E_E 491
Review Session #7

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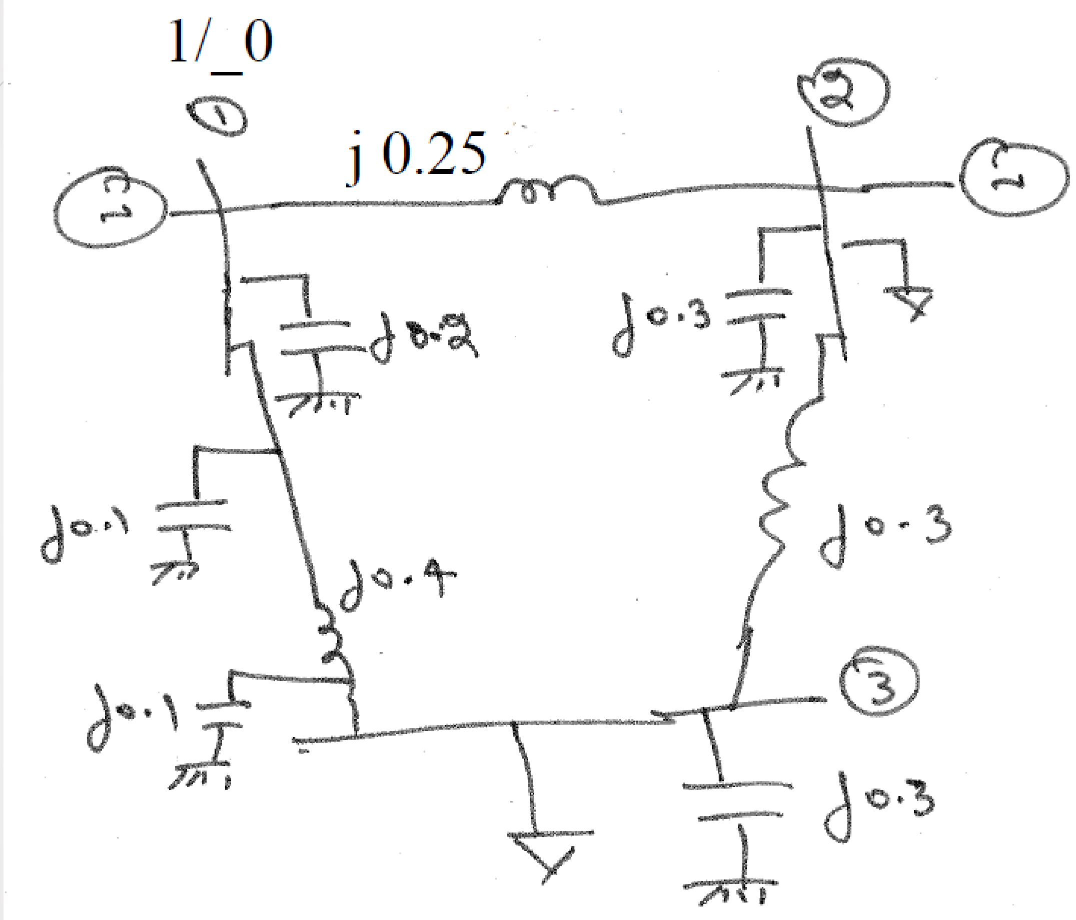
Fall 2020

Fast Decoupled Ex.



$P_{G_2} = 1.0, V_2 = 1.04, P_{L_2} = 0.25, Q_{L_2} = 0.1, P_{L_3} = 0.5, Q_{L_3} = 0.3$

Fast Decoupled Ex.

Using DC Power Flow, we get:

$$\begin{bmatrix} \delta_2 \\ \delta_3 \end{bmatrix} = \begin{bmatrix} 0.0888 \\ -0.0375 \end{bmatrix} \quad \text{So} \quad x^0 = \begin{bmatrix} 0.0888 \\ -0.0375 \\ 1 \end{bmatrix}; \begin{bmatrix} P_2^0 \\ P_3^0 \\ q_3^0 \end{bmatrix} = \begin{bmatrix} 0.805 \\ -0.524 \\ -0.5038 \end{bmatrix}; \begin{bmatrix} \Delta P_2^0 \\ \Delta P_3^0 \\ \Delta q_3^0 \end{bmatrix} = \begin{bmatrix} -0.055 \\ 0.029 \\ 0.2 \end{bmatrix}$$

Now

$$B_\delta = -\text{Imag}\left[Y_{bus}\right]_{2:3,\,2:3} = \begin{bmatrix} 7.03 & -3.33 \\ -3.33 & 5.43 \end{bmatrix}$$

$$B_V = -\text{Imag}\left[Y_{bus}\right]_{3,3} = 5.43$$

$$\begin{bmatrix} \Delta\delta_2^0 \\ \Delta\delta_3^0 \end{bmatrix} = B_\delta^{-1} \begin{bmatrix} \Delta P_2^0 / V_2^0 \\ \Delta P_3^0 / V_3^0 \end{bmatrix} = \begin{bmatrix} -0.00695 \\ 0.00124 \end{bmatrix}$$

$$\Delta V_3^0 = B_V^{-1}\left[\Delta q_3^0 / V_3^0\right] = 0.0375$$

$$x^1 = x^0 + \Delta x^0 = \begin{bmatrix} \delta_2^0 + \Delta\delta_2^0 \\ \delta_3^0 + \Delta\delta_3^0 \\ V_3^0 + \Delta V_3^0 \end{bmatrix} = \begin{bmatrix} 0.0818 \\ -0.0362 \\ 1.0375 \end{bmatrix}$$

Fast Decoupled Ex.

