SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT – III
NEWTON RAPHSON METHOD

INTRODUCTION

- The Newton Raphson technique , converges equally fast for large as well as small systems.
- Most widely used for solving simultaneous non – linear algebraic equations.
- It is a successive approximation procedure based on an initial estimate of the unknown and the use of Taylor’s series expansion

ALGORITHM

- Formulate Y_{bus} matrix
- Assume flat start for starting voltage solution

  $\delta_i^0 = 0$, for i=1,2,3 …..N for all buses except slack bus

  $|V_i^0| = 1.0$ for i=M+1, M+2, ……N(for all PQ buses)

  $|V_i| = |V_i|_{spec}$ for all PV buses and slack bus.
- For load buses calculate P_i^{cal} and Q_i^{cal}.
- For PV buses, check for Q-limit violation.

  If $Q_{i(min)} < Q_i^{cal} < Q_{i(\max)}$, the bus acts as P-V bus.

  If $Q_i^{cal} > Q_{i(\max)}$ $Q_{i(spec)} = Q_{i(\max)}$

  If $Q_i^{cal} < Q_{i(min)}$ $Q_{i(spec)} = Q_{i(\max)}$, the P-V bus will act as PQ bus.
- Compute mismatch vector using,

  $\Delta P_i = P_{i(spec)} - P_i^{cal}$ $\Delta Q_i = Q_{i(spec)} - Q_i^{cal}$

ALGORITHM

- Compute,

$$\Delta P_{i(\max)} = \max|\Delta P_i|; \quad i=1,2,3 \ldots..N'$$

$$\Delta Q_{i(\max)} = \max|\Delta Q_i|; \quad i=M+1, M+2, \ldots\ldots N$$

- Compute Jacobian matrix using Form $J=\begin{bmatrix} \frac{\partial P}{\partial \delta} & |V| & \frac{\partial P}{\partial V} \\ \frac{\partial Q}{\partial \delta} & |V| & \frac{\partial Q}{\partial V} \end{bmatrix}$
- Obtain state vector $\begin{bmatrix} \Delta\delta \\ \frac{\Delta V}{|V|} \end{bmatrix} = |J|^{-1} \begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix}$
- Update state vector using,

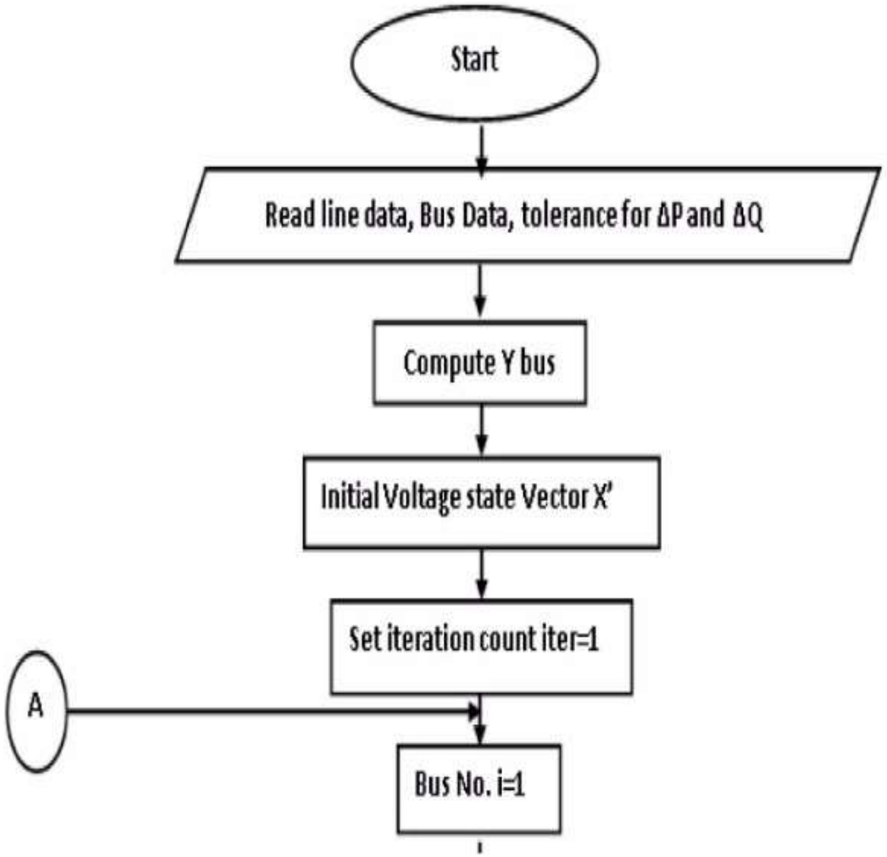
$$V^{new} = V_{old} + \Delta V = V_{old}\left[1 + \frac{\Delta V}{|V|old}\right]$$

$$\delta^{new} = \delta_{old} + \Delta\delta$$

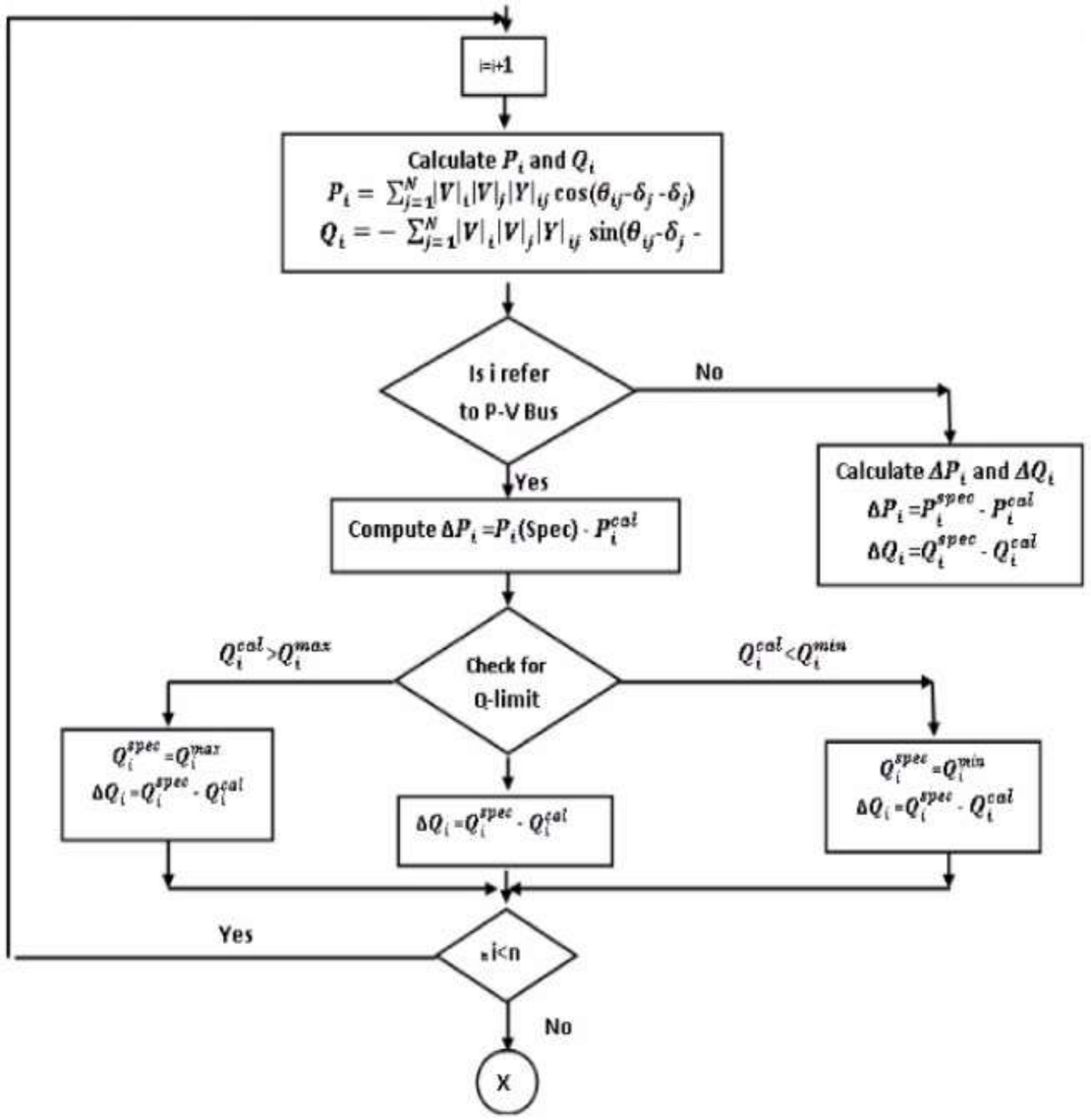
- This procedure is continued until,

$\Delta P_i < \varepsilon \quad \Delta Q_i < \varepsilon$, otherwise go to step 3.

