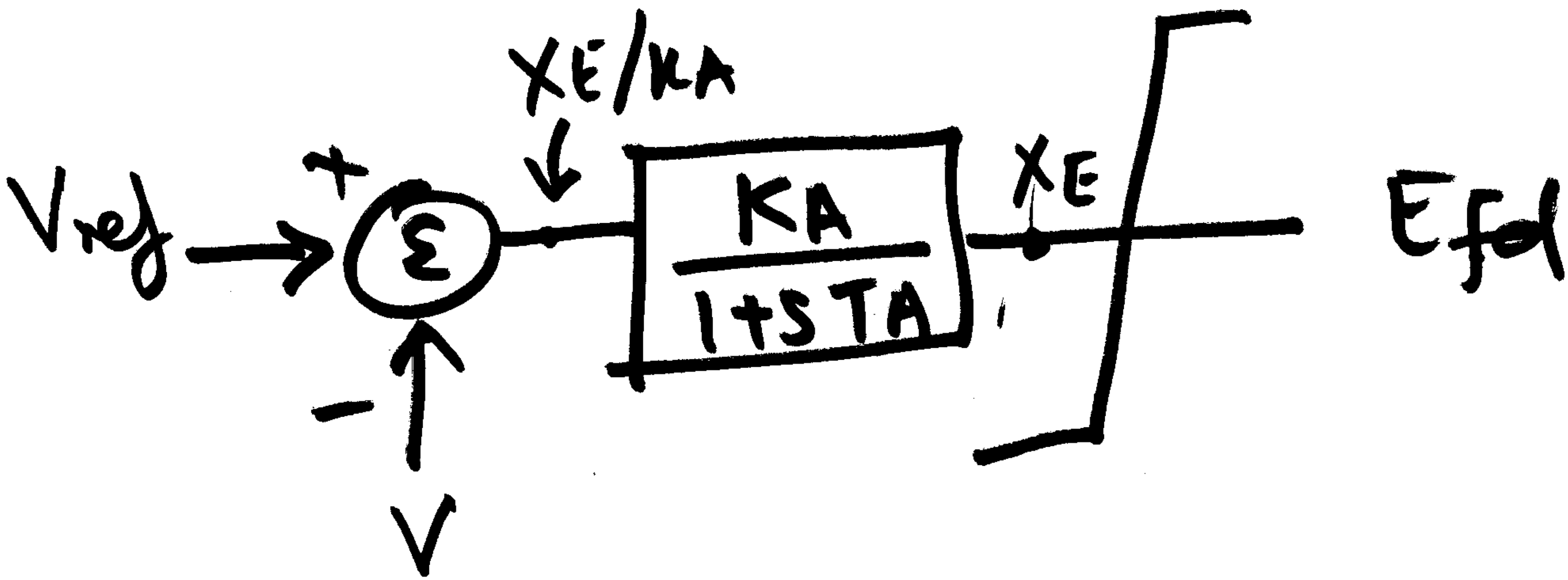


$$\underbrace{\left(E_{fd} + (x_d - x_q) i_d\right)}_{} e^{j\delta}$$

$$= \underline{\tilde{A} + j\tilde{B}}$$

$$\delta = \left(\tan^{-1} B/A\right)$$

$$\left[E_{fd} + (x_d - x_q) i_d\right] = |A + jB|$$



$$V_{ref} = V + \frac{E_{fd}}{K_A}.$$

$$\frac{d\delta}{dt} = \omega - \omega_0 = 0$$

$$\omega = \omega_0 .$$

$$\frac{2H}{\omega_B}\frac{d\omega}{dt} = T_m - (\psi_d i_q - \psi_q i_d) \quad (1)$$

$$\frac{2H}{\omega_B}\frac{d\Delta\omega}{dt} = \Delta T_m - \Delta(\psi_d i_q - \psi_q i_d)$$

$$i_{q0}\,\Delta\psi_d + \psi_{d0}\,\Delta i_q - i_{d0}\,\Delta\psi_q - \psi_{q0}\,\Delta i_d$$

$$\boxed{\frac{d\Delta\delta}{dt} = \Delta\omega} \quad \text{—} \ (2)$$

ΔV_d
ΔV_q

$\xrightarrow{d\psi/dt}$

$\dfrac{d\Delta i_d}{dt}$, $\dfrac{d\Delta i_q}{dt}$

Δi_d, Δi_q

ΔE_d, ΔE_q.

