Brief introduction to
Continuation Power Flow (CPF) program

Rui Bo

1. Continuation Power Flow (CPF) Program

Continuation Power Flow (CPF) program implements the continuation power flow solver and plots the PV curve as well as the prediction-correction trajectory.

Book “Computational Methods for Electric Power Systems” authored by Mariesa Crow is referenced during implementation of the programs, and the notations are in accordance with those in the book.

Please note that execution of the program requires the MATPOWER package is included in the searching path of MATLAB environment.

The author would like to thank Fangxing Li for his help in developing the program. One of his courses taught at the University of Tennessee, Knoxville, “Computational Methods for Power System Analysis”, has been a valuable source.

1.1. Features

- ✓ Obtain the PV curve through simulation employing prediction-correction (predictor/corrector) method
- ✓ The PV curve as well as the prediction-correction trajectory could be plotted
- ✓ PV curve of every bus is available for plotting
- ✓ Load at (or near) the nose point of the PV curve, i.e., maximum load value, is obtained
- ✓ Simulation step-sizes for voltage predictor/corrector and lambda predictor/corrector could be specified by users to seek balance between running time and accuracy
- ✓ Tested on a given 6 bus system, and the 30 bus system included in MATPOWER
- ✓ Source codes are self-explanatory
- ✓ Sufficient comments are provided in the source codes

1.2. Limitations

- ✓ Sparse matrix techniques have not been employed
- ✓ Presently CPF with respect to load at only one bus is supported. It could be easily extended to load change at multiple buses
- ✓ Presently no more than one generator at each bus is assumed. It could be extended to support multiple generators at one bus with moderate coding
- ✓ Screen printouts are not very nicely formatted just for simplicity
- ✓ Enforcement of generator Q limit is not considered. It could be implemented with 'ENFORCE_Q_LIMS' option in MATPOWER power flow solver.
- ✓ It is not fully tested for the case with inconsecutive bus numbering

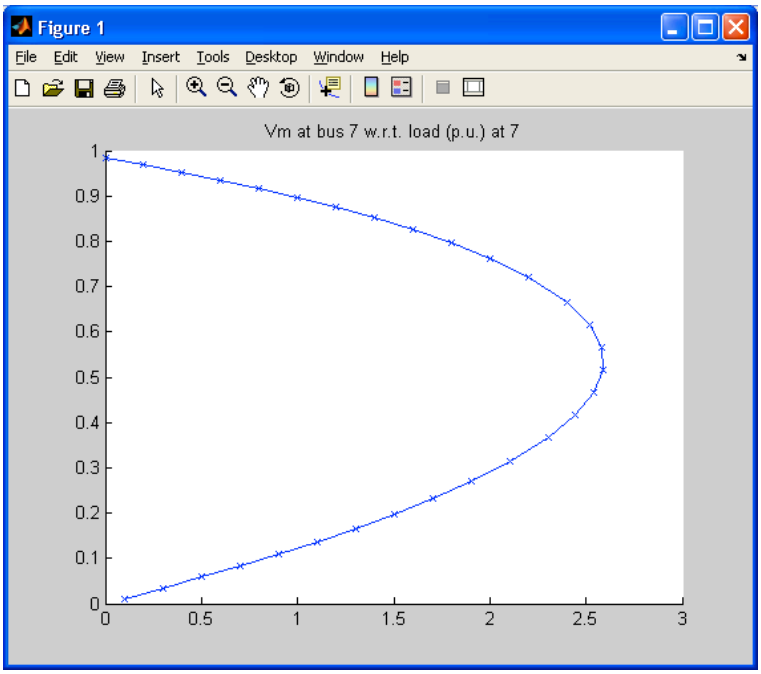
1.3. Demonstration

Running ‘test_cpf.m’ will generate the following outputs. The test case is a 30 bus case included in MATPOWER package. The PV curve with respect to load at bus 7 is plotted by the CPF program as follows.

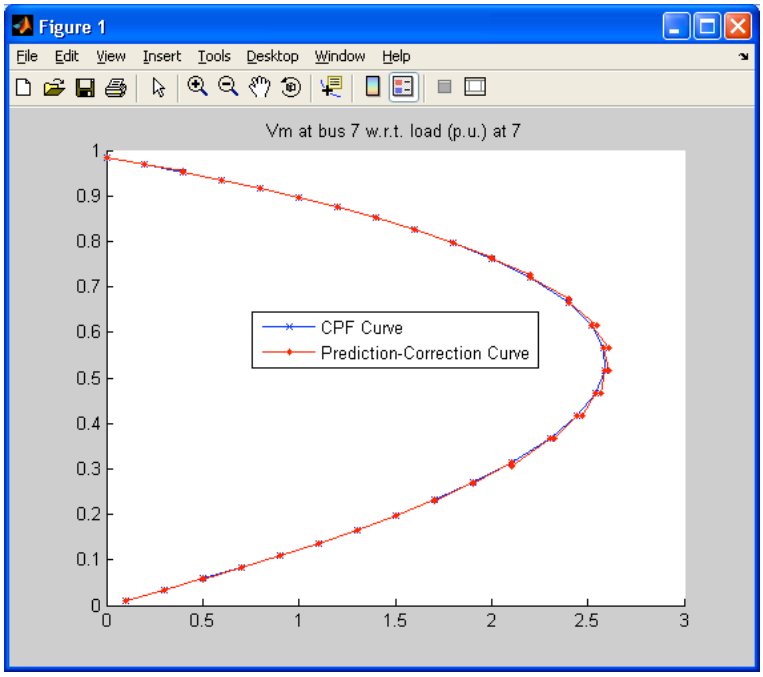
```
>> test_cpf

------------testing continuation power flow (CPF) solver
Start Phase 1: voltage prediction-correction (lambda increasing).
    [Info]: Approaching nose area of PV curve, or voltage correction fails.
    [Info]: 13 data points contained in phase 1.
Switch to Phase 2: lambda prediction-correction (voltage decreasing).
    [Info]: Leaving nose area of PV curve, or lambda correction fails.
    [Info]: 6 data points contained in phase 2.
Switch to Phase 3: voltage prediction-correction (lambda decreasing).
    [Info]: lambda is less than 0.
            CPF finished.
    [Info]: 11 data points contained in phase 3.
maximum lambda is 2.585415

Start plotting CPF curve(s)...
Plotting is done.
>>
```



The PV curve, as well as the prediction-correction trajectory, is plotted by the CPF program as follows.



2. File Structure

The file structure is as follows.

1) Source code files.
   cpf.m: CPF solver
   cpf_predict.m: prediction step of CPF
   cpf_correctLambda.m: correct lambda in correction step
   cpf_correctVoltage.m: correct voltage in correction step
   drawPVcurves.m: draw PV curves
2) Case data files.
   case6bus.m: a 6 bus system in problem 3.6 in book 'Computational Methods for Electric Power Systems' authored by Mariesa Crow
3) Test files.
   test_cpf.m: test CPF solver