İZMİR KÂTİP ÇELEBİ UNIVERSITY

2010

Midterm Project	
Course Name:	EEE306-Power Systems
Date:	22.05.2020
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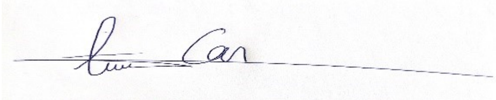
Signature	

ABSTRACT

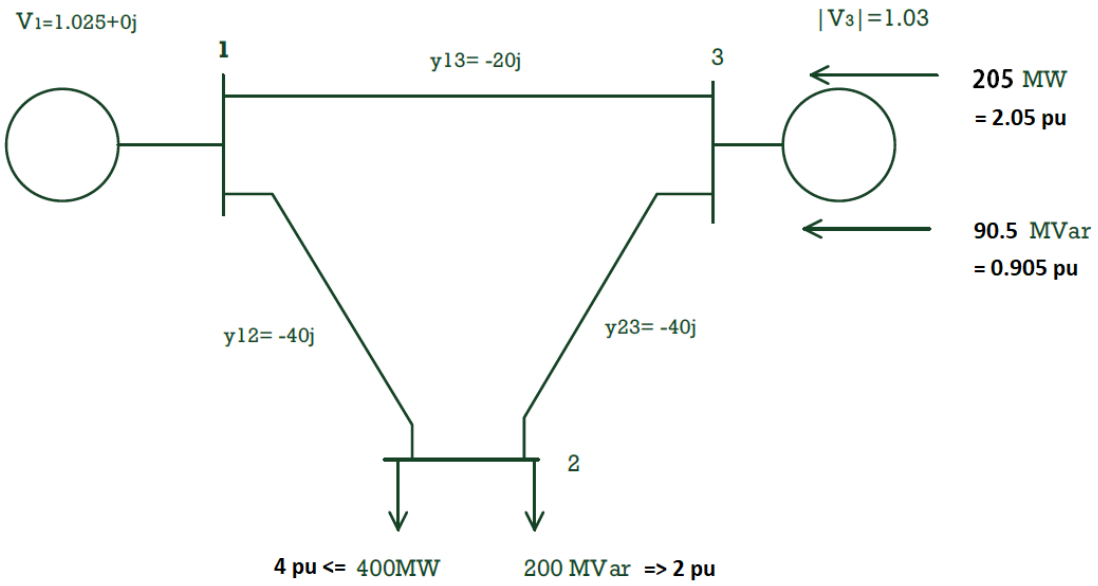
In this assignment, power flow solution of the system was performed both with hand calculation and with MATLAB m-file code by using Gauss-Seidel method. Initial estimates of $V2(0) = 1 + j0$ pu and $V3(0) = 1.03 + j0$ and keeping $|V3| = 1.03$ pu, and the phasor values of $V2$ and $V3$ was determined by performing three iterations.

Problem Solution:

Last two digit of my student number is 05 so, Voltage magnitude at bus 3 is fixed at 1.03 pu with a real and reactive power generation of 205 MW, 90.5 MVar, respectively.

100 MVA Base Value ;

$$\frac{400MW}{100} = 4\,pu\,, \frac{200MVar}{100} = 2\,pu\,, \frac{205MW}{100} = 2.05\,pu\,, \frac{90.5MVar}{100} = 0.905\,pu$$



- Admittance of each line,

$$Y_{12} = Y_{21} = Y_{32} = Y_{23} = -j40$$

$$Y_{13} = Y_{31} = -j20$$

- The admittance matrix is given as,

$$Y_{bus} = \begin{matrix} Y_{12+13} & -Y_{12} & -Y_{13} \\ -Y_{21} & Y_{21+23} & -Y_{23} \\ -Y_{31} & -Y_{32} & Y_{31+32} \end{matrix}$$

$$Y_{bus} = \begin{matrix} -j60 & j40 & j20 \\ j40 & -j80 & j40 \\ j20 & j40 & -j60 \end{matrix}$$

- **Gaus Seidal Power Flow Method**

The power for **generator** bus are taken as **positive** while the power for **load** buses are taken as **negative**. For given system;

$$\boldsymbol{V_1} = 1.025 + j0\ ,\ \boldsymbol{V_2^{(0)}} = 1 + j0\,,\ \boldsymbol{V_3^{(0)}} = 1.03 + j0$$