$\Delta \omega$

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

$\Delta\psi$

$\left.\begin{matrix}\Delta V_d \\ \Delta V_q\end{matrix}\right\}$

$\left.\begin{matrix}\Delta E_d \\ \Delta E_q\end{matrix}\right\} \Delta\delta$

$\Delta\omega$

$$\Delta V = \Delta\sqrt{Vd^2 + Vq^2}.$$

$$V = \sqrt{Vd^2 + Vq^2}.$$

$$V^2 = (Vd^2 + Vq^2)$$

$$2V_0 \Delta V = 2V_{d0}\, \Delta V_d + 2V_{q0}\, \Delta V_q$$

$$\Delta V = V_{d0}/V_0\, \Delta V_d + \frac{V_{q0}}{V_0}\, \Delta V_q.$$

$$\frac{K_A}{1+sT_A}$$

↑ continuous.

$$\frac{1}{1+sT_A}$$

$$\dot{x}_e = -\frac{1}{T_A}x + \frac{1}{T_A}u$$

$$y = x_e$$

$$\frac{x_{e_{k+1}} - x_{e_k}}{h} = -\frac{1}{T_A} x_k - \frac{1}{T_A} u_k$$

$$y_k = x_{e_k}$$

$$E_d = -E\sin\delta$$

$$E_q = E\cos\delta$$

9×9

$$\frac{d\Delta x}{dt} = A \Delta x + B \Delta u$$

$$\Delta x = \begin{bmatrix} \Delta \omega \\ \Delta \delta \\ \Delta \psi_d \\ \Delta \psi_q \\ \Delta \psi_f \\ \Delta \psi_H \\ \Delta \psi_G \\ \Delta \psi_K \\ \Delta E_{fd} \end{bmatrix} \qquad \Delta u = \begin{bmatrix} \Delta T_m \\ \Delta V_{ref} \end{bmatrix}$$

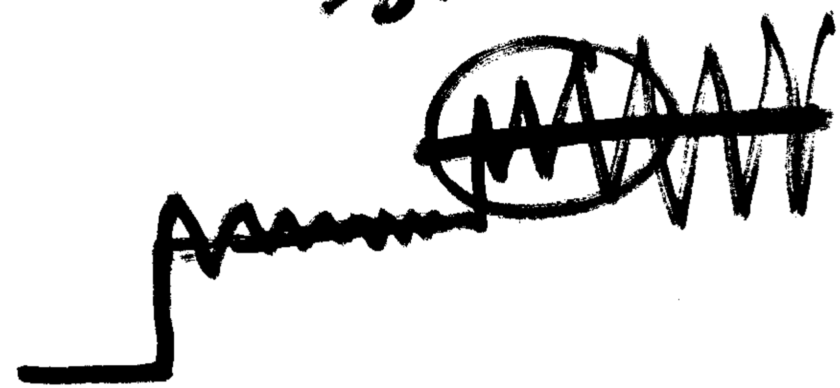
9

0.0 → 0.5

$T_m = 0.5$ → stable as per the sim.

0.5pu → 1.0 pu

$T_m = 1.0$



$$\frac{d\psi_d}{dt} = 0$$

$$\frac{d\psi_q}{dt} = 0$$

} Neglected stator → slow transient

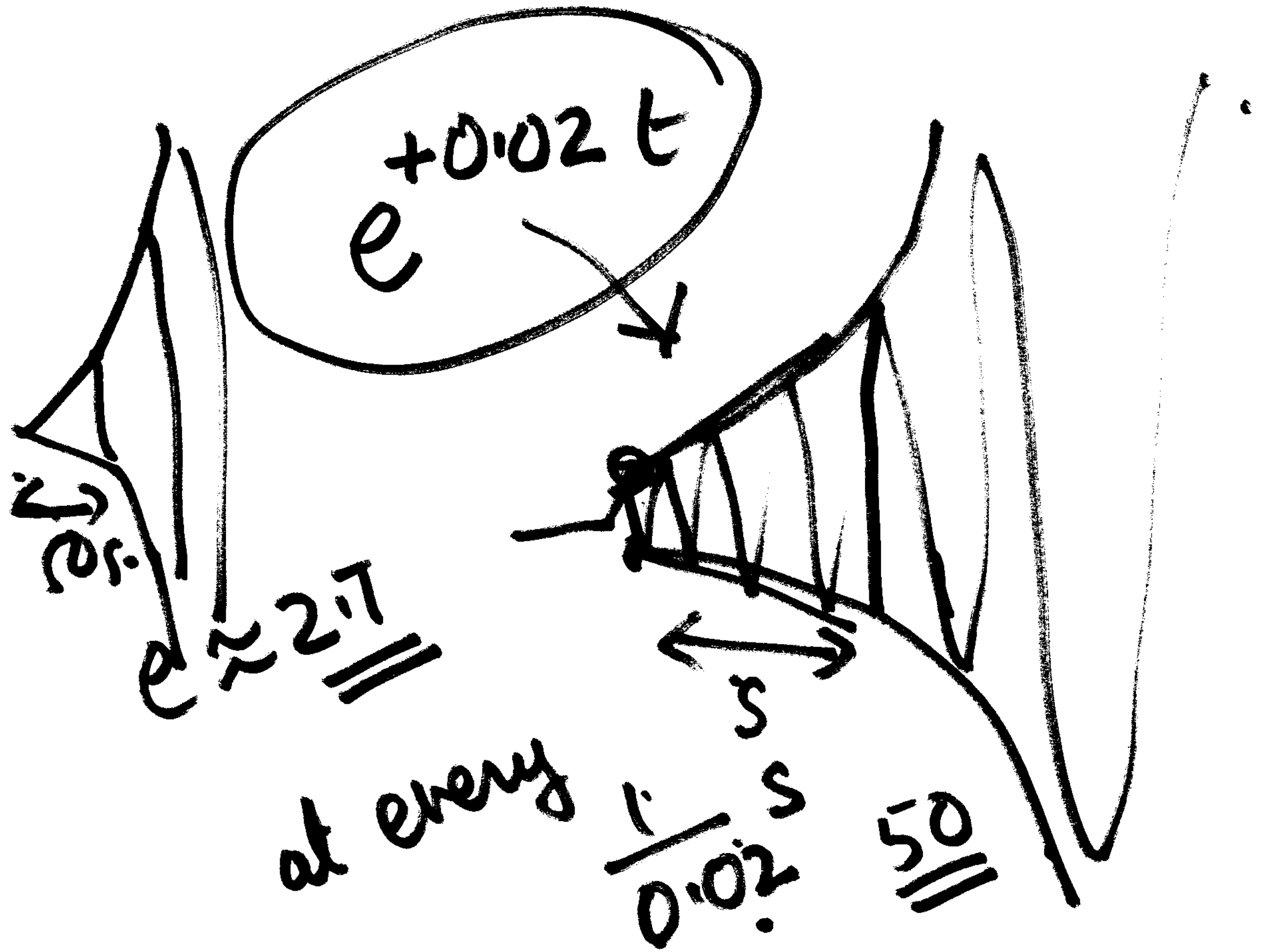
$$A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix}$$

ψ_d ψ_q

$$
\begin{bmatrix} \frac{d\Delta\psi_d}{dt} \;(\leftarrow 0) \\ \frac{d\Delta\psi_q}{dt} \;(\leftarrow 0) \\ \frac{d\psi_F}{dt} \\ \vdots \\ \frac{d\Delta\delta}{dt} \\ \frac{d\Delta\omega}{dt} \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} \Delta\psi_d \\ \Delta\psi_q \\ \vdots \\ \Delta\delta \\ \Delta\omega \end{bmatrix}
$$

$$\dot{x}_r = A_r x_r \quad (2)$$

$$x_r = \begin{bmatrix} \psi_F \\ \psi_H \\ \vdots \\ \Delta\delta \\ \Delta\omega \end{bmatrix}$$


e +0.02 t
e ≈ 2.7
s
at every
1/0.02 s
50