SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT – III

PROBLEM - GAUSS SEIDAL METHOD

1. **The figure given below shows a power system.**
Bus 1:Slack bus V $_{Specified}$=1.05p.u
Bus 2:PV bus $|V|$=1.2p.u P_g=3 p.u
Bus 3: PQ bus P_L=4p.u Q_L=2p.u

Carry out one iteration of load flow solution by G-S method. Take Q limits of generator 2 as 0 < Q < 3.

Step 1:Form Y_{bus} matrix

$$Y_{bus} = \begin{bmatrix} 3-j9 & -2+j5 & -1+j4 \\ -2+j5 & 5-j14 & -3+j9 \\ -1+j4 & -3+j9 & 4-j13 \end{bmatrix}$$

Step 2: Initial voltages are considered as 1 p.u for all buses.

$V_2^0 = 1.2+j0 \qquad V_3^0 = 1+j0$

Bus 1 is slack bus so its voltage remains constant for all iterations.

$V_1^0 = V_1^1 = V_1^2 = V_1^3 = 1.05+j0$

Step 3: Start iteration count, for first iteration set k=0

Step 4: Bus 1 is slack bus p=1 $\therefore V_1^1$= 1.05+j0

Step 5: Bus 2 is generator bus(p=2)

For generator bus calculate the phase of the voltage

To calculate phase angle of bus voltage estimate the reactive power at bus 2 by using.

$$Q_{p,cal}^{k+1} = (-1)\, \text{im}\left\{ (V_p^k)^* \times \left[\sum_{q=1}^{p-1} Y_{pq} V_q^{k+1} + \sum_{q=p}^{n} Y_{pq} v_q^k \right] \right\}$$

Substitute k=0 and p=2

$$Q_2^1 = (-1)\, \text{im}\{ (V_2^0)^* \times [\sum_{q=1}^{1} Y_{2q} V_q^1 + \sum_{2}^{3} Y_{2q} v_q^0] \}$$

$$Q_2^1 = (-1)\,\text{im}\{(V_2^0)^* * [Y_{21}\,V_1^1 + Y_{22}\,V_2^0 + Y_{23}\,V_3^0]\}$$

$$= (-1)\,\text{im}\{(1.2 - j0) * [(-2 + j5)(1.05 + j0) + (5 - j14)(1.2 + j0) + (-3 + j9)(1 + j0)]\}$$

$$= (-1)\text{im}\{j1.08 - j3.06\} \qquad \therefore \mathbf{Q_2^1 = 3.06\ p.u} \qquad \boxed{0 < Q < 3.}$$

The Q-limit is violated which is greater than the upper limit. Set $Q_2 = 3\ p.u$ Therefore the bus acts as load bus. ∴ $V_2^0 = 1+j0$

For load bus calculate the value of voltage magnitude and phase angle,

$$V_p^{k+1} = \frac{1}{Y_{pp}}\left[\frac{P_p - jQ_p}{(V_p^k)^*} - \sum_{q=1}^{p-1} Y_{pq} V_q^{k+1} - \sum_{q=p+1}^{n} Y_{pq} v_q^k\right]$$

$$V_2^1 = \frac{1}{Y_{22}}\left[\frac{P_2 - jQ_2}{(V_2^0)^*} - Y_{21} V_1^1 - Y_{23} v_3^0\right]$$

$$= \frac{1}{5-j14}\left[\frac{3+j3}{1-j0} - (-2+j5)(1+j0) - (-3+j9)(1-j0)\right]$$

$$V_2^1 = 1.023 + j0.063\text{p.u} = 1.02\angle 3.54°\text{p.u}$$

Step 6: Bus 3 as load bus,

$$V_3^1 = \frac{1}{Y_{33}}\left[\frac{P_3 - jQ_3}{(V_3^0)^*} - Y_{31} v_1^1 - Y_{32} v_2^1\right]$$

$$= \frac{1}{4-j13}\left[\frac{-4+j2}{1-j0} - (-1+j4)(1.05+j0) - (-3+j9)(1.023+j0.063)\right]$$

$$V_3^1 = 0.803 - j0.194\text{ p.u} = 0.826\angle -13.60\text{ p.u}$$

Result:

The voltages at the end of first iteration is,

$V_1^1 = 1.05 + j0$ p.u

$V_2^1 = 1.023 + j0.063$ p.u

$V_3^1 = 0.803 - j0.194$ p.u

Advantages and disadvantages of G-S method.

Advantages:

- Simple calculation and less programming task.
- Less memory requirement.
- Useful for small systems.

Disadvantages:

- Requires large number of iterations to reach convergence
- Not suitable for large systems
- Convergence time increases with size of the system.


thank you