1) **First Iteration**

$$\boldsymbol{V_2^{(1)}} = \frac{1}{Y_{22}}\left[\frac{P_2 - jQ_2}{V_2^{(0)*}} - Y_{21}.V_1^{(0)} - Y_{23}.V_3^{(0)}\right]$$

$$\boldsymbol{V_2^{(1)}} = \frac{1}{-j80}\left[\frac{-4 + j2}{1} - j40x1.025 - j40x1.03\right]$$

$$\boldsymbol{V_2^{(1)}} = 1.003746 \llcorner -2.8553\, pu$$

$$\boldsymbol{V_3^{(1)}} = \frac{1}{Y_{33}}\left[\frac{P_3 - jQ_3}{V_3^{(0)*}} - Y_{31}.V_1^{(0)} - Y_{32}.V_2^{(1)}\right]$$

$$\boldsymbol{V_3^{(1)}} = \frac{1}{-j60}\left[\frac{2.05 - j0.905}{1.03} - j20x1.025 - j40x1.003746 \llcorner -2.8553\right]$$

$$\boldsymbol{V_3^{(1)}} = 1.02464 \llcorner -0.009062\, pu$$

2) **Second Iteration**

$$\boldsymbol{V_2^{(2)}} = \frac{1}{Y_{22}}\left[\frac{P_2 - jQ_2}{V_2^{(1)*}} - Y_{21}.V_1^{(0)} - Y_{23}.V_3^{(1)}\right]$$

$$\boldsymbol{V_2^{(2)}} = \frac{1}{-j80}\left[\frac{-4 + j2}{1.003746 \llcorner 2.8553} - j40x1.025 - j40x1.02464 \llcorner -0.009062\right]$$

$$\boldsymbol{V_2^{(2)}} = 0.9986 \llcorner -2.7797\, pu$$

$$\boldsymbol{V_3^{(2)}} = \frac{1}{Y_{33}}\left[\frac{P_3 - jQ_3}{V_3^{(1)*}} - Y_{31}.V_1^{(0)} - Y_{32}.V_2^{(2)}\right]$$

$$\boldsymbol{V_3^{(2)}} = \frac{1}{-j60}\left[\frac{2.05 - j0.905}{1.02464 \llcorner 0.009062} - j20x1.025 - j40x0.9986 \llcorner -2.7797\right]$$

$$\boldsymbol{V_3^{(2)}} = 1.02134 \llcorner 0.05932\, pu$$

3) Third Iteration

$$\boldsymbol{V_2^{(3)}} = \frac{1}{Y_{22}}\left[\frac{P_2 - jQ_2}{V_2^{(2)*}} - Y_{21}.V_1^{(0)} - Y_{23}.V_3^{(2)}\right]$$

$$\boldsymbol{V_2^{(3)}} = \frac{1}{-j80}\left[\frac{-4+j2}{0.9986\angle 2.7797} - j40x1.025 - j40x1.02134\angle 0.05932\right]$$

$$\boldsymbol{V_2^{(3)}} = 0.9969\angle -2.7752\,pu$$

$$\boldsymbol{V_3^{(3)}} = \frac{1}{Y_{33}}\left[\frac{P_3 - jQ_3}{V_3^{(2)*}} - Y_{31}.V_1^{(0)} - Y_{32}.V_2^{(3)}\right]$$

$$\boldsymbol{V_3^{(3)}} = \frac{1}{-j60}\left[\frac{2.05 - j0.905}{1.02134\angle -0.05932} - j20x1.025 - j40x0.9969\angle -2.7752\right]$$

$$\boldsymbol{V_3^{(3)}} = 1.02022\angle 0.07244\,pu$$

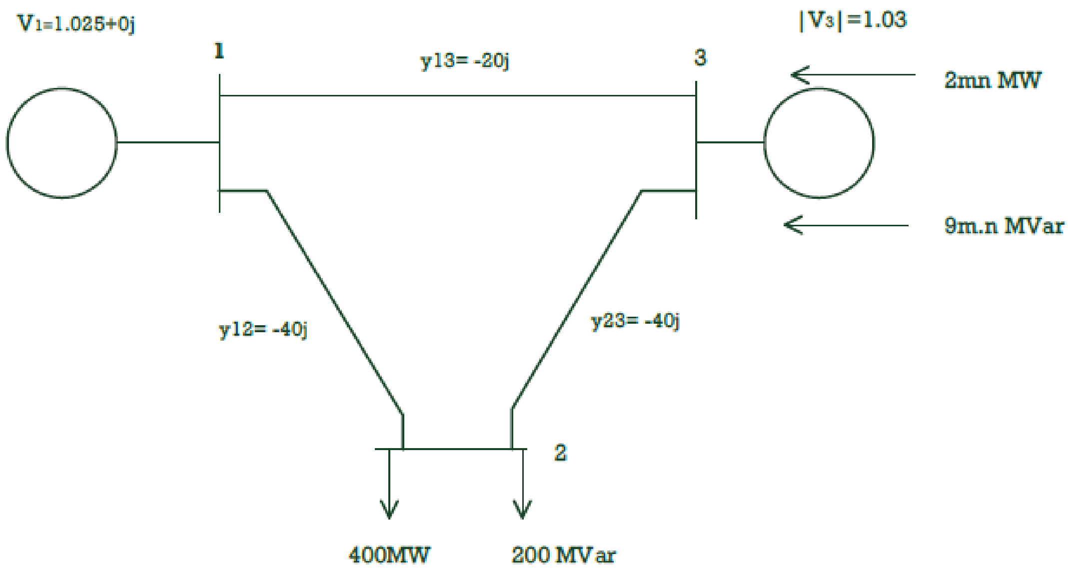
Iteration Number	V1	V2	V3
0	$1.025\angle 0\,pu$	$1.00\angle 0\,pu$	$1.03\angle 0\,pu$
1	$1.025\angle 0\,pu$	$1.003746\angle -2.8553\,pu$	$1.02464\angle -0.009062\,pu$
2	$1.025\angle 0\,pu$	$0.9986\angle -2.7797\,pu$	$1.02134\angle 0.05932\,pu$
3	$1.025\angle 0\,pu$	$0.9969\angle -2.7752\,pu$	$1.02022\angle 0.07244\,pu$

