Exp - 07	Load Flow Solution Using Gauss Seidal Method

Aim:

To write the MATLAB coding to find the voltage value of various buses in a power system by using Gauss Seidal algorithm.

Apparatus Required:

SI.No	Apparatus	Specification
1	PC	Dual core, RAM 512 MB 1.2 GHz speed, 80 GB
2	MATLAB	7.5

Theory:

The gauss-seidel method is an iterative algorithm for solving a set of non linear load flow equations. The process of computing all the bus voltages is called one itera-tion .the iterative process is then repeated till the bus voltage converges with in prescribed accuracy. the converges of bus voltage is quite sensitive to the initial values assumed. Based on practical experiences it is easier to get a set of initial voltages very close to final solution. To compute the (k+1)th iteration value of the bus –p voltage, the (k+1)th iteration values of voltages are used for all buses less than p and kth iteration values of voltages are used for all buses greater than or equal to p.

It is important to note that the slack bus is a reference bus and so its voltage will not change .therefore in each iteration the slack bus voltage is not modified. For generator bus, the reactive power is not refer specified .thee in order to calculate the phase of bus voltage of a generator bus. The non-linear load flow equation is given by

Algorithm:

Step 1: Assume a flat voltage profile 1+j0bfor all buses except the slack bus

Step 2: Assume a suitable value of ε called convergence criterian

Step 3: Set iteration count, k=0 and assumed voltage profile of the buses are denoted as $V_i^0, V_2^0, ...V_n^0$

Step 4: Set the bus count P = 1

Step 5: Check for slack bus, If it is a slack bus go to step 12 otherwise continue

Step 6: Check for generator bus, if it is generator bus go to next step else go to step 9

Step 7: Temporarily set $\left|V_p^K\right| = \left|V_p\right|_{spec}$ where $\left|V_p^k\right|_{spec}$ is specified reactive power of generator bus

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

The calculated reactive power may be within specified limit or it may violate the limits.

If the calculated reactive power is within the specified limit, then consider the bus as generator bus and set $Q_p = Q_{p,cal}^{k+1}$, for this iteration and go to step 8

If the calculated reactive power violates the specified limit then treat the bus as load bus

if $Q_p^{k+1}, cal \le Q_{p\min} then\ Q_p = Q_{p\min}$

or $Q_p^{k+1}, cal \ge Q_{p\max} then\ Q_p = Q_{p\max}$

since the bus is treated as load bus $\left(U_p^k\right)$ need not be replaced by $\left|V_p\right|_{spec}$ go to step 9

Step 8: For generator bus the phase voltage of the bus can be calculated as

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

$$\delta_p^{k+1} = \tan^{-1}\left[\frac{\operatorname{Im} part\, of V_p^{k+1}, temp}{realpart\, of\ V_p^{k+1}, temp}\right]$$

Now the $(k+1)^{th}$ iteration voltage of the generator bus is given by

$$V_p^{k+1} = \left|V_p\right|_{spec} \angle \delta_p^{k+1}$$

Step 9: For load bus, V_p^{k+1} is calculated as

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

Step 10: An acceleration factor, α , can be used for faster convergence

$$V_{p,acc}^{k+1} = V_p^k + \alpha\left(V_p^{k+1} - V_p^k\right)$$

then $V_p^{k+1} = V_p^{k+1}, acc$

Step 11: Calculate the change in bus-P voltage

$$\Delta V_p^{k+1} = V_p^{k+1} - V_p^k$$

Step 12: Repeat steps 5 to 11 until all the bus voltages have been calculated. For this, increment the bus count by 1 until the bus count is n.

Step 13: Find the largest amoung $\Delta V_1^{k+1}, \Delta V_2^{k+1} ....\Delta V_n^{k+1}$ Let this be $\left|\Delta V_{\max}\right|$. If $\left|\Delta V_{\max}\right|$. is less than ε , then move to the next step, else increment the iteration count and go to step 4

Step 14: Calculate the line flow and slack bus power using the bus voltages.

Program:

```
clear all;
clc;
n=input('num of buses');
alpha=input('enter the acceleration factor alpha');
for i=1:n
    for j=1:n
        fprintf('enter the admittance between %d & %d',i,j);
        y(i,j)=input('=');
    end
end
Y(n,n)=0;
for i=1:n
    for j=1:n
        if i==j
            for k=1:n
                Y(i,j)=Y(i,j)+y(i,k);
            end
        else
            Y(i,j)=-y(i,j);
        end
    end
end
for i=1:n
    Bus=i
   a(i)=input('enter the slackbus:0,loadbus=1,gen.bus=-1');
   v(i)=input('enter the voltage');
   th(i)=input('enter the theta value');
   p(i)=input('enter the real power');
   q(i)=input('enter the reactive power');
   if a(i)==-1
       d(i)=v(i);
       ql(i)=input('enter the lower limit');
       qu(i)=input('enter the upper limit');
   end
end
for m=1:5
iter=m
for i=1:n
    v(i)=v(i)*complex(cos(th(i)),sin(th(i)));
    vl(i)=v(i);
end
for i=1:n
    if a(i)==-1
        b=0;
        c=0;
        for j=1:i-1
            b=b+Y(i,j)*v(j);
        end
        for j=1:n
            c=c+Y(i,j)+v(j);
        end
        q(i)=-imag(v(i)*(b+c));
        if q(i)<ql(i)
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            q(i)=ql(i);
            a(i)=1;
        elseif q(i)>qu(i)
            q(i)=qu(i);
            a(i)=1;
        end
        fprintf('reactive power value of bus %d is %d',i,q(i))
    end
end
for i=2:n
    b=0;
    c=0;
    for j=1:i-1
        b=b+Y(i,j)*v(j);
    end
    for j=i+1:n
        c=c+Y(i,j)*v(j);
    end
    v(i)=((complex(p(i),-q(i))/v(i)-b-c))/Y(i,i);
    if a(i)==-1
        v(i)=d(i)*complex(cos(th(i)),sin(th(i)));
    end
    v(i)=vl(i)+alpha*(v(i)-vl(i));
    th(i)=angle(v(i));
end
for i=1:n
    if a(i)==-1
        v(i)=d(i);
    else
        v(i)=abs(v(i));
    end
end
v
th*180/pi
end
```

Result: