N-R | -snage u 0. iteraciji:

ne rač. se za ref. čv.

$$P_i^{(0)} = \sum_{j=1}^{n} U_i^{(0)} \cdot U_j^{(0)} \cdot Y_{ij} \cdot \cos(\delta_i^{(0)} - \delta_j^{(0)} - \theta_{ij}) \quad ; \; i = 1 \dots (n-1)$$

$$P_2^{(0)} = U_2^{(0)} \cdot U_1^{(0)} \cdot Y_{21} \cdot \cos(\delta_2^{(0)} - \delta_1^{(0)} - \theta_{21}) + U_2 \cdot U_2 \cdot Y_{22} \cdot \cos(-\theta_{22}) + U_2^{(0)} \cdot U_3^{(0)} \cdot Y_{23} \cdot \cos(-\theta_{2,3})$$

$\vdots$

$$Q_i^{(0)} = \sum U_i \cdot U_j \cdot Y_{ij} \cdot \sin(\delta_i^0 - \delta_j^0 - \theta_{ij})$$

$$Q_2^{(0)} = U_2^0 \cdot U_1^0 \cdot Y_{21} \cdot \sin(\delta_2^0 - \delta_1^0 - \theta_{21}) + U_2^0 \cdot U_2^0 \cdot Y_{22} \cdot \sin(-\theta_{22}) + U_2^0 \cdot U_3^0 \cdot Y_{23} \cdot \sin(-\theta_{23})$$

$\vdots$

$$\Delta P_2^{(0)} = P_2^{zad} - P_2^{(0)}$$

$$\Delta Q_2^{(0)} = Q_2^{zad} - Q_2^{(0)}$$

$$\begin{bmatrix} \Delta P_2 \\ \Delta Q_2 \end{bmatrix} = \begin{bmatrix} J_1 & \emptyset \\ \emptyset & J_4 \end{bmatrix} \begin{bmatrix} \Delta \delta_2 \\ \Delta U_2 \end{bmatrix} \qquad \Delta P_2 = J_1 \cdot \Delta \delta_2 \qquad \Delta Q_2 = J_4 \cdot \Delta U_2$$

$$\Delta P_2^{(0)} = \left(\frac{\partial P_2}{\partial \delta_2}\right)^{(0)} \cdot \Delta \delta_2^{(0)} \rightarrow \Delta \delta_2^{(0)} = \left[\frac{\partial P_2}{\partial \delta_2}\right]^{-1} \cdot \Delta P_2^{(0)} \quad \text{tj.} \quad \Delta \delta_2^{(0)} = [J_1]^{-1} \cdot \Delta P_2^{(0)}$$

$$\Delta Q_2^{(0)} = \left(\frac{\partial Q_2}{\partial U_2} \cdot U_2\right)^{(0)} \left(\frac{\Delta U_2}{U_2}\right)^{(0)} \rightarrow \left(\frac{\Delta U_2}{U_2}\right)^{(0)} = \left[\left(\frac{\partial Q_2}{\partial U_2} \cdot U_2\right)^{(0)}\right]^{-1} \cdot \Delta Q_2^{(0)} \quad \text{tj.} \quad \left(\frac{\Delta U_2}{U_2}\right)^{(0)} = [J_4]^{-1} \cdot \Delta Q_2^{(0)}$$

$$U_2^{(1)} = U_2^{(0)} + \left(\frac{\Delta U_2}{U_2}\right)^{(0)} \cdot U_2^{(0)}$$

$$\delta_2^{(1)} = \delta_2^{(0)} + \Delta \delta_2^{(0)}$$

$$P_2^{(1)} = U_2^{(1)} \cdot U_1^{(1)} \cdot Y_{21} \cdot \cos(\delta_2^{(1)} - \delta_1^{(1)} - \theta_{21}) + U_2^{(1)} \cdot U_2^{(1)} \cdot Y_{22} \cdot \cos(-\theta_{22}) + \dots$$

$$Q_2^{(1)} = U_2^{(1)} \cdot U_1^{(1)} \cdot Y_{21} \cdot \sin(\delta_2^{(1)} - \delta_1^{(1)} - \theta_{21}) + U_2^{(1)} \cdot U_1^{(1)} \cdot Y_{22} \cdot \sin(-\theta_{22}) + \dots$$

$$\begin{bmatrix} \Delta P_2 \\ \Delta P_3 \end{bmatrix} = [J_1] \begin{bmatrix} \Delta \delta_2 \\ \Delta \delta_3 \end{bmatrix} \rightarrow \begin{bmatrix} \Delta \delta_2 \\ \Delta \delta_3 \end{bmatrix} = [J_1]^{-1} \cdot \begin{bmatrix} \Delta P_2 \\ \Delta P_3 \end{bmatrix}$$

$$\begin{bmatrix} \Delta Q_2 \\ \Delta Q_3 \end{bmatrix} = [J_4] \cdot \begin{bmatrix} \Delta U_2 \\ \Delta U_3 \end{bmatrix} \rightarrow \begin{bmatrix} \Delta U_2 \\ \Delta U_3 \end{bmatrix} = [J_4]^{-1} \cdot \begin{bmatrix} \Delta Q_2 \\ \Delta Q_3 \end{bmatrix}$$

$$|U_2^{(1)}| = |U_2^{(0)}| + \Delta U_2^{(0)} \qquad |U_3^{(1)}| = |U_3^{(0)}| + \Delta U_3^{(0)}$$

$$\delta_2^{(1)} = \delta_2^{(0)} + \Delta \delta_2^{(0)}$$

$$\delta_3^{(1)} = \delta_3^{(0)} + \Delta \delta_3^{(0)}$$

$$Z_T[\Omega] = \frac{U_n^2}{S_n}\left[\frac{P_{cu}}{S_n} + j\sqrt{(u_k)^2 - \left(\frac{P_{cu}}{S_n}\right)^2}\right]$$

$$Z_T[p.u] = Z_T[\Omega]\cdot\frac{S_B}{U_n^2}$$

$$Y_T[p.u] = \frac{1}{Z_T}$$

$$Y_{12}' = \frac{Y_T}{a} \; ; \; Y_{10}' = \frac{Y_T}{a}\cdot\left(\frac{1}{a}-1\right)$$

$$Y_{20}' = Y_T\cdot\left(1-\frac{1}{a}\right)$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = [Y]\cdot\begin{bmatrix} U_1 \\ U_2 \end{bmatrix}$$

$$S_{1-2}' = U_1(U_1^* - U_2^*)\cdot Y_{12}'^* + |U_1|^2\cdot Y_{10}'^*$$

$$S_{2-1}' = U_2(U_2^* - U_1^*)\cdot Y_{12}'^* + |U_2|^2\cdot Y_{20}'^*$$

$$S_{1-2}'' = U_1(U_1^* - U_2^*)\cdot Y_{12}''^* + |U_1|^2\cdot Y_{10}''^*$$

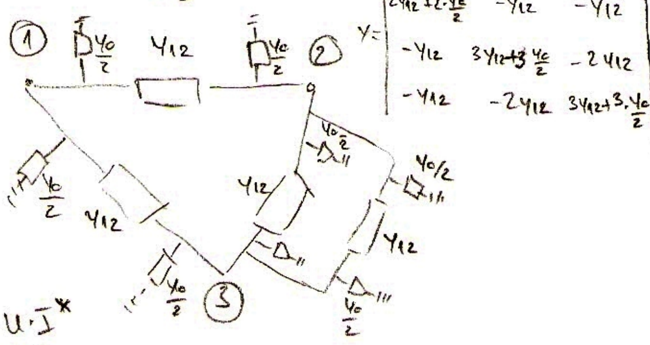
$$S_{2-1}'' = U_2(U_2^* - U_1^*)\cdot Y_{12}''^* + |U_2|^2\cdot Y_{20}''^*$$

$$\Delta S' = S_{1-2}' + S_{2-1}' \; ; \; \Delta S'' = S_{1-2}'' + S_{2-1}''$$

$Z_{voda} = (R_1 + jX_1)\cdot l$; $Y_{voda} = \frac{1}{Z_{voda}}$

$Y_0 = j\cdot B_1\cdot l$

$Y_0[p.u] = Y_0\cdot\frac{U_n^2}{S_B}$ $\qquad Y[p.u] = Y_{voda}\cdot\frac{U_n^2}{S_B}$



$$Y = \begin{vmatrix} 2Y_{12} + 2\cdot\frac{Y_0}{2} & -Y_{12} & -Y_{12} \\ -Y_{12} & 3Y_{12} + 3\frac{Y_0}{2} & -2Y_{12} \\ -Y_{12} & -2Y_{12} & 3Y_{12} + 3\cdot\frac{Y_0}{2} \end{vmatrix}$$

$S = U\cdot I^*$

$I = \frac{S^*}{U^*}$

ISTOSMJ. TOKOVI SNAGE: čv. ref. → taj kut $\delta = 0$

- S_t je uvijek negativno, S_q pozitivno!
- u matrici Y križam referentni redak i stupac.

$[Z] = [Y]^{-1}$; $\begin{bmatrix} \delta_1 \\ \delta_2 \end{bmatrix} = [Z]\cdot\begin{bmatrix} P_1 \\ P_2 \end{bmatrix}$; $P_{1-2} = \frac{\delta_1 - \delta_2}{X_{1-2}} = (\delta_1 - \delta_2)\cdot Y_{1-2}$

$P_{2-3} = \frac{\delta_2 - \delta_3}{X_{2-3}} = (\delta_2 - \delta_3)\cdot Y_{2-3}$

KRATKI SPOJ: $X_1''[\Omega] = \frac{X_1\%}{100}\cdot\frac{U_n^2}{S_{n1}}$; $X_1''[p.u] = X_1''\cdot\frac{S_B}{U_n^2}$

$\begin{bmatrix} U_1^k \\ U_2^k \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + j[Z]\cdot\begin{bmatrix} 0 \\ 0 \\ I_m \end{bmatrix}$ $\quad X_2''[\Omega] = \frac{X_2\%}{100}\cdot\frac{U_n^2}{S_{n2}}$; $X_2''[p.u] = X_2''\cdot\frac{S_B}{U_n^2}$

$Y = \frac{1}{X}$

$I_{ks} = -I_m$

$I_{ks} = -I_m\cdot\frac{S_B}{\sqrt{3}\cdot U_n}$ $\qquad I_{1-3} = (U_1 - U_3)\cdot Y_{1-3}$; $I_{1-2} = (U_1 - U_2)\cdot Y_{1-2}, \ldots$

GAUSS-SEIDEL Pomoću Y:

$U_2^{(0)} = 1 + j0$
$U_3^{(0)} = 1 + j0$
čv. 1 je referentno

$$U_i^{(k+1)} = \frac{KL_i}{(U_i^{(k)})^*} - \sum_{j=1}^{i-1} YL_{ij}\cdot U_j^{(k+1)} - \sum_{j=i+1}^{n} YL_{ij}\cdot U_j^{(k)}$$

$$KL_i = \frac{P_i - jQ_i}{Y_{ii}} \; ; \; YL_{p,i} = \frac{Y_{pi}}{Y_{pp}}$$

$$U_2^{(1)} = \frac{KL_2}{(U_2^{(0)})^*} - YL_{2,1}\cdot U_1^{(1)} - YL_{2,3}\cdot U_3^{(0)}$$

$$U_3^{(1)} = \frac{KL_3}{(U_3^{(0)})^*} - YL_{3,1}\cdot U_1^{(1)} - YL_{3,2}\cdot U_2^{(1)}$$

$KL_2 = \frac{S_2^*}{Y_{22}}$; $KL_3 = \frac{S_3^*}{Y_{33}}$; $YL_{2,1} = \frac{Y_{21}}{Y_{22}}$; $YL_{2,3} = \frac{Y_{23}}{Y_{22}}$

$\alpha = 1{,}2$ - faktor ubrzanja $\qquad YL_{3,1} = \frac{Y_{31}}{Y_{33}}$; $YL_{3,2} = \frac{Y_{32}}{Y_{33}}$

$\Delta U_2^{(1)} = U_2^{(1)} - U_{2ub}^{(0)}$

$U_{2ub}^{(1)} = U_{2ub}^{(0)} + \alpha\cdot\Delta U_2$

$U_3^{(1)} = U_3^{(1)} - U_{3ub}^{(0)}$

$U_{3ub}^{(1)} = U_{3ub}^{(0)} + \alpha\cdot\Delta U_3$

N-R metoda: $\quad [J] = ?$

imamo 3 čvorišta, 1. je referentno

$U_2^{(0)} = U_3^{(0)} = 1 + j0$ p.u.

$\delta_1^{(0)} = \delta_2^{(0)} = \delta_3^{(0)} = 0°$

- u Y matrici se križa referentno čv.!

$$J_1 = \begin{bmatrix} \frac{\partial P_2}{\partial \delta_2} & \frac{\partial P_2}{\partial \delta_3} \\ \frac{\partial P_3}{\partial \delta_3} & \frac{\partial P_3}{\partial \delta_3} \end{bmatrix} = \begin{bmatrix} m_{22} & m_{23} \\ m_{32} & m_{33} \end{bmatrix}$$

$$m_{22} = -\sum_{\substack{j=1 \\ j\neq i}}^{3} U_i^0\cdot U_j^0\cdot Y_{ij}\sin(\delta_i^0 - \delta_j^0 - \theta_{ij})$$

$$= -U_2^0\cdot U_1^0\cdot Y_{21}\sin(\delta_2^0 - \delta_1^0 - \theta_{21}) - U_2^0 U_3^0 Y_{23}\sin(\delta_2^0 - \delta_3^0 - \theta_{23})$$

$$m_{33} = -U_3^0\cdot U_1^0\cdot Y_{31}\sin(\delta_3^0 - \delta_1^0 - \theta_{31}) - U_3^0 U_2^0 Y_{23}\sin(\delta_3^0 - \delta_2 - \theta_{32})$$

$$m_{23} = U_2^0\cdot U_3^0\cdot Y_{23}\cdot\sin(\delta_2^0 - \delta_3^0 - \theta_{23})$$

$$m_{32} = m_{23}$$

$$J_4 = \begin{bmatrix} \frac{\partial Q_2}{\partial U_2} & \frac{\partial Q_2}{\partial U_3} \\ \frac{\partial Q_3}{\partial U_2} & \frac{\partial Q_3}{\partial U_3} \end{bmatrix} = \begin{bmatrix} n_{22} & n_{23} \\ n_{32} & n_{33} \end{bmatrix}$$

$$n_{22} = 2\cdot U_2^0\cdot Y_{22}\cdot\sin(-\theta_{2,2}) + \sum_{\substack{j=1 \\ j\neq 2}}^{3} U_j^0\cdot Y_{2j}\cdot\sin(\delta_i^0 - \delta_j^0 - \theta_{ij})$$

$$n_{22} = 2\cdot U_2^0 Y_{22}\sin(-\theta_{2,2}) + U_1^0 Y_{21}\sin(\delta_2^0 - \delta_1^0 - \theta_{21}) + U_3^0\cdot Y_{23}\sin(\delta_2^0 - \delta_3^0 - \theta_{23})$$

$$n_{33} = 2\cdot U_3^0\cdot Y_{33}\cdot\sin(-\theta_{3,3}) + U_1^0\cdot Y_{31}\sin(\delta_3^0 - \delta_1^0 - \theta_{31}) + U_2^0\cdot Y_{32}\sin(\delta_3^0 - \delta_2^0 - \theta_{32})$$

$$n_{23} = U_2^0\cdot Y_{23}\cdot\sin(\delta_2^0 - \delta_3^0 - \theta_{23})$$

$$n_{32} = n_{23}$$