Problem MATLAB Solution:

```
% Turhan Can Kargın - 150403005
% EEE306-Power Systems
% Midterm Project
% Due: 22.05.2020
% Power flow/ Load flow solution by the gauss seidel method
clear all;
clc;
%Formation of Admittance matrix
%line data matrix formation
%Line data |From bus| To Bus |Transfer admittance|
 Ldata =  [     1         2            -40.0i
                1         3            -20.0i
                2         3            -40.0i];
   Lo=Ldata(:,1);
   Lt=Ldata(:,2);
   yL=Ldata(:,3);
```

```
   bus_no=max(max(Lo),max(Lt));
   branch_no=length(Lo);
   %Zero matrix formation
   YB=zeros(bus_no,bus_no);
   %For off diagonal elements
   for k=1:branch_no
       YB(Lo(k),Lt(k))=-yL(k);
       YB(Lt(k),Lo(k))=YB(Lo(k),Lt(k));
   end
   %For diagonal elements
   for m=1:bus_no;
       for n=1:branch_no
           if Lo(n)==m
               YB(m,m)=YB(m,m)+yL(n);
           else
               if Lt(n)==m
               YB(m,m)=YB(m,m)+yL(n);
               end
           end
       end
   end
       % Bus type and bus data matrix formation
%----------------------------------------%
       %| bus |  Pgi |  Qgi | Pli |  Qli |  ViR+ViI*j|
       %| no  |      |      |     |      |           |
Busdata=[ 1     0.00   0.00  0.00   0.00   1.025+0.00i;
          2     0.00   0.00  4.00   2.00   1.00+0.00i;
          3     2.05   0.905  0.00   0.00   1.03+0.00i;];
GenMw=Busdata(:,2);
GenMvar=Busdata(:,3);
LoadMw=Busdata(:,4);
LoadMvar=Busdata(:,5);
V=Busdata(:,6);
Pb=GenMw-LoadMw;
Qb=GenMvar-LoadMvar;
itmax=3; % Question is asking for 3 iteration
%Formation of gauss seidal method
for it=1:itmax
    for i=2:bus_no
         SigVY=0;
      for j=1:bus_no
            if j~=i
            SigVY=SigVY+YB(i,j)*V(j);
            end
        end
           V(i)=(1/YB(i,i))*((Pb(i)-Qb(i))/((conj(V(i))))-SigVY)% Our Formula
      end
  end
YB
V

%Command Window

YB =

   0.0000 -60.0000i   0.0000 +40.0000i   0.0000 +20.0000i
   0.0000 +40.0000i   0.0000 -80.0000i   0.0000 +40.0000i
   0.0000 +20.0000i   0.0000 +40.0000i   0.0000 -60.0000i


V =

   1.0250 + 0.0000i
   1.0245 - 0.0229i
   1.0246 + 0.0034i
```

Conclusion:



m = 0 n = 5

In this study, our aim is to determine phasor values of $V2$ and $V3$ by using Gauss-Seidel method with three iterations which the system is the above given figure one-line diagram of a simple three-bus power system with generation at buses 1 and 3. The voltage at bus 1 is $V1$ = 1.025∠0° per unit. Voltage magnitude at bus 3 is fixed at 1.03 pu with a real and reactive power generation of 2mn MW, 9m.n MVar, respectively. A load consisting of 400 MW and 200 MVar is taken from bus 2. Line admitances are marked in per unit on a 100 MVA base. Firstly, the hand calculation was performed and then MATLAB m-file solution is performed. Finally, it was determined that according to result hand calculation and MATLAB solution results are very similar.