9-9-2020 Sebin Wilson E

Roll No. 26

EXPERIMENT No.4

FORMATION OF BUS ADMITTANCE MATRIX

Aim

To formulate a Y- Bus using two-dimensional matrix by step by step method, develop a computer program and implement on four bus system.

Software Platform

Scilab

Theory

The Y-bus /Z-bus matrix constitutes the models of the passive portions of the power network. Y-bus matrix is often used in solving load flow problems. It has gained widespread applications owing to its simplicity of data preparation and the ease with which the bus admittance matrix can be formed and modified for network changes. Of course, sparsity is one of its greatest advantages as it heavily reduces computer memory and time requirements. In short circuit analysis, the generator and transformer impedances must also be taken into account. In contingency analysis, the shunt elements are neglected, while forming the Z-bus matrix, which is used to compute the outage distribution factors. This can be easily obtained by inverting the Y-bus matrix. The impedance matrix is a full matrix and is most useful for short circuit studies. Initially, the Y-bus matrix is formed by considering line data only. After forming the Y-bus matrix, the modified Y-bus matrix is formed by adding the generator and transformer admittances to the respective diagonal elements and is inverted to form the Z-bus matrix.

The performance equation for a n-bus system in terms of admittance matrix can be written as,

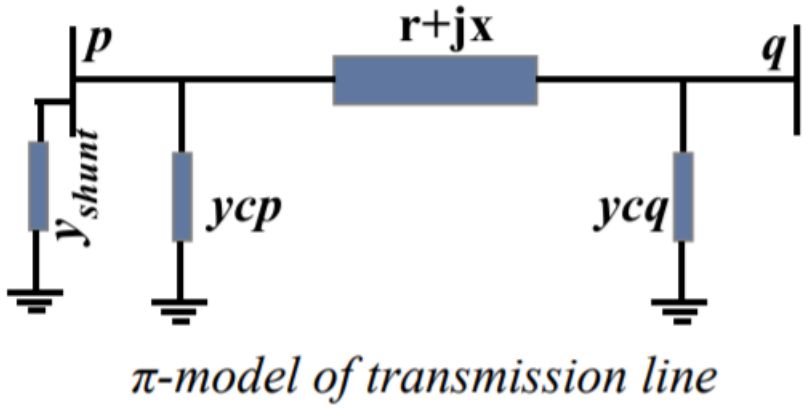
$$\begin{pmatrix} Y_{11} & Y_{12} & \cdots & Y_{1N} \\ Y_{21} & Y_{22} & \cdots & Y_{2N} \\ \vdots & \ddots & \cdots & \vdots \\ Y_{NN} & Y_{N2} & \cdots & Y_{NN} \end{pmatrix} * \begin{pmatrix} V_1 \\ V_2 \\ \vdots \\ V_N \end{pmatrix} = \begin{pmatrix} I_1 \\ I_2 \\ \vdots \\ I_N \end{pmatrix}$$

I = Ybus.V

The admittances Y11, Y22, …, Ynn are called the self-admittances at the nodes and all other admittances are called the mutual admittances of the nodes.

Inspection method

The admittance matrix can be formed from the parameters of system components. A diagonal element Ypp is the sum of all admittances connected to the pth bus. An off-diagonal element Ypq is the negative sum of the all admittances directly connected between pth and qth buses.



π-model of transmission line

We start with [Ybus] array initially set to zero. The dimensions of [Ybus] are n x n bus, where 'n' is the number of buses (or the total no. of nodes, including reference node). Consider an element having admittance ypq connected between buses p and q. Four entries in Ybus are affected: Ypp , Yqq , Ypq and Yqp . We modify these entries as below,

Ypp,new = Ypp,old + ypq + ycp (1.1a)

Yqq,new = Yqqold + yqp + ycq (1.1b)

Ypq,new = Ypq,old – ypq (1.1c)

Yqp,new = Yqp,old – yqp (1.1d)

We add the elements one by one and modify the entries of [Ybus] as per equations (1.1). If an element is connected from ith bus to reference, only entry Ypp is affected.

Program

Problem 1

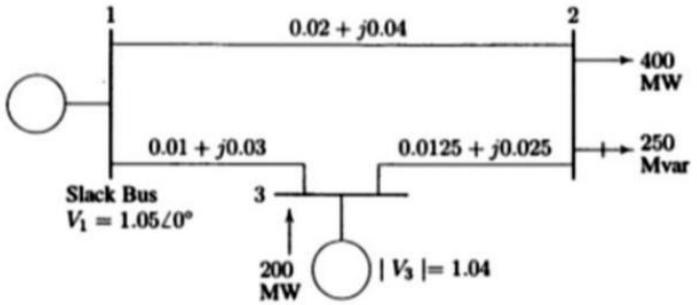
Form the Y Bus for the system shown in figure by step by step method.

Line No. (k)	*From Bus lp(k)*	*To Bus lq(k)*	*Line Impedance*	*ycp*	*ycq*
1	1	2	0.01+j0.04	j0.08	j0.08
2	1	3	0+j0.1	0	0
3	2	3	0.04+j0.16	j0.09	j0.09
4	2	5	0.06+j0.18	j0.08	j0.08
5	2	5	0.06+j0.18	j0.08	j0.08
6	3	4	0+j0.1	0	0
7	4	5	0.1+j0.3	0	0

yshunt(i)	0	0	0	0	j0.3

Problem 2

For the network shown in figure, determine the bus admittance matrix .

