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CERTIFICATION COURSE**

Computer aided power system analysis

GSLF with multiple generators

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N -Bus system having m generators

$$m < N$$

For convenience, we assume that the m generators are connected at the first m buses of the system.

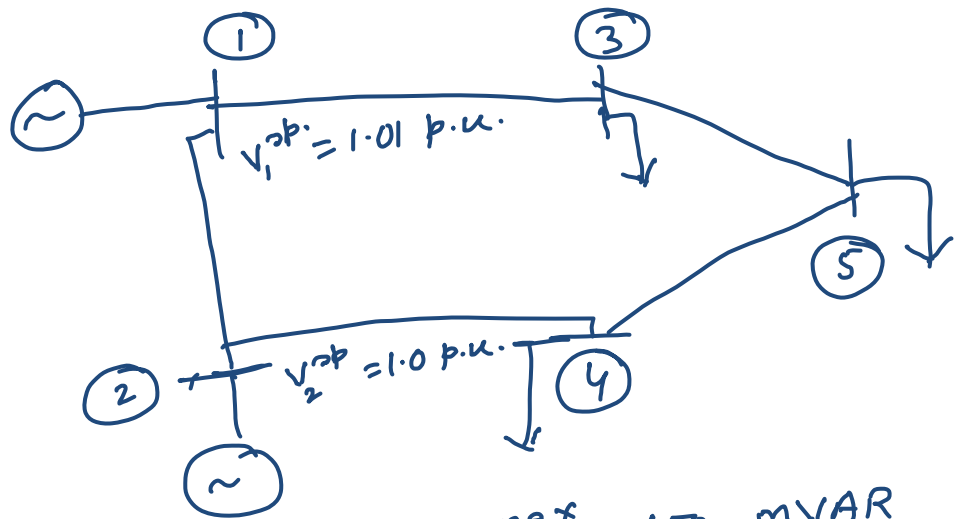
e.g. if $m=10$, 1, 2, --- 10

Bus 1 is always assumed to be the slack bus

Slack-bus	→	Bus 1
PV bus	→	Buses 2, 3, --- m
Load bus	→	Buses $m+1$, $m+2$, --- N

We have
 $V_i^{\text{spec}} \quad \forall i=1, \dots, m$





For bus 2

$$Q_2^{\max} = 100 \text{ MVAR}$$

125 MVAR $\rightarrow$ supply

60 MVAR $\rightarrow$ absorb

$$Q_i^{\max} \quad \forall i=1, 2$$

$$Q_i^{\min} \quad \forall i=1, 2$$

$$Q_2^{\min} = -50 \text{ MVAR}$$

$$\begin{cases} Q_i^{\max} & \forall i=1, \dots, m \\ Q_i^{\min} & \forall i=1, \dots, m \end{cases}$$

Algorithm.

1. Take initial guess.
For generator buses $\longrightarrow$
For load buses $\longrightarrow$

$$\begin{array}{ll} V_i^{sp} \angle 0^\circ & \text{generator} \\ \forall i = 1, \dots, M \\ 1.0 \angle 0^\circ & \forall i = M+1, \dots, N \\ & \text{load buses} \end{array}$$

2. Set iteration count $j = 1$

3. For $\forall i = 2, \dots, M$, do the following:

$$i) \text{ Calculate } Q_i^{(j)} = \sum_{k=1}^N V_i^{(j-1)} V_k^{(j-1)} Y_{ik} \sin(\theta_i^{(j-1)} - \theta_k^{(j-1)} - \delta_{ik})$$

If $Q_i^{\min} \leq Q_i^{(j)} \leq Q_i^{\max}$, then we update $\bar{V}_i^{(j)} = V_i^{sp} \angle \beta$

$$\beta = \angle A_i, \text{ where,}$$

$$A_i = \frac{1}{Y_{ii}} \left[\frac{P_i - jQ_i^{(j)}}{\bar{V}_i^{*(j-1)}} - \sum_{k=1}^{i-1} \bar{Y}_{ik} \bar{V}_k^{(j)} - \sum_{k=i+1}^N \bar{Y}_{ik} \bar{V}_k^{(j-1)} \right]$$

PV to PQ switching $\leftarrow$
 If $Q_i^{(j)} > Q_i^{\max}$, then we calculate,

$$\bar{V}_i^{(j)} = \frac{1}{Y_{ii}} \left[\frac{P_i - jQ_i^{\max}}{\bar{V}_i^{*(j-1)}} - \sum_{k=1}^{i-1} \bar{Y}_{ik} \bar{V}_k^{(j)} - \sum_{k=i+1}^N \bar{Y}_{ik} \bar{V}_k^{(j-1)} \right]$$

Complex value $\leftarrow$
 If $Q_i^{(j)} < Q_i^{\min}$, then

$$\bar{V}_i^{(j)} = \frac{1}{Y_{ii}} \left[\frac{P_i - jQ_i^{\min}}{\bar{V}_i^{*(j-1)}} - \sum_{k=1}^{i-1} \bar{Y}_{ik} \bar{V}_k^{(j)} - \sum_{k=i+1}^N \bar{Y}_{ik} \bar{V}_k^{(j-1)} \right]$$