

EXPERIMENT-4

OBJECTIVE

To develop a computer program to solve the set of non linear load flow equations using Gauss seidal load flow algorithm.

SOFTWARE USED

MATLAB

THEORY

Load flow analysis is the most frequently performed system study by electric utilities. This analysis is performed on a symmetrical steady-state operating condition of a power system under 'normal' mode of operation and aims at obtaining bus voltages and line/transformer flows for a given load condition. This information is essential both for long term planning and next day operational planning. In long term planning, load flow analysis helps in investigating the effectiveness of alternative plans and choosing the 'best' plan for system expansion to meet the projected operating state. In operational planning, it helps in choosing the 'best' unit commitment plan and generation schedules to run the system efficiently for them next day's load condition without violating the bus voltage and line flow operating limits.

The Gauss seidal method is an iterative algorithm for solving a set of non- linear algebraic equations. The relationship between network bus voltages and currents may be represented by either loop equations or node equations. Node equations are normally preferred because the number of independent node equation is smaller than the number of independent loop equations.

The network equations in terms of the bus admittance matrix can be written as,

$$\bar{I}_{\text{bus}} = [\bar{Y}_{\text{bus}}] \bar{V}_{\text{bus}} \quad (1)$$

For a n bus system, the above performance equation can be expanded as,

$$\begin{bmatrix} I_1 \\ I_2 \\ \vdots \\ \vdots \\ I_p \\ \vdots \\ I_n \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} & \dots & Y_{1p} & Y_{1n} \\ Y_{12} & Y_{22} & \dots & Y_{2p} & Y_{2n} \\ \vdots & \vdots & & \vdots & \vdots \\ \vdots & \vdots & & \vdots & \vdots \\ Y_{p1} & Y_{p2} & \dots & Y_{pp} & Y_{pn} \\ \vdots & \vdots & & \vdots & \vdots \\ Y_{n1} & Y_{n2} & \dots & Y_{np} & Y_{nn} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ \vdots \\ \vdots \\ V_p \\ \vdots \\ V_n \end{bmatrix} \quad (2)$$

where n is the total number of nodes.

V_p is the phasor voltage to ground at node p .

I_p is the phasor current flowing into the network at node p .

At the p^{th} bus, current injection:

$$I_p = Y_{p1}V_1 + Y_{p2}V_2 + Y_{pp}V_p + \dots + Y_{pn}V_n$$

$$= \sum_{q=1}^n Y_{pq}V_q = Y_{pp}V_p + \sum_{\substack{q=1 \\ q \neq p}}^n Y_{pq}V_q \quad (3)$$

$$V_p = \frac{1}{Y_{pp}} \left[I_p - \sum_{\substack{q=1 \\ q \neq p}}^n Y_{pq}V_q \right] \quad (4)$$

At bus p , we can write $P_p - jQ_p = V_p^* I_p$

Hence, the current at any node p is related to P , Q and V as follows:

$$\therefore I_p = \frac{(P_p - jQ_p)}{V_p^*} \quad (\text{for any bus } p \text{ except slack bus } s)$$

Substituting for I_p in Equation (4),

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

ALGORITHM:

Step 1: Read the input data.

Step 2: Find out the admittance matrix.

Step 3: Choose the flat voltage profile $1+j0$ to all buses except slack bus.

Step 4: Set the iteration count $p = 0$ and bus count $i = 1$.

Step 5: Check the slack bus, if it is the generator bus then go to the next step otherwise go to Next step 7.

Step 6: Before the check for the slack bus if it is slack bus then go to step 11 otherwise go to Next step.

Step 7: Check the reactive power of the generator bus within the given limit.

Step 8: If the reactive power violates a limit then treat the bus as load bus.

Step 9: Calculate the phase of the bus voltage on load bus

Step 10: Calculate the change in bus voltage of the repeat step mentioned above until all the bus voltages are calculated.

Step 11: Stop the program and print the results

PROBLEM STATEMENT

For the sample system the generators are connected at all the four buses by loads are at buses 2 and 3. Values of real and reactive power are listed in tables. All buses other than the slack are PQ type.

Assuming a flat voltage start find the voltages and bus angles at the three buses at the end of the first GS iteration

Bus	$P_i(\text{pu})$	$Q_i(\text{pu})$	$V_i(\text{pu})$	Remarks
1	-	-	$1.04 \angle 0^\circ$	Slack bus
2	0.5	-0.2	-	PQ bus
3	-1.0	0.5	-	PQ bus
4	0.3	-0.1	-	PQ bus

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