DFACTS DEVICES FOR VOLTAGE REGULATION IN DISTRIBUTION SYSTEM

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OUTLINE

- INTRODUCTION
- PROBLEM STATEMENT
- MODELLING AND SIMULATION
- RESULT

LITERATURE REVIEW

DFACTS, or Distributed Flexible AC Transmission System, dynamically control parameters like voltage, current, and impedance in the power grid. These devices enhance power handling capacity, voltage regulation, system stability, and address issues like harmonics reduction.

Types of D-FACTs devices:

DSSC (Series compensation)

provides series compensation to control active power flow and regulate system voltage. It can be distributed along the transmission line to influence line impedance.

D-STATCOM (Shunt compensation)

used for reactive power compensation and voltage regulation. It injects or absorbs reactive power to maintain a stable voltage profile in the distribution system.

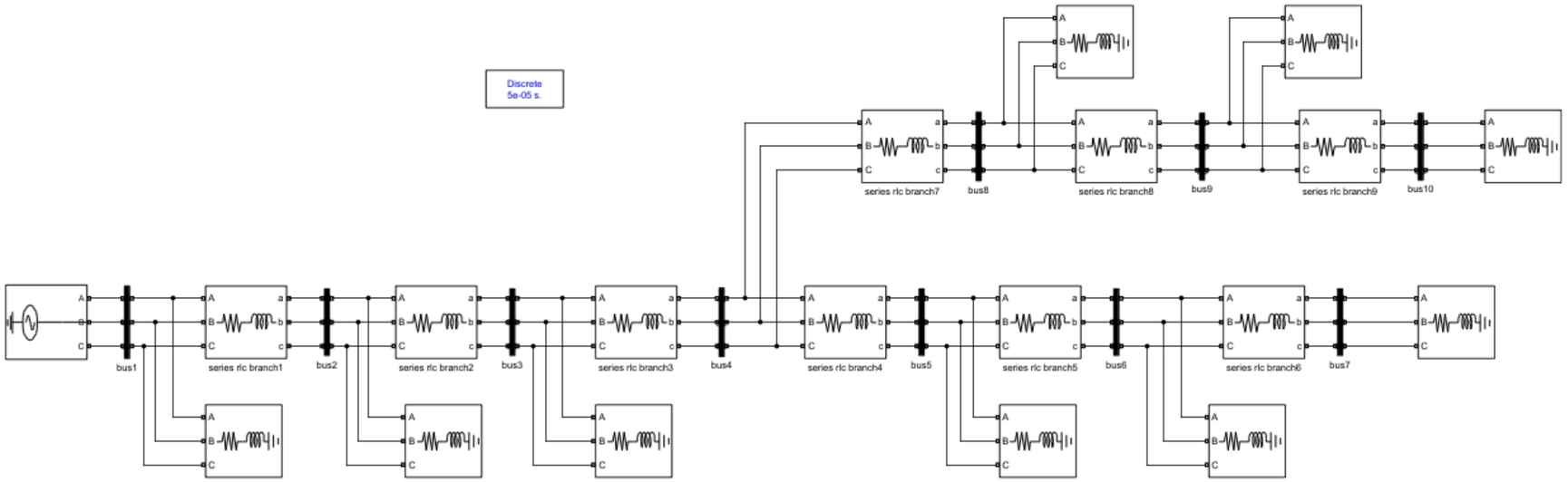
RESEARCH GAP

- **Optimal location of FACTS devices**
  Determining the best location and size of FACTS devices in a highly interconnected network is also a complex task
- **Coordination of FACTS devices with power system components**
  As the number of FACTS devices in a power system increases, interactions among themselves will be a serious concern.
- **Economic benefits of FACTS device utilization**
  Lastly, very few researchers have addressed the economic benefits of utilizing FACTS devices. Studies should be carried out on existing FACTS projects in terms of installation, maintenance and other associated costs of FACTS device utilization

PROBLEM STATEMENTS

- MODEL A DISTRIBUTION SYSTEM AND PLOT THE VOLATGE PROFILE OF THAT SYSTEM
- PLOT DIFFERENT VOLTAGE PROFLILES OF SYSTEM FOR DIFFERENT POWER FACTORS OF THE LOAD AT ONE BUS.
- MODELLING OF DIFFERENT DFACTS DEVICES
- PLOT THE VOLTAGE PROFILE OF DISTRIBUTION SYSTEM WITH DIFFEERENT DFACTS DEVICES AND COMPARING THE PERFORMANCE OF EACH DEVICE
- PLOT THE VOLTAGE PROFILES WITH D-FACT DEVICES AT DIFFERENT LOCATIONS

MATLAB MODEL OF THE DISTRIBUTION SYSTEM



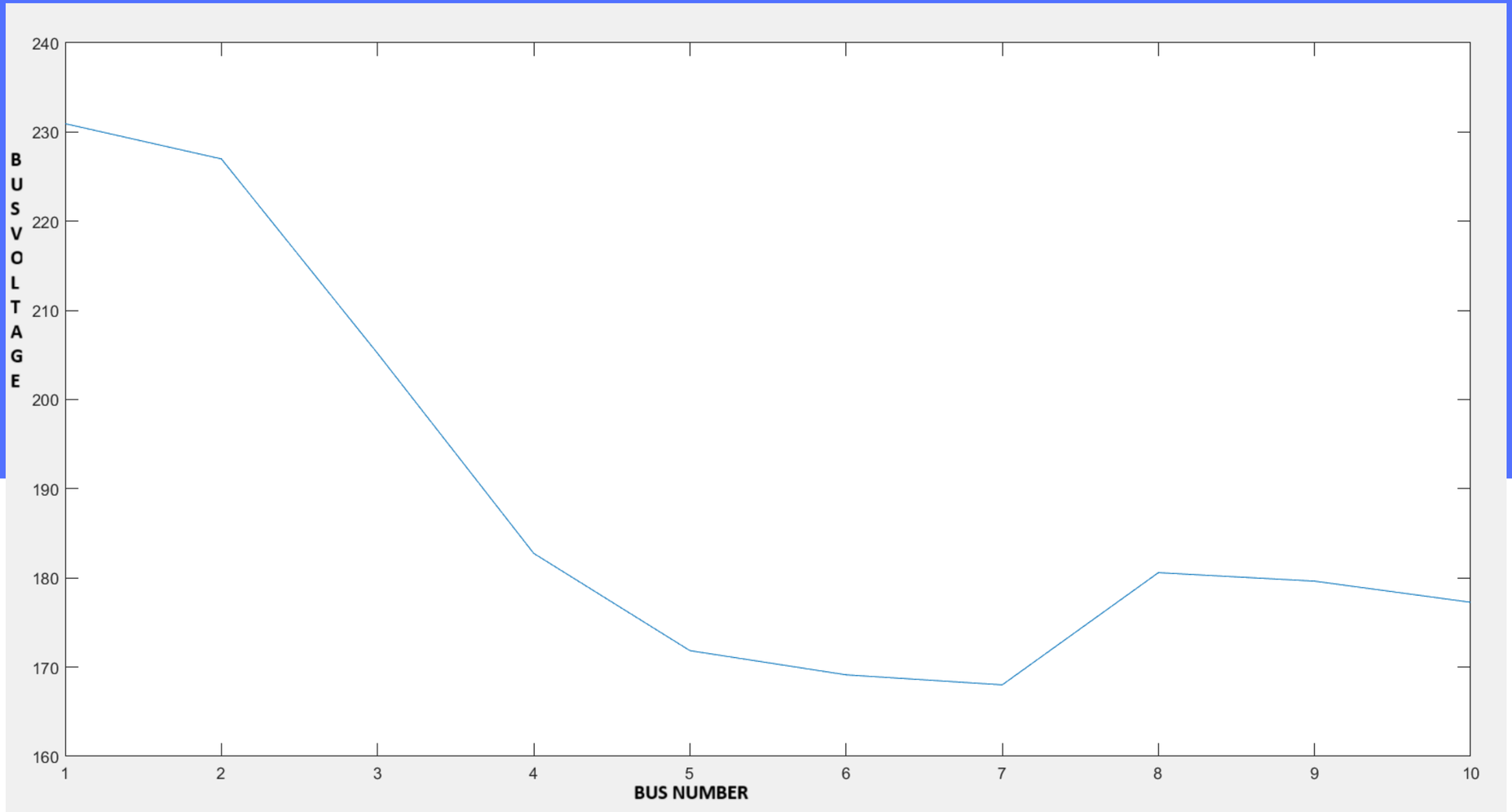
SOURCE VOLTAGE: 400V LINE TO LINE
LOAD: ACTIVE POWER-2500W
REACTIVE POWER-1500W

SERIES BRANCH	RESISTANCE VALUE IN Ω	INDUCTANCE VALUE IN HENRY
1-2	0.12	0.00027
2-3	0.78	0.00177
3-4	0.96	0.00218
4-5	0.96	0.00218
5-6	0.36	0.000821
6-7	0.3	0.00068
4-8	0.18	0.00041
8-9	0.12	0.00027
9-10	0.6	0.00136

TABLE 01 : List of resistance and inductance values taken for RL branches

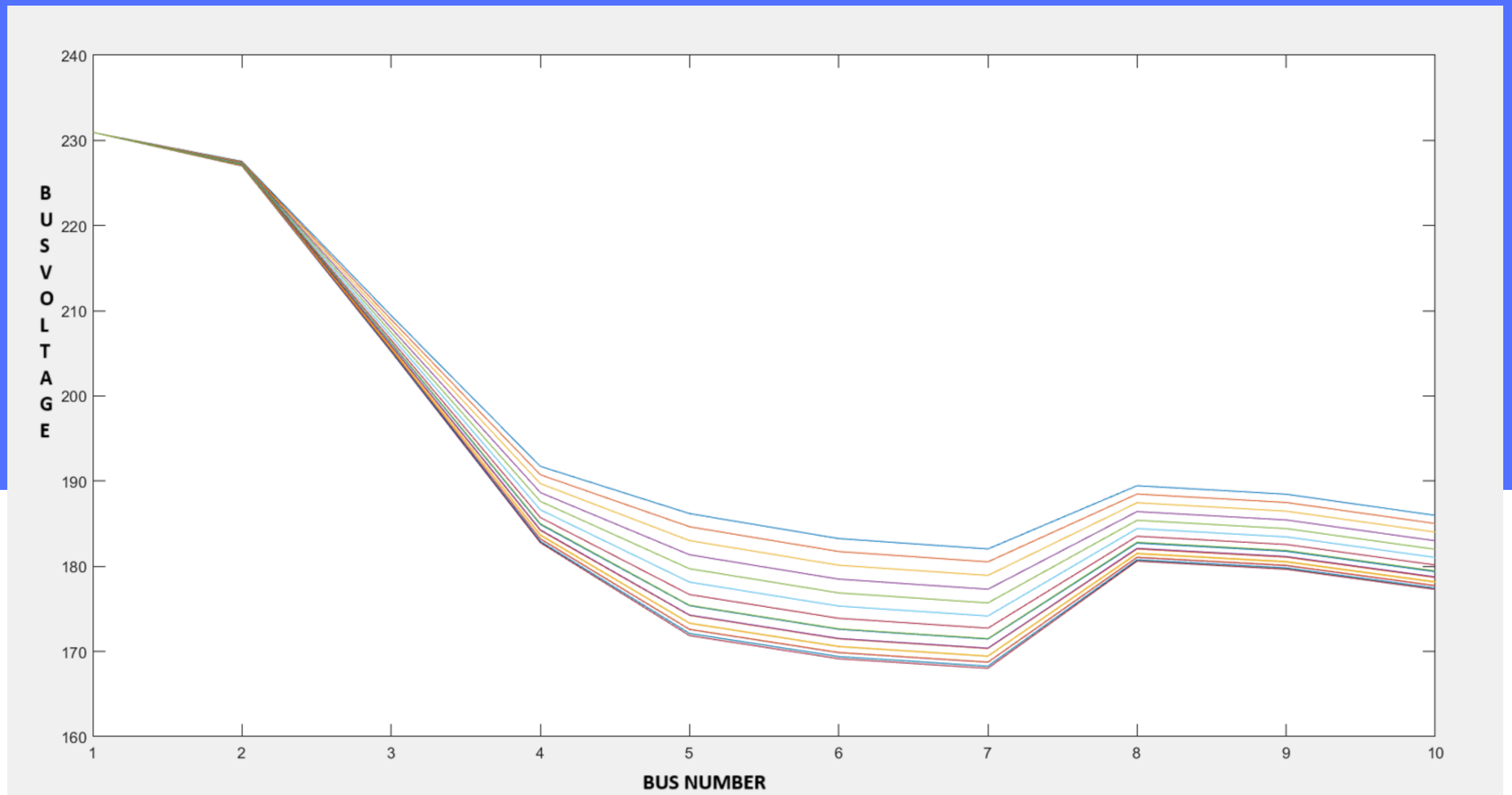
a simple radial distribution system with voltage and current measurements at each bus

VOLTAGE PROFILE OF THE DISTRIBUTION SYSTEM



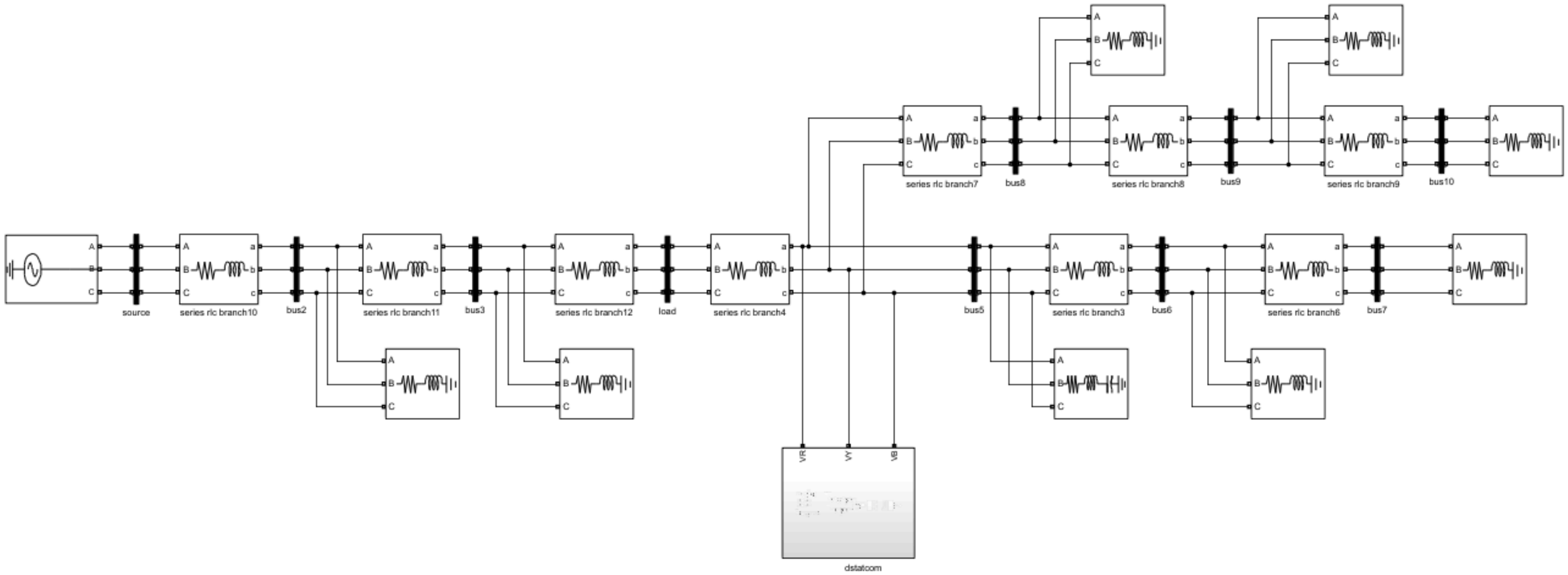
VOLTAGE PROFILE OF DISTRIBUTION SYSTEM

VOLTAGE PROFILE OF THE DISTRIBUTION SYSTEM FOR DIFFERENT POWER FACTOR LOADS AT BUS 5



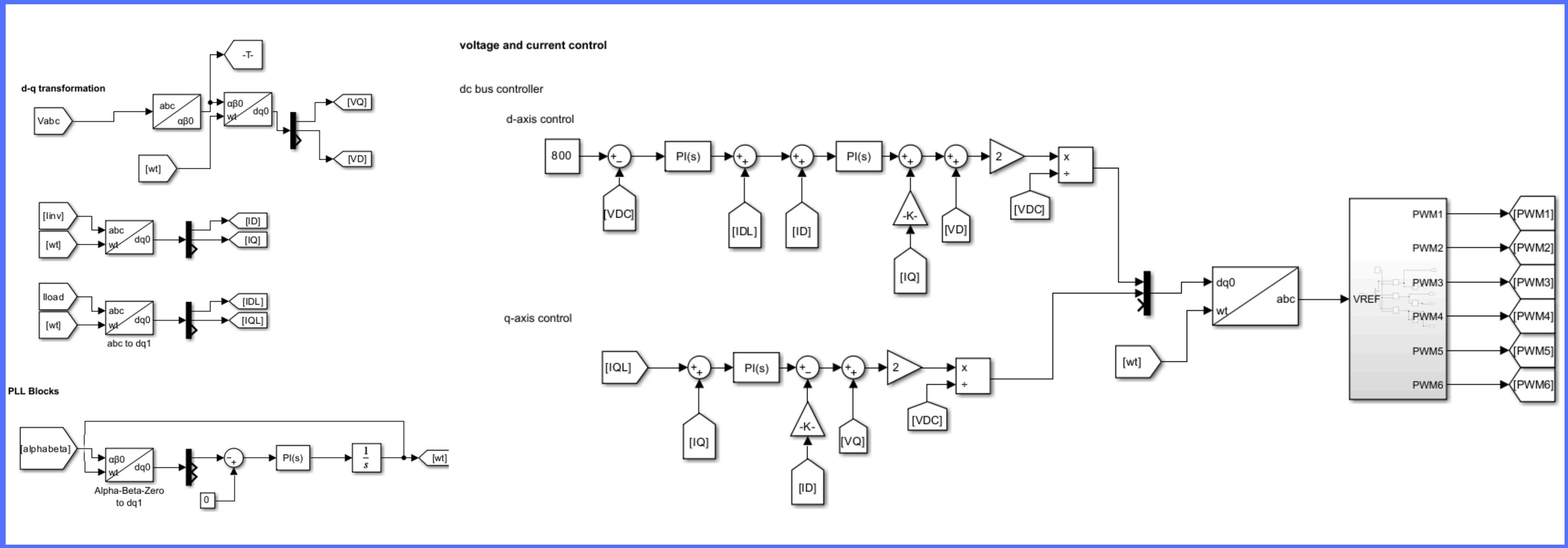
DIFFERENT VOLTAGE PROFILES FOR DIFFERENT LOAD POWER FACTORS AT ONE NODE 5

MATLAB MODEL OF THE DISTRIBUTION SYSTEM WITH DSTATCOM



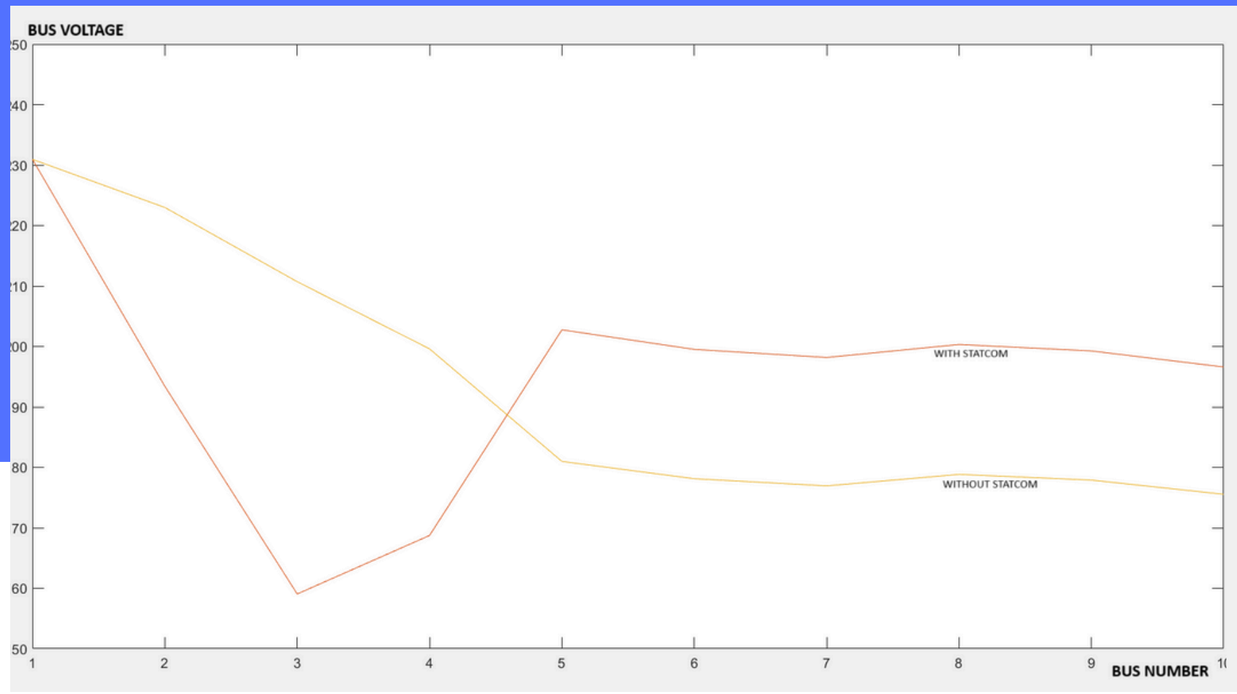
D-STATCOM CONNECTED TO THE DISTRIBUTIVE SYSTEM

CONTROLLER CIRCUIT OF D-STATCOM

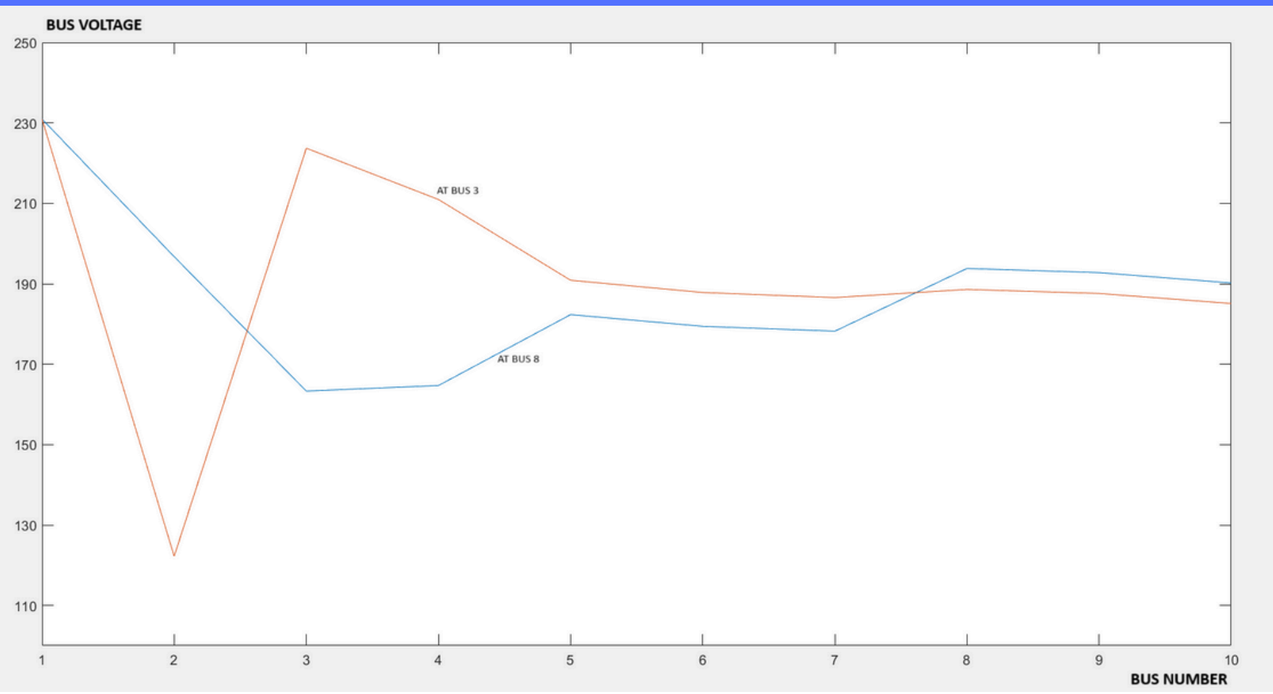


(a) DQ TRANSFORMATION BLOCK, (b) PLL BLOCK,
(c) DC VOLTAGE REGULATOR AND QUADRATURE CURRENT CONTROL BLOCK

VOLTAGE PROFILE OF THE DISTRIBUTION SYSTEM WITH DSTATCOM

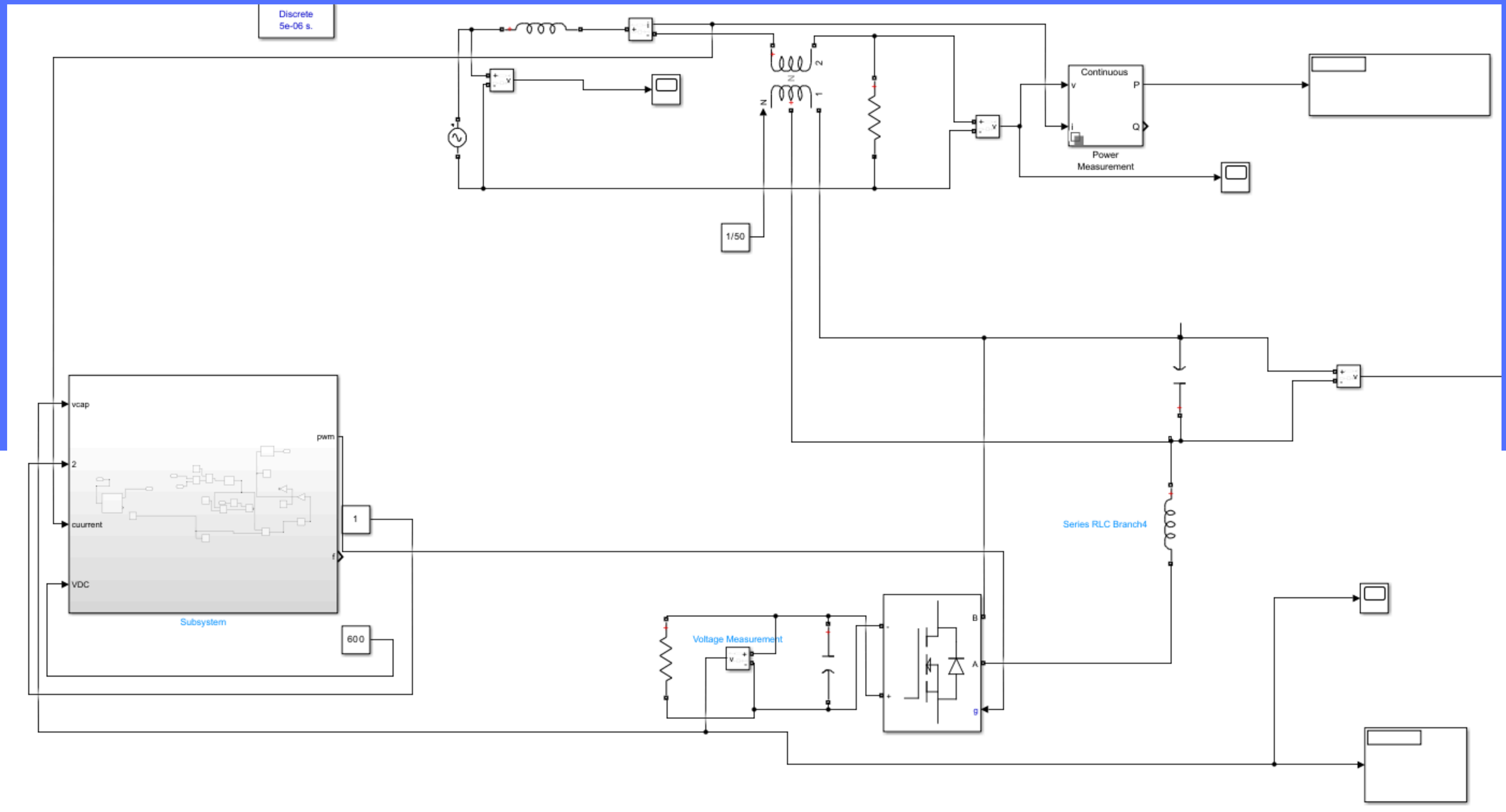


VOLTAGE PROFILE COMPARISON OF DISTRIBUTED SYSTEM WITH AND WITHOUT D-STATCOM

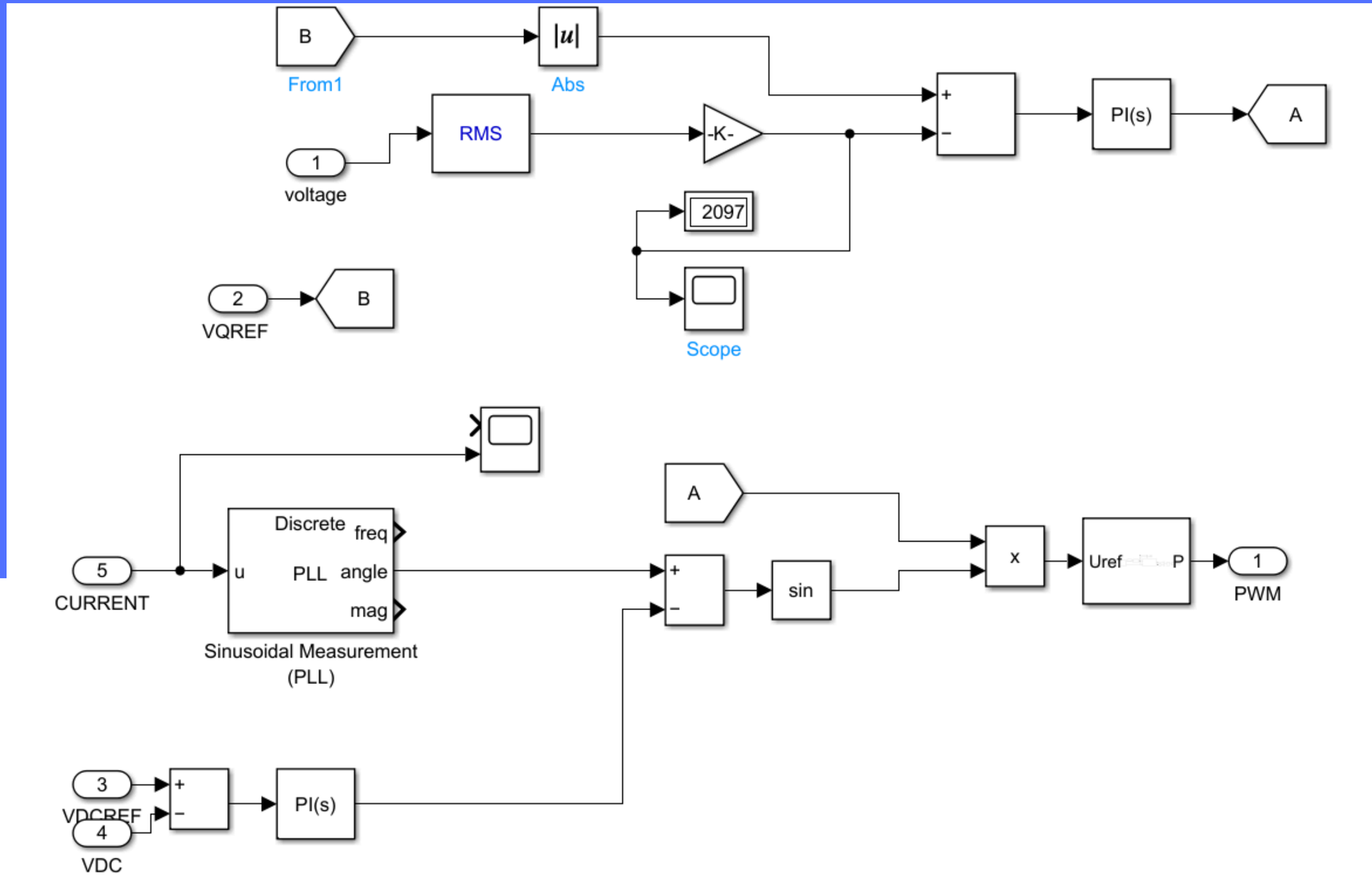


VOLTAGE PROFILE COMPARISON OF DISTRIBUTED SYSTEM AT BUS 3 AND BUS 8

TEST MODEL FOR DSSC DEVICE

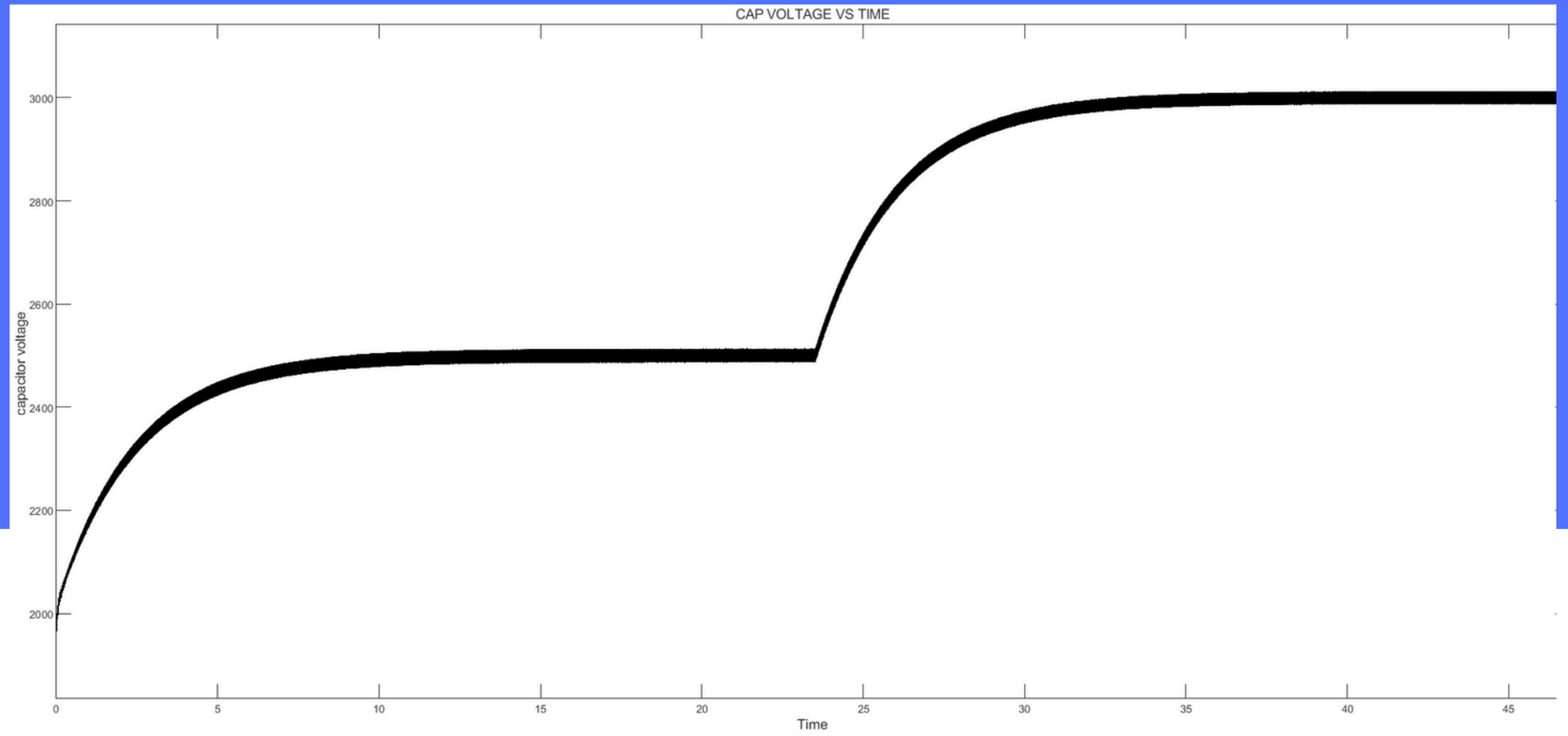


CONTROL SYSTEM FOR DSSC



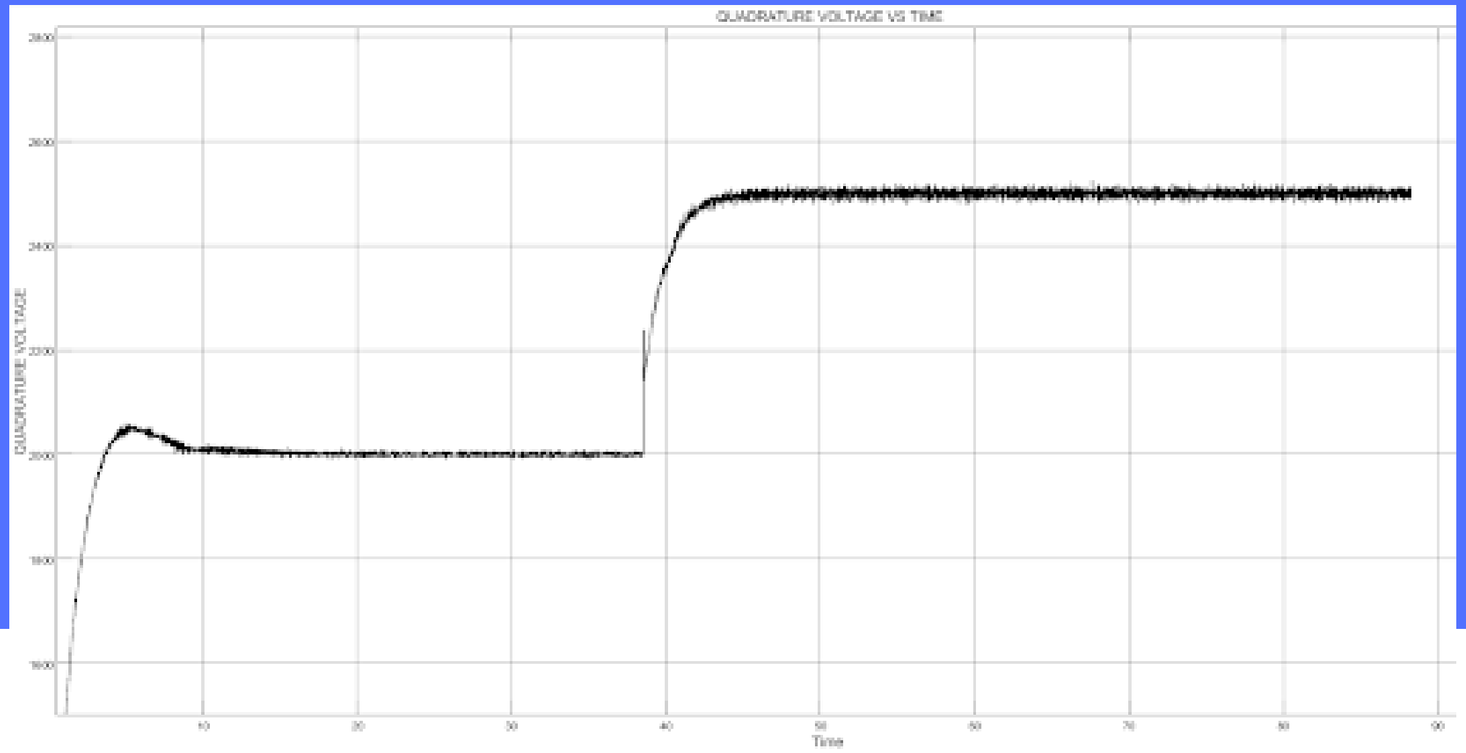
CONTROL SYSTEM USED TO CONTROL THE CAPACITOR VOLTAGE AND QUADRATURE VOLTAGE OF DSSC

TRANSIENT VOLTAGE RESPONSE OF DC CAPACITOR WHICH IS USED IN DSSC



VOLTAGE OF CAPACITOR USED IN DSSC TRACKING THE REFERENCE 2500V AND TRACKING THE REFERENCE 3000V WHEN REFERENCE IS CHANGED