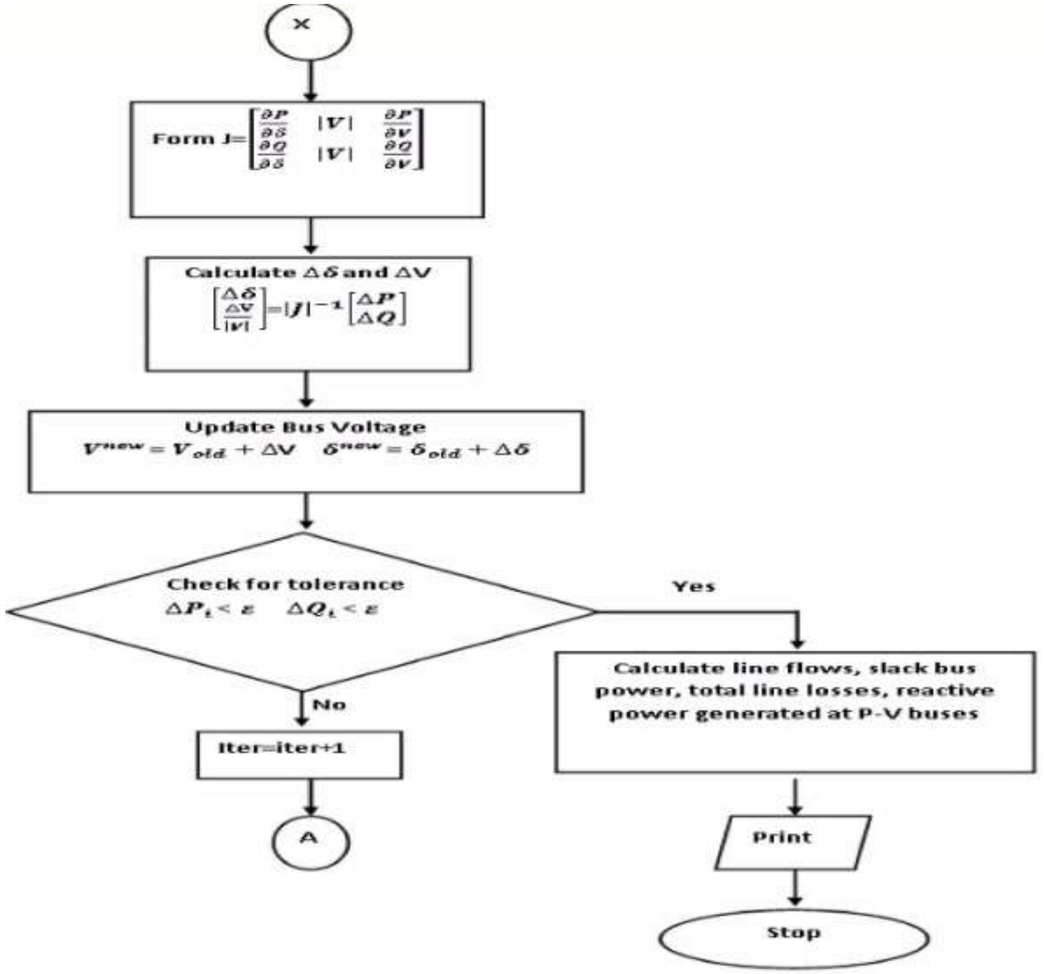
FLOWCHART


Start
Read line data, Bus Data, tolerance for ΔP and ΔQ
Compute Y bus
Initial Voltage state Vector X'
Set iteration count iter=1
A
Bus No. i=1

FLOWCHART


i=i+1
Calculate P_i and Q_i
$P_i = \sum_{j=1}^{N} |V|_i |V|_j |Y|_{ij} \cos(\theta_{ij} - \delta_j - \delta_j)$
$Q_i = - \sum_{j=1}^{N} |V|_i |V|_j |Y|_{ij} \sin(\theta_{ij} - \delta_j -$
Is i refer to P-V Bus
No
Yes
Calculate ΔP_i and ΔQ_i
$\Delta P_i = P_i^{spec} - P_i^{cal}$
$\Delta Q_i = Q_i^{spec} - Q_i^{cal}$
Compute $\Delta P_i = P_i(\text{Spec}) - P_i^{cal}$
$Q_i^{cal} > Q_i^{max}$
Check for Q-limit
$Q_i^{cal} < Q_i^{min}$
$Q_i^{spec} = Q_i^{max}$
$\Delta Q_i = Q_i^{spec} - Q_i^{cal}$
$\Delta Q_i = Q_i^{spec} - Q_i^{cal}$
$Q_i^{spec} = Q_i^{min}$
$\Delta Q_i = Q_i^{spec} - Q_i^{cal}$
Yes
i<n
No
X

FLOWCHART


x
Form J= $\begin{bmatrix} \frac{\partial P}{\partial \delta} & |V| & \frac{\partial P}{\partial V} \\ \frac{\partial Q}{\partial \delta} & |V| & \frac{\partial Q}{\partial V} \end{bmatrix}$
Calculate Δδ and ΔV
$\begin{bmatrix} \frac{\Delta \delta}{\Delta V} \\ \frac{\Delta V}{|V|} \end{bmatrix} = |J|^{-1} \begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix}$
Update Bus Voltage
$V^{new} = V_{old} + \Delta V \quad \delta^{new} = \delta_{old} + \Delta \delta$
Check for tolerance
$\Delta P_i < \varepsilon \quad \Delta Q_i < \varepsilon$
Yes
No
Iter=iter+1
A
Calculate line flows, slack bus power, total line losses, reactive power generated at P-V buses
Print
Stop


thank
you