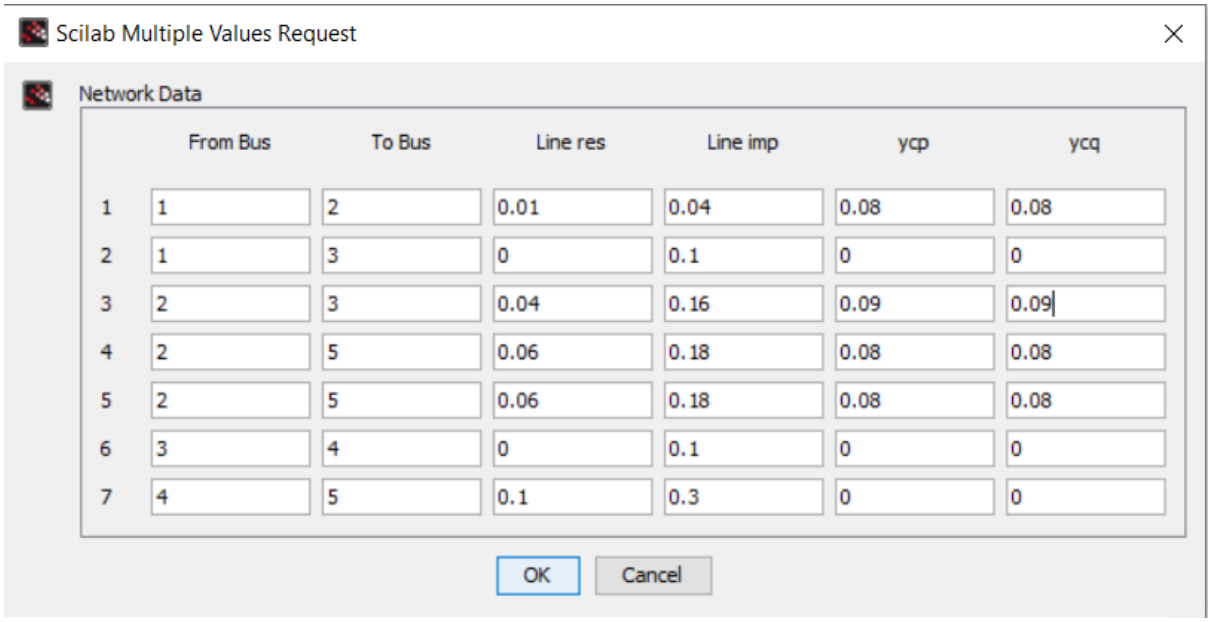


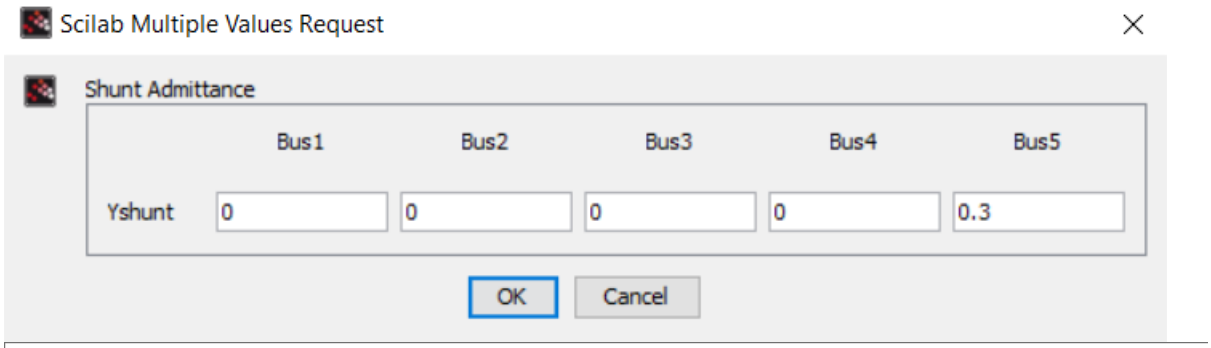
Sample Program (All)

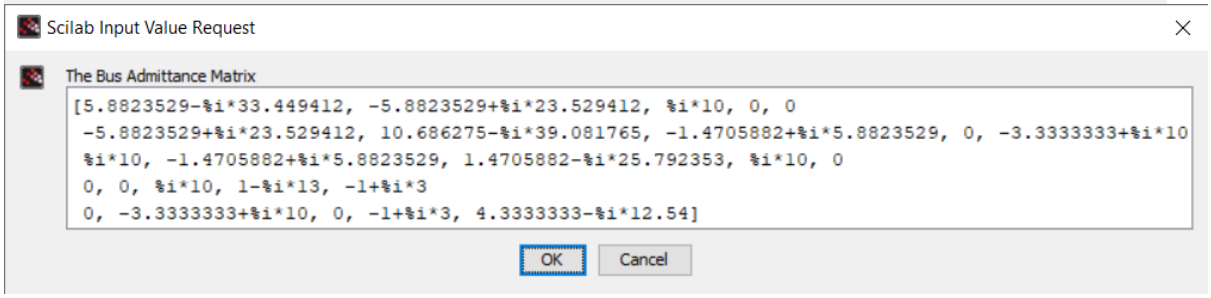
```
clc;
clear;
//input
buses=input("Enter the number of buses:")
line=input("Enter the number of lines:")
Ybus=zeros(buses,buses)
net_data=zeros(line,6)
Yshunt=zeros(1,buses)
row=list()
for i=1:line
row(i)=string(i)
end
row=list2vec(row)
sh_col=list()
for i=1:buses
sh_col(i)="Bus"+string(i)
end
sh_col=list2vec(sh_col)
column=['From Bus';'To Bus';'Line res';'Line
imp';'ycp';'ycq']
net_data=x_mdialog("Network
Data",row,column,string(net_data))
Yshunt=x_mdialog("Shunt
Admittance","Yshunt",sh_col,string(Yshunt))
net_data=resize_matrix(net_data,-1,-1,"constant")
Yshunt=resize_matrix(Yshunt,-1,-1,"constant")
//Extraction
from=net_data(:,1)
to=net_data(:,2)
z=(net_data(:,3)+net_data(:,4)*%i)
ycp=net_data(:,5)*%i
ycq=net_data(:,6)*%i
Yshunt=Yshunt*%i
//logic
for i=1:line
p=from(i)
q=to(i)
Ybus(p,p)=Ybus(p,p)+1/z(i)+ycp(i)
Ybus(q,q)=Ybus(q,q)+1/z(i)+ycq(i)
Ybus(p,q)=Ybus(p,q)-1/z(i)
Ybus(q,p)=Ybus(q,p)-1/z(i)
end
for i=1:buses
Ybus(i,i)=Ybus(i,i)+Yshunt(i)
end
//display
x_matrix('The Bus Admittance Matrix',Ybus)
disp("The Bus Admittance Matrix")
disp(Ybus)
```

Sample Output-1

```
Enter the number of buses:5
Enter the number of lines:7
```





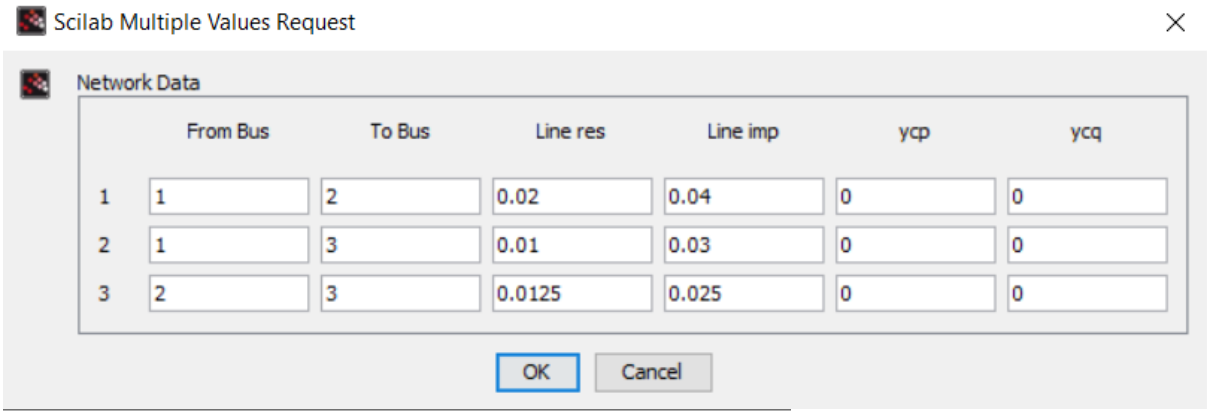


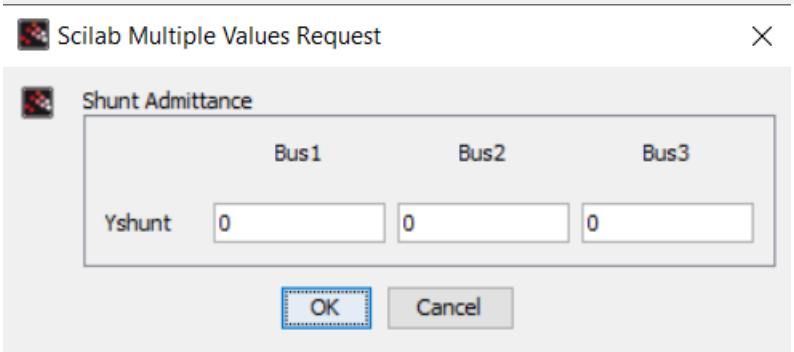
Scilab 6.1.0 Console

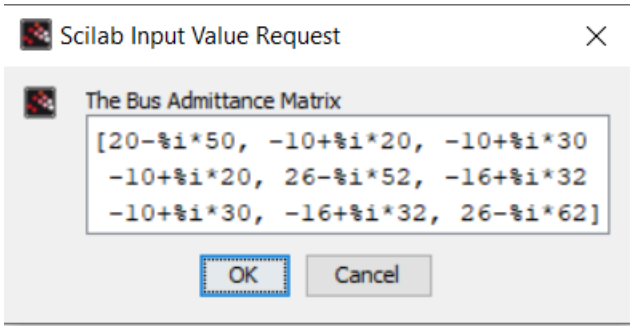
```
Enter the number of buses:5

Enter the number of lines:7


 "The Bus Admittance Matrix"

  5.8823529 - 33.449412i  -5.8823529 + 23.529412i   0.        + 10.i         0. + 0.i    0.        + 0.i
 -5.8823529 + 23.529412i   10.686275 - 39.081765i  -1.4705882 + 5.8823529i   0. + 0.i   -3.3333333 + 10.i
  0.        + 10.i        -1.4705882 + 5.8823529i   1.4705882 - 25.792353i   0. + 10.i   0.        + 0.i
  0.        + 0.i          0.        + 0.i          0.        + 10.i         1. - 13.i  -1.        + 3.i
  0.        + 0.i         -3.3333333 + 10.i         0.        + 0.i        -1. + 3.i    4.3333333 - 12.54i

-->
```

Sample Output – 2

```
Enter the number of buses:3
Enter the number of lines:3
```








```
"The Bus Admittance Matrix"

 20. - 50.i  -10. + 20.i  -10. + 30.i
-10. + 20.i   26. - 52.i  -16. + 32.i
-10. + 30.i  -16. + 32.i   26. - 62.i
```

Result

The Y- bus matrix was formed for the given system by step by step method and the results were verified by manual calculation.