TRANSIENT VOLTAGE RESPONSE OF QUADRATURE VOLTAGE WHICH IS GENERATED BY DSSC



TRANSIENT RESPONSE OF QUADRATURE VOLTAGE TRACKING THE REFERENCE 2000V AND TRACKING THE REFERENCE 2500V WHEN REFERENCE IS CHANGED

QUADRATURE VOLTAGE PLOT

CONCLUSION

As we plot voltage profile of distribution system we realised there is a drop in voltage as we move away from source.we also made plot of voltage profile for different power factor loads at one node and we realised that voltage profile is relatively good for leading power loads rather than lagging power factor loads.So we concluded that if we provide reactive power to the system the voltage profile is improved.so we modelled the D-STATCOM which provides reactive power and implemented in the system.we observed that voltage profile is improved with d-statcom included.we also tried to develop other d-facts devices like DSSC which are partially completed.

FUTURE SCOPE

In developing other D-FACTS devices like DSSC, we are able to control the capacitor voltage and the quadrature voltage.We should be able to do angle control which is 90° lagging or leading. And we should implement it in the distribution system to improve the voltage profile and compare with the voltage profile without using the d-fact device. There is scope in determining the best position for the device to implement in the distribution system.

MATLAB CODE FOR PLOTTING VOLTAGE PROFILE OF DISTRIBUTION SYSTEM FOR DIFFERENT POWER FACTOR LOADS AT ONE BUS

project code.m

```
phi = [-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90];
s= 2915.4759;
for i = 1:((length(phi)-1)/2)
    simIn(i) = Simulink.SimulationInput('old');
    simIn(i) = setVariable(simIn(i),'q2',(-1*s*sind(phi(i))));
    simIn(i) = setVariable(simIn(i),'p2',s*cosd(phi(i)));
    simIn(i) = setVariable(simIn(i),'q3',0);
end
for i =((length(phi)-1)/2)+1:(length(phi))
     simIn(i) = Simulink.SimulationInput('old');
simIn(i) = setVariable(simIn(i),'q3',s*sind(phi(i)));
    simIn(i) = setVariable(simIn(i),'p2',s*cosd(phi(i)));
    simIn(i) = setVariable(simIn(i),'q2',0);
end
simOutputs = sim(simIn);
for x= 1:10
    for y=1:19
        v5(x,y)= simOutputs(1,y).voltages(1,x)

    end
end
plot(v5)
```

CODE TO PLOT VOLTAGE PROFILES FOR DIFFERENT POWER FACTOR LOADS

REFERENCES

1.Understanding Facts: Concepts and Technology of Flexible AC Transmission Systems (PB) Systems by Narain-G-hingorani.

2.Utilization of FACTS devices in power systems: A review by Irene N. Muisyo and Keren K. Kaberere

3.S. R. Gaigowal and M. M. Renge, "Some studies of distributed series FACTS controller to control active power flow through transmission line," 2013 International Conference on Power, Energy and Control (ICPEC), Dindigul, India, 2013, pp. 124-128, doi: 10.1109/ICPEC.2013.6527636.

THANK YOU