Now,

$$\begin{bmatrix} P_2^1 \\ P_3^1 \\ q_3^1 \end{bmatrix} = \begin{bmatrix} 0.769 \\ -0.512 \\ -0.315 \end{bmatrix} \quad \text{and} \quad \begin{bmatrix} \Delta P_2^1 \\ \Delta P_3^1 \\ \Delta q_3^1 \end{bmatrix} = \begin{bmatrix} P_2^1 - 0.75 \\ P_3^1 + 0.5 \\ q_3^1 + 0.3 \end{bmatrix} = \begin{bmatrix} -0.0195 \\ 0.01245 \\ -0.01545 \end{bmatrix}$$

$$\begin{bmatrix} \Delta\delta_2^1 \\ \Delta\delta_3^1 \end{bmatrix} = B_\delta^{-1} \begin{bmatrix} \Delta P_2^0 / V_2^0 \\ \Delta P_3^0 / V_3^0 \end{bmatrix} = \begin{bmatrix} -0.00222 \\ 0.000928 \end{bmatrix};$$

$$\Delta V_3^1 = B_V^{-1} \left(\frac{\Delta q_3^1}{V_3^1} \right) = 0.00284$$

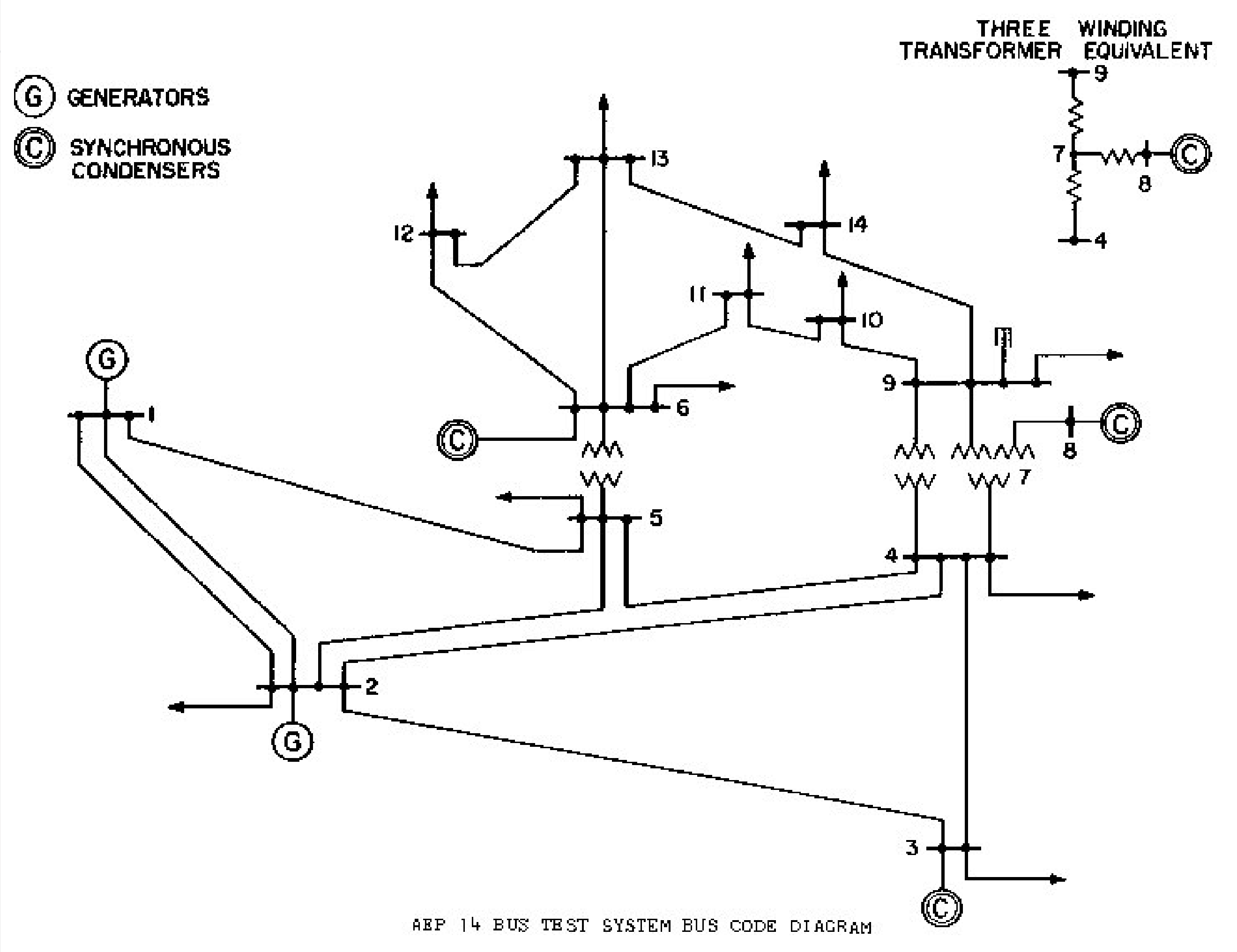
Now

$$x^{(2)} = x^{(1)} + \Delta x^{(1)} = \begin{bmatrix} \delta_2^{(1)} + \Delta\delta_2^{(1)} \\ \delta_3^{(1)} + \Delta\delta_3^{(1)} \\ V_3^{(1)} + \Delta V_3^{(1)} \end{bmatrix} = \begin{bmatrix} 0.0796 \\ -0.0353 \\ 1.0403 \end{bmatrix}$$

Therefore,

$$\delta^{(2)} = \begin{bmatrix} 0 \\ 0.0796 \\ -0.0353 \end{bmatrix} ; \quad V^{(2)} = \begin{bmatrix} 1 \\ 1.04 \\ 1.040375 \end{bmatrix}$$

Q-limits (IEEE 14-Bus System)



Questions?