Short guide on RNMs

The folder includes nine excel files which contain very detailed information on the following case studies:

1. Urban case;
2. Semi-Urban case;
3. Rural case;
4. Low Voltage Urban case;
5. Low Voltage Semi-Urban case;
6. Medium Voltage Rural case;
7. Substation Ring case;
8. Switching Substation case;
9. Two substations case.

For each table a corresponding Matlab® script has been built to be run by the Matpower[1] routine developed by the Cornell University (see next). Additionally, an example of script is provided which runs a power flow simulation and plots some basic results.

MATPOWER basic instructions

In the following a short set of basic instructions are provided to install Matpower and to run the power flow in the cited case studies.

Step 1: Download Matpower from http://www.pserc.cornell.edu//matpower/, extract it to a folder and include the folder in Matlab path (Home->Set Path).

Step 2: In Matlab, go to the folder in which the networks are contained.

```
cd 'c:\directory'
```

[1] MATPOWER is a package of MATLAB(R) M-files for solving power flow and optimal power flow problems. It is intended as a simulation tool for researchers and educators that is easy to use and modify. MATPOWER is designed to give the best performance possible while keeping the code simple to understand and modify. MATPOWER is covered by the 3-clