INDIAN INSTITUTE OF TECHNOLOGY , GUWAHATI

POWER ENGINEERING LAB

EE_572

By : Rohit bagdi

214102113

To: Dr. Sanjib ganguly

Ass. : Arunima dutta &

Purushottam kumar

ASSIGNMENT–4 (part 1)

Do write program codes to execute the 'Forward-backward sweep load flow algorithm' for 33-node, 69-node, and 52-node test distribution networks.

Procedure : For "*'Forward-backward sweep load flow*" first we have to calculate the load current at each bus and after the load current calculation be have to calculate the line current for all line . to calculate the line current we have to start the calculation from end points of the system this procedure is called "BACKWARD" sweep . after the calculation of line current we will calculate the value of voltage at each node , this procedure is called as FORWARD sweep . after complete calculation of voltage we will find the difference between new voltage and old voltage check it's value . error should be less then our accuracy or equal. Then we will stop the iteration /calculation other wise we will continue to perform forward-backward sweep method(continue with iteration).

For performing the forward-backward sweep method first we have to calculate the end points of the system like for the 33-bus system end points are :18,22,25 & 33.similarly for the system 69 and 52 also.

The code for finding the end points is :

```
count=1;
for line_no=length(linedata)+1:-1:1
     if line_no<length(linedata)
        if linedata(line_no+1,1)~=linedata(line_no,2)
            end_point(count)=linedata(line_no,2);
            count=count+1;
        end
     end
     if line_no==length(linedata)+1
         end_point(count)=length(linedata)+1;
         count=count+1;
```

```
    end
end
```

We know that apparent power for a bus is :

$$S = V.I^*$$

We want to calculate the load current at each bus so:

$$I_i = S_i^* / V_i^* = (P_i - j*Q_i) / V_i^*$$

this is for calculation of load current at i^{th} bus .

for first iteration we will calculate the current at the reference voltage (reference voltage magnitude is 1 and angle is 0^o).

```
%load current at each bus

    for i=1:length(linedata)+1
        load_current(i,1)=(P(i)-j*Q(i))/conj (Vlt_new(i,1));

    end
```

For calculation of load current at each bus

after load current calculation we will calculate the value of line current

Line current $_{i-1}$ = load current $_i$ + Line current $_i$

2<=i<=33 , for all load bus

Code for the calculation of line current is :

```
% finding the line or bus current
    for i=1:length(end_point)
     endbus = end_point(i);
        for k= endbus:-1:1
         p=k;
         if p>0
         if p== endbus
            bus_current(p,1)=k;
            bus_current(p,2)=bus_current(p,2)+load_current(p);
         else
        if linedata(p,1)== linedata(p,2)-1

            present_bus=linedata(p,1);
```

```
            next_bus=linedata(p,2);

            bus_current(present_bus,1) = present_bus;
            bus_current(present_bus,2) =
bus_current(present_bus,2)+load_current(present_bus) +
bus_current(next_bus,2);
        else

            present_bus=linedata(p,1);
            next_bus=linedata(p,2);

            bus_current(present_bus,1)=present_bus;

bus_current(present_bus,2)=bus_current(present_bus,2)+bus_current(next_bus,2)
;

            break
        end
         end
         end
        end
    end
```

our backward sweep is completed and we are going to calculate the value of voltage by forward sweep the code is :

```
for point=1:length(linedata(:,1))

        starting_node=linedata(point,1);
        ending_node=linedata(point,2);
        lineno=linedata(point,5);
        Vlt_new(ending_node,1)=Vlt_new(starting_node,1)-
bus_current(lineno+1,2)*z(point,3);

 end
```

we successfully calculate the value of load current , line current and bus voltages .

now we have to calculate the error between old voltage and new voltage see the error is less the or accuracy or not, if error is less than our accuracy then we will stop the iteration other we will continue with the code :

