EE 521 Power System Analysis and EE 523 Power System Stability and Control Algorithms

Preamble and Control Inputs

```
systemName =
"ieee11-caseTwo-"

powerFlowMethod =
"NRPF"
```

Read CDF file and store the data in neat MATLAB `tables: busData` and `branchData`.

`busData = 11×18 table`

	bus	busName	loadFlowArea	lossZone	busType	vFinal
1	1	"Bus 1 HV"	1	1	3	1.0300
2	2	"Bus 2 HV"	1	1	2	1.0100
3	3	"Bus 3 HV"	2	1	2	1.0300
4	4	"Bus 4 HV"	2	1	2	1.0100
5	5	"Bus 5 HV"	1	1	0	1.0200
6	6	"Bus 6 LV"	1	1	0	1.0120
7	7	"Bus 7 ZV"	1	1	0	1.0210
8	8	"Bus 8 TV"	3	1	0	1.0100
9	9	"Bus 9 LV"	2	1	0	1.0020
10	10	"Bus 10 LV"	2	1	0	1.0010
11	11	"Bus 11 LV"	2	1	0	1.0150

`branchData = 10×15 table`

	i	j	loadFlowArea	lossZone	ckt	type	R
1	1	5	1	1	1	0	0
2	2	6	1	1	1	0	0
3	3	11	2	1	1	0	0
4	4	10	2	1	1	0	0
5	5	6	1	1	1	0	0.0025
6	6	7	1	1	1	0	0.0010
7	7	8	1	1	1	0	0.0037
8	8	9	2	1	1	0	0.0055
9	9	10	2	1	1	0	0.0010
10	10	11	2	1	1	0	0.0025

```
N = 11
numBranch = 10
```

Extract Y_{Bus}, Adjacency List E from the `branchData table`.

```
ybusTable = 11×11 table
```

...

	1	2	3	4	5
1 1	0.0000 -59.9880i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 +59.9880i
2 2	0.0000 + 0.0000i	0.0000 -59.9880i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i
3 3	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 -59.9880i	0.0000 + 0.0000i	0.0000 + 0.0000i
4 4	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 -59.9880i	0.0000 + 0.0000i
5 5	0.0000 +59.9880i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	3.9604 -99.5701i
6 6	0.0000 + 0.0000i	0.0000 +59.9880i	0.0000 + 0.0000i	0.0000 + 0.0000i	-3.9604 +39.6040i
7 7	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i
8 8	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i
9 9	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i
10 10	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 +59.9880i	0.0000 + 0.0000i
11 11	0.0000 + 0.0000i	0.0000 + 0.0000i	0.0000 +59.9880i	0.0000 + 0.0000i	0.0000 + 0.0000i

Run Newton Raphson Power Flow and obtain a steady state snapshot of the system variables $P_i, Q_i, V_i, \delta_i \ \forall$ buses $i \in [1, N], i \in \mathbb{N}$

```
Iteration Number 1 Jacobian:
JTable = 17×17 table
```

...

	$delta_2$	$delta_3$	$delta_4$	$delta_5$	$delta_6$	$delta_7$
1 P_2	60.5879	0	0	0	-60.5879	0
2 P_3	0	61.7876	0	0	0	0
3 P_4	0	0	60.5879	0	0	0
4 P_5	0	0	0	101.3916	-39.6040	0
5 P_6	-60.5879	0	0	-39.6040	199.2017	-99.0099
6 P_7	0	0	0	0	-99.0099	126.0097
7 P_8	0	0	0	0	0	-26.9998
8 P_9	0	0	0	0	0	0
9 P_10	0	0	-60.5879	0	0	0
10 P_11	0	-61.7876	0	0	0	0
11 Q_5	0	0	0	-3.9604	3.9604	0
12 Q_6	-0	0	0	3.9604	-13.8614	9.9010
13 Q_7	0	0	0	0	9.9010	-12.6032

	$delta_2$	$delta_3$	$delta_4$	$delta_5$	$delta_6$	$delta_7$
14 Q_8	0	0	0	0	0	2.7022
15 Q_9	0	0	0	0	0	0
16 Q_10	0	0	-0	0	0	0
17 Q_11	0	-0	0	0	0	0

Iteration Number 2 Jacobian:
JTable = 17×17 table

...

	$delta_2$	$delta_3$	$delta_4$	$delta_5$	$delta_6$	$delta_7$
1 P_2	64.3143	0	0	0	-64.3143	0
2 P_3	0	64.4459	0	0	0	0
3 P_4	0	0	63.7632	0	0	0
4 P_5	0	0	0	109.4332	-44.7054	0
5 P_6	-64.3143	0	0	-43.3132	224.7675	-117.1400
6 P_7	0	0	0	0	-113.9729	147.1125
7 P_8	0	0	0	0	0	-32.2870
8 P_9	0	0	0	0	0	0
9 P_10	0	0	-63.7632	0	0	0
10 P_11	0	-64.4459	0	0	0	0
11 Q_5	0	0	0	-3.9040	-2.5600	0
12 Q_6	7.4638	0	0	11.3619	-14.5457	-4.2799
13 Q_7	0	0	0	0	27.3912	-26.4053
14 Q_8	0	0	0	0	0	7.5339
15 Q_9	0	0	0	0	0	0
16 Q_10	0	0	7.3998	0	0	0
17 Q_11	0	7.5334	0	0	0	0

Iteration Number 3 Jacobian:
JTable = 17×17 table

...

	$delta_2$	$delta_3$	$delta_4$	$delta_5$	$delta_6$	$delta_7$
1 P_2	61.1546	0	0	0	-61.1546	0
2 P_3	0	62.4514	0	0	0	0
3 P_4	0	0	60.4908	0	0	0
4 P_5	0	0	0	104.0460	-41.2510	0
5 P_6	-61.1546	0	0	-39.8939	204.8646	-103.8161
6 P_7	0	0	0	0	-101.0427	129.3982
7 P_8	0	0	0	0	0	-27.5832

	$delta_2$	$delta_3$	$delta_4$	$delta_5$	$delta_6$	$delta_7$
8 P_9	0	0	0	0	0	0
9 P_10	0	0	-60.4908	0	0	0
10 P_11	0	-62.4514	0	0	0	0
11 Q_5	0	0	0	-4.1447	-2.7286	0
12 Q_6	7.0047	0	0	10.8431	-14.2238	-3.6240
13 Q_7	0	0	0	0	24.1099	-23.0510
14 Q_8	0	0	0	0	0	6.6574
15 Q_9	0	0	0	0	0	0
16 Q_10	0	0	7.0010	0	0	0
17 Q_11	0	7.1934	0	0	0	0

Iteration Number 4 Jacobian:
JTable = 17×17 table

...

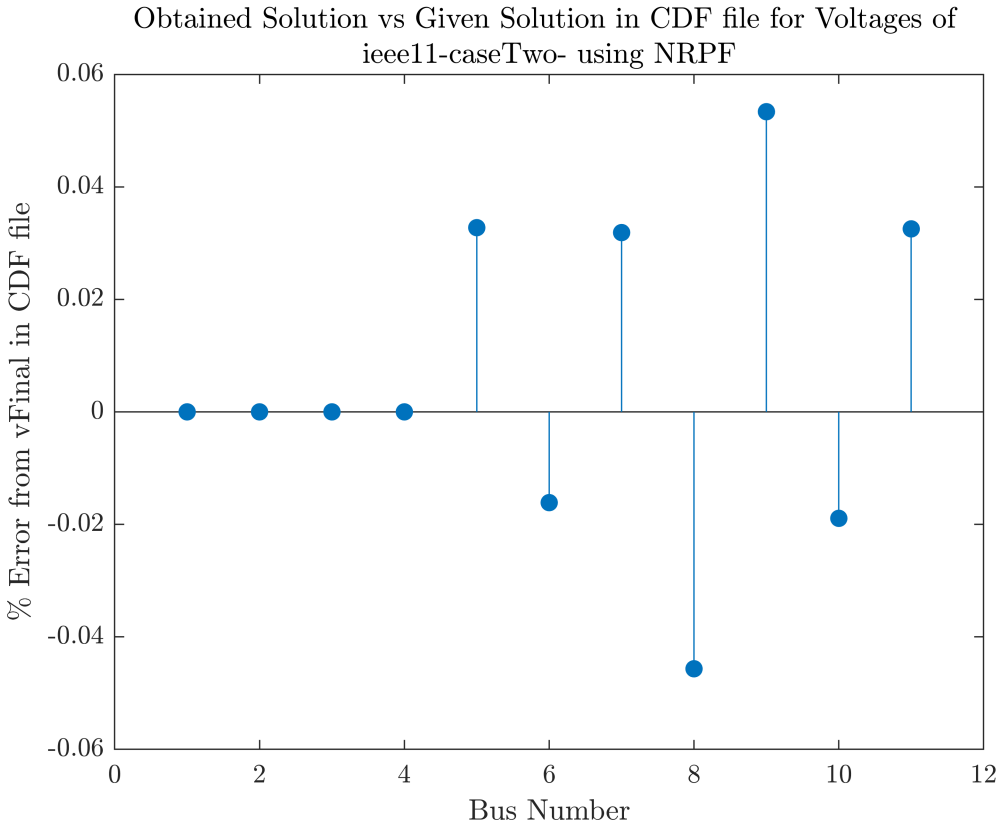
	$delta_2$	$delta_3$	$delta_4$	$delta_5$	$delta_6$	$delta_7$
1 P_2	60.9063	0	0	0	-60.9063	0
2 P_3	0	62.3224	0	0	0	0
3 P_4	0	0	60.2338	0	0	0
4 P_5	0	0	0	103.6639	-40.9989	0
5 P_6	-60.9063	0	0	-39.6348	203.3142	-102.7731
6 P_7	0	0	0	0	-100.0132	127.9725
7 P_8	0	0	0	0	0	-27.1827
8 P_9	0	0	0	0	0	0
9 P_10	0	0	-60.2338	0	0	0
10 P_11	0	-62.3224	0	0	0	0
11 Q_5	0	0	0	-4.1236	-2.7890	0
12 Q_6	6.9999	0	0	10.8523	-14.1924	-3.6598
13 Q_7	0	0	0	0	23.9384	-22.8184
14 Q_8	0	0	0	0	0	6.6388
15 Q_9	0	0	0	0	0	0
16 Q_10	0	0	6.9999	0	0	0
17 Q_11	0	7.1900	0	0	0	0

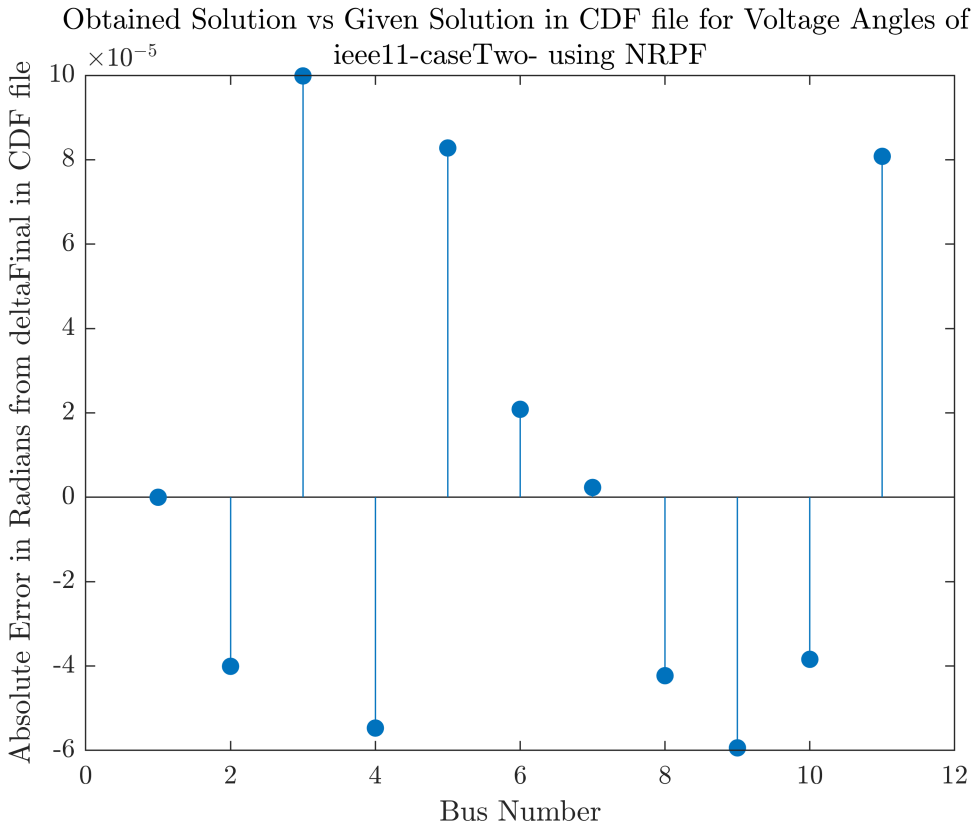
Convergence using NRPF achieved in 4 iterations.
resultTable = 11×4 table

	P	Q	V	delta
1 Bus_1	6.9125	0.9763	1.0300	0
2 Bus_2	6.9999	0.2874	1.0100	-0.1631

	P	Q	V	delta
3 Bus_3	7.1900	1.3188	1.0300	-0.3319
4 Bus_4	6.9999	0.9600	1.0100	-0.5076
5 Bus_5	-0.0003	0.0001	1.0203	-0.1099
6 Bus_6	0.0001	0.0004	1.0118	-0.2775
7 Bus_7	-9.6704	-0.9992	1.0213	-0.4128
8 Bus_8	-0.0002	0.0006	1.0095	-0.5526
9 Bus_9	-17.6690	-0.9991	1.0025	-0.7645
10 Bus_10	0.0003	0.0005	1.0008	-0.6233
11 Bus_11	0	0.0001	1.0153	-0.4467

Compare obtained snapshot values of V_i and δ_i against the ones given in the CDF file.





Economic Dispatch and Optimal Power Flow Calculations:

```
Elapsed time is 1.369501 seconds.
```

Have a nice day!

In case you encounter a Java Heap Memory error, delete the above gif, or go to `Preferences->General->Java Heap Memory` and increase the allocated size.