Complete code for the forward-backward sweep is

```
while max_v_err_r>=0.0001 & no_iter<100
%max_v_err_r>=0.0001
 Vlt_old=Vlt_new;
 bus_current=zeros(length(busdata(:,1)),2);

    %load current at each bus

    for i=1:length(linedata)+1
        load_current(i,1)=(P(i)-j*Q(i))/conj (Vlt_new(i,1));

    end

 % finding the line or bus current
    for i=1:length(end_point)
     endbus = end_point(i);
        for k= endbus:-1:1
         p=k;
         if p>0
         if p== endbus
            bus_current(p,1)=k;
            bus_current(p,2)=bus_current(p,2)+load_current(p);
         else
        if linedata(p,1)== linedata(p,2)-1

            present_bus=linedata(p,1);
            next_bus=linedata(p,2);

            bus_current(present_bus,1) = present_bus;
            bus_current(present_bus,2) =
bus_current(present_bus,2)+load_current(present_bus) +
bus_current(next_bus,2);
        else

            present_bus=linedata(p,1);
            next_bus=linedata(p,2);

            bus_current(present_bus,1)=present_bus;

bus_current(present_bus,2)=bus_current(present_bus,2)+bus_current(next_bus,2)
;
            %k=0;
            break
        end
         end
         end
        end
    end

    for point=1:length(linedata(:,1))

        starting_node=linedata(point,1);
        ending_node=linedata(point,2);
```

```
        lineno=linedata(point,5);
        Vlt_new(ending_node,1)=Vlt_new(starting_node,1)-
bus_current(lineno+1,2)*z(point,3);

    end
     error=Vlt_new-Vlt_old;

     max_v_err_r=max(abs(error));
     busdata(:,3)=abs(Vlt_new);

     no_iter=no_iter+1;

end
```

After calculation of voltage at all node we will calculate the power loss for the system the code for power loss :

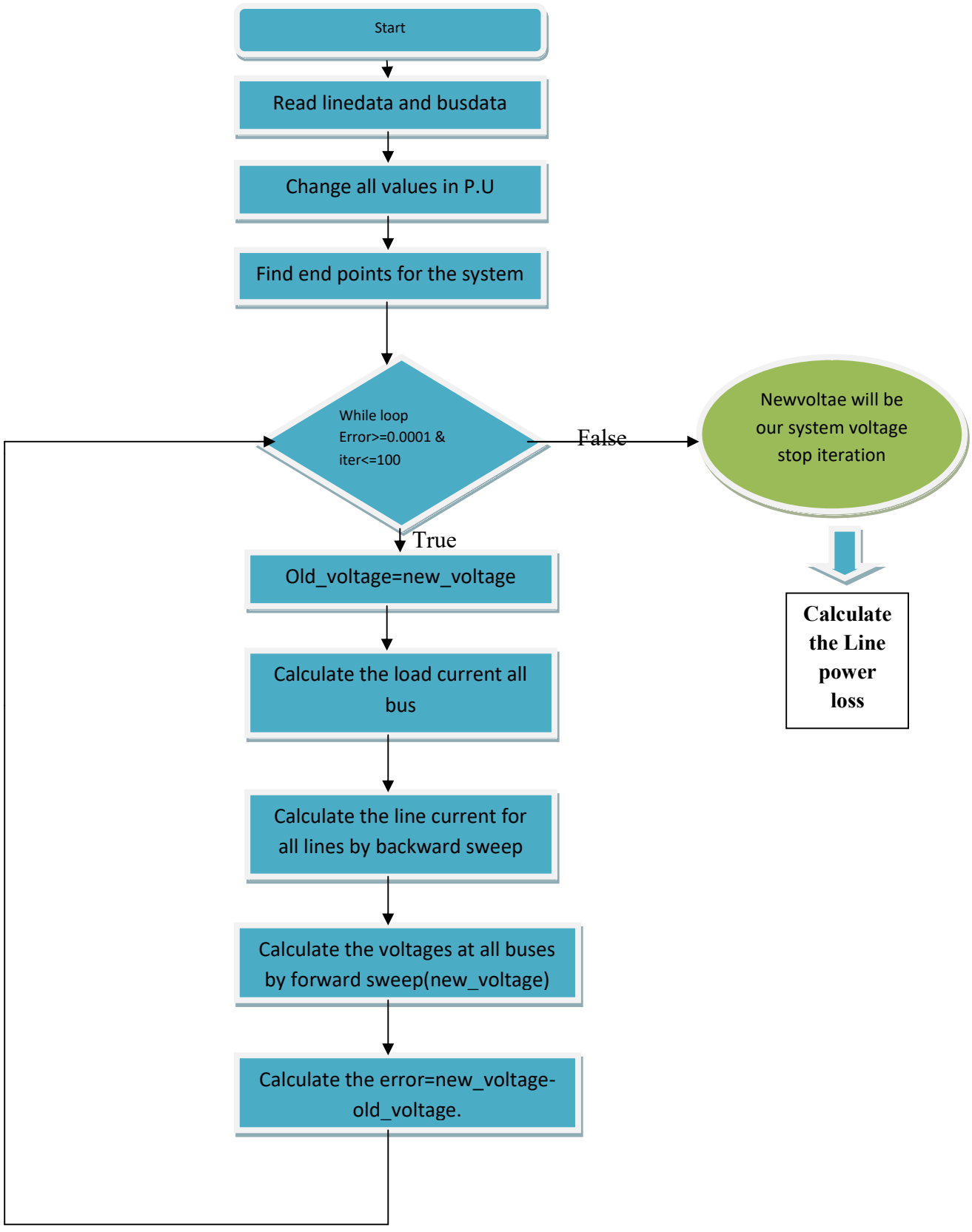
```
Ploss=0;

  for point=1:length(linedata(:,1))

        lineno=linedata(point,5);
        Ploss=Ploss+abs(bus_current(lineno+1,2))^2*real(z(point,3));


  end
```

FLOW CHART FOR THE FORWARD-BACKWARD SWEEP METHOD



Results for 69-bus system

(1) End points are = 69 67 65 52 50 46 35 27

(2) Final system voltages are

Bus no.	Voltage (complex)	Voltage in magnitude
1	1.+ 0.0i	1.0000
2(Max. voltage bus)	0.9999 - 2.14e-05i	1.0000
3	0.999 - 4.28e-05i	0.9999
4	0.999- 0.00010i	0.9998
5	0.999 - 0.00032i	0.9990
6	0.9900 + 0.000852i	0.9901
7	0.98079 + 0.002074i	0.9808
8	0.978574 + 0.0023629i	0.9786
9	0.9774393 + 0.002511i	0.9774
10	0.972 + 0.0039372i	0.9724
11	0.97131 + 0.00421i	0.9713
12	0.968142 + 0.005096i	0.9682
13	0.965211 + 0.0058i	0.9652
14	0.96231 + 0.00662264i	0.9623
15	0.95944 + 0.007373i	0.9595
16	0.95889755 + 0.00751141i	0.9589
17	0.9580151 + 0.0077411i	0.9580
18	0.9580 + 0.00774i	0.9580
19	0.957539 + 0.00788i	0.9576
20	0.957240 + 0.007971i	0.9573
21	0.95675+ 0.00811i	0.9568
22	0.956749 + 0.00811i	0.9568
23	0.9566779+ 0.008139i	0.9567
24	0.9565210 + 0.0081i	0.9566
25	0.95634 + 0.008232i	0.9564
26	0.956278 + 0.008253i	0.9563
27	0.95625848 + 0.00825i	0.9563
28	0.9999260 - 4.7230279e-05i	0.9999
29	0.99985 - 9.260e-05i	0.9999
30	0.99973 - 5.550e-05i	0.9997
31	0.9997119 - 4.8956e-05i	0.9997
32	0.99961 - 1.62101e-05i	0.9996
33	0.999349 + 6.0997e-05i	0.9993
34	0.99901332 + 0.000163i	0.9990
35	0.99895 + 0.00018159i	0.9989
36	0.99992 - 5.182e-05i	0.9999
37	0.99975 - 0.00016365i	0.9997
38	0.9996 - 0.00020581i	0.9996
39	0.99955 - 0.0002179i	0.9995
40	0.999541 - 0.0002186i	0.9995

41	0.99885 - 0.00041007i	0.9988
42	0.998551 - 0.00049i	0.9986
43	0.99851 - 0.00050148i	0.9985
44	0.99850 - 0.0005041i	0.9985
45	0.9984051 - 0.000535597i	0.9984
46	0.998404765 - 0.0005358i	0.9984
47	0.9997894 - 0.0001345i	0.9998
48	0.9985431 - 0.00091552i	0.9985
49	0.9946932 - 0.003326i	0.9947
50	0.994146 - 0.00366i	0.9942
51	0.9785377 + 0.002367i	0.9785
52	0.9785280 + 0.002371i	0.9785
53	0.974652 + 0.0028763i	0.9747
54	0.97141 + 0.003305i	0.9714
55	0.96693 + 0.00389i	0.9669
56	0.96256 + 0.004456i	0.9626
57	0.9400 + 0.0108582i	0.9401
58	0.928935 + 0.0140144i	0.9290
59	0.92463 + 0.0152i	0.9248
60	0.91958 + 0.01685i	0.9197
61	0.9121 + 0.01781i	0.9123
62	0.91188 + 0.017853i	0.9121
63	0.9114895 + 0.01791i	0.9117
64	0.909585 + 0.018149i	0.9098
65(minimum voltage bus)	0.90901 + 0.018223i	0.9092
66	0.9712511 + 0.004237i	0.9713
67	0.971250 + 0.0042364i	0.9713
68	0.96781 + 0.005197i	0.9678
69	0.96781 + 0.005197i	0.9678

Results for 33-bus system

(1) End points are = 33 25 22 18

(2) Final system voltages are

Bus no.	Voltage (complex)	Voltage in magnitude
1	1.0000 + 0.0000i	1.0000
2(Max. voltage bus)	0.9970 + 0.0003i	0.9970
3	0.9829 + 0.0016i	0.9829
4	0.9755 + 0.0028i	0.9755
5	0.9681 + 0.0039i	0.9681
6	0.9497 + 0.0022i	0.9497
7	0.9462 - 0.0016i	0.9462
8	0.9413 - 0.0010i	0.9413
9	0.9351 - 0.0022i	0.9351

10	0.9292 - 0.0032i	0.9292
11	0.9284 - 0.0031i	0.9284
12	0.9269 - 0.0029i	0.9269
13	0.9208 - 0.0043i	0.9208
14	0.9185 - 0.0056i	0.9185
15	0.9171 - 0.0062i	0.9171
16	0.9157 - 0.0065i	0.9157
17	0.9137 - 0.0077i	0.9137
18(minimum voltage bus)	0.9131 - 0.0079i	0.9131
19	0.9965 + 0.0001i	0.9965
20	0.9929 - 0.0011i	0.9929
21	0.9922 - 0.0014i	0.9922
22	0.9916 - 0.0018i	0.9916
23	0.9794 + 0.0011i	0.9794
24	0.9727 - 0.0004i	0.9727
25	0.9694 - 0.0011i	0.9694
26	0.9477 + 0.0029i	0.9477
27	0.9452 + 0.0038i	0.9452
28	0.9337 + 0.0051i	0.9337
29	0.9255 + 0.0063i	0.9255
30	0.9219 + 0.0080i	0.9220
31	0.9178 + 0.0066i	0.9178
32	0.9169 + 0.0062i	0.9169
33	0.9166 + 0.0061i	0.9166

Results for 52-bus system

(1) End points are = 52 50 48 46 44 42 40 38 37 34 31 29 26 24 19 17 14 13 15 12 7 5 3

(2) Final system voltages are

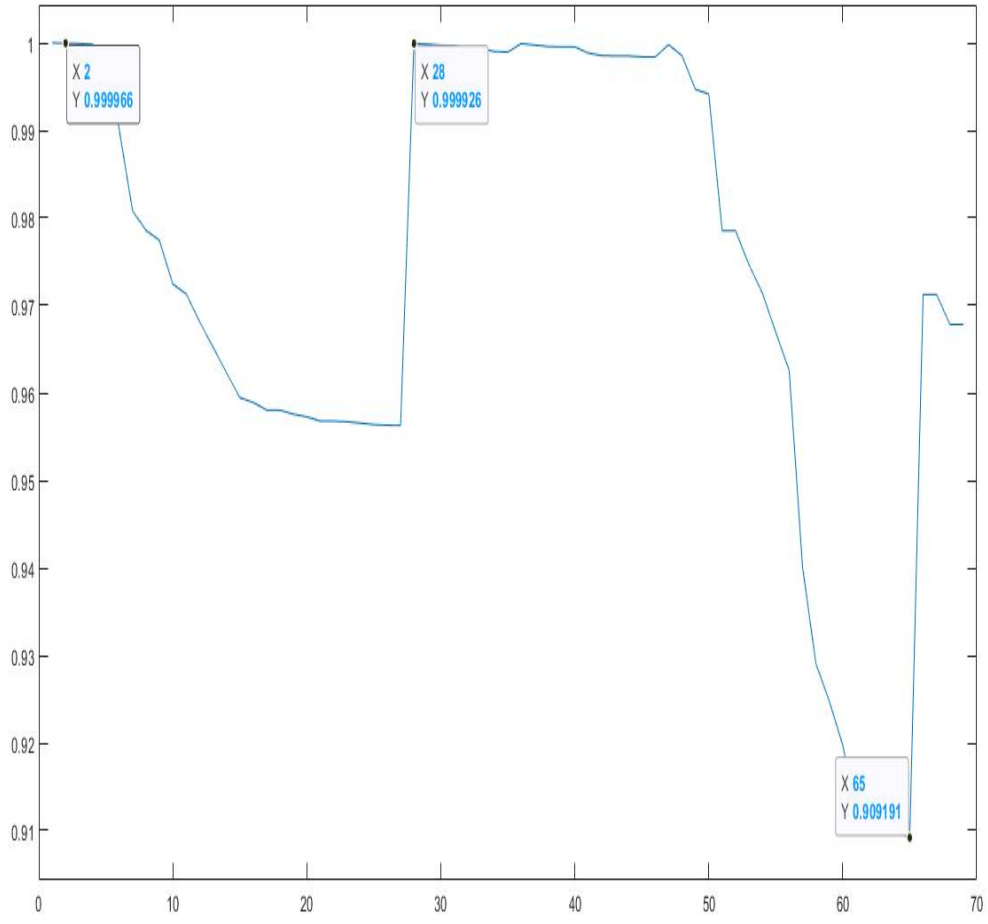
Bus no.	Voltage (complex)	Voltage in magnitude
1	1.+ 0.0i	1.0000
2	0.956 + 0.001693i	0.9560
3	0.94864 + 0.00199i	0.9486
4	0.93754 + 0.002338i	0.9375
5	0.935741 + 0.002404i	0.9357
6	0.927634 + 0.002711i	0.9276
7	0.92642 + 0.00276i	0.9264
8	0.905112 + 0.00351i	0.9051
9	0.882758+ 0.0043454i	0.8828
10	0.850264 + 0.005557i	0.8503
11	0.847771 + 0.0056364i	0.8478
12	0.84644 + 0.005685i	0.8465
13	0.8442 + 0.005764i	0.8441

14	0.841805 + 0.00583i	0.8418
15	0.8411 + 0.00588i	0.8411
16	0.844220 + 0.0057711i	0.8442
17	0.839226 + 0.00599i	0.8392
18	0.8324068 + 0.00618i	0.8324
19	0.82835 + 0.0063251i	0.8284
20(Max. voltage bus)	0.987756 + 0.0005356i	0.9878
21	0.9790725 + 0.00088532i	0.9791
22	0.96474 + 0.00149i	0.9647
23	0.95295 + 0.001972i	0.9529
24	0.9499 + 0.002085i	0.9500
25	0.9600762 + 0.001717i	0.9601
26	0.9583 + 0.001798i	0.9583
27	0.9823 + 0.0007716i	0.9824
28	0.97876 + 0.000928i	0.9788
29	0.976942+ 0.0010054i	0.9769
30	0.9754581 + 0.0010769i	0.9755
31	0.970371 + 0.00129729i	0.9704
32	0.90874 + 0.00305481i	0.9087
33	0.7970129 + 0.0067i	0.7970
34	0.794866 + 0.006854i	0.7949
35	0.781674 + 0.0073428i	0.7817
36	0.7699667+ 0.007808i	0.7700
37	0.767211 + 0.007919i	0.7673
38	0.7798 + 0.00741i	0.7799
39	0.75735 + 0.007919i	0.7574
40	0.754382 + 0.00801i	0.7544
41	0.724679 + 0.008854i	0.7247
42	0.720567 + 0.008986i	0.7206
43	0.71482 + 0.009144i	0.7149
44	0.70584 + 0.009421i	0.7059
45	0.7113 + 0.009211i	0.7114
46	0.7071 + 0.009327i	0.7072
47	0.6959 + 0.00965i	0.6960
48	0.6949 + 0.00967i	0.6951
49	0.6891 + 0.0098i	0.6892
50(minimum voltage bus)	0.6842 + 0.00995i	0.6843
51	0.6857 + 0.00991i	0.6858
52	0.6851 + 0.00993i	0.6852

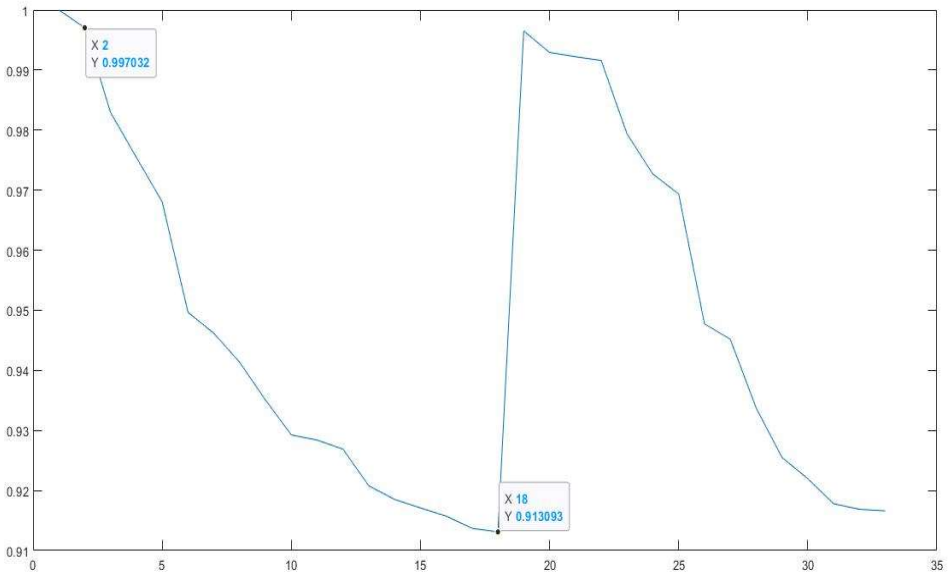
Final results for the all system

Bus-system	*33-bus system*	*69-bus system*	*52-bus system*
Min. voltage bus	18^{th} Bus	65^{th} Bus	50^{th} Bus
Min. voltage (p.u)	0.9131	0.9092	0.6842
Max. voltage bus	2^{th} Bus	2^{th} Bus	20^{th} Bus
Max. voltage(p.u)	0.9970	1	0.9877
Power loss(kw)	202.6650	224.9783	791.9124

Voltage plot for each bus for 69-bus system



Voltage plot for each bus for 33-bus system



Voltage plot for each bus for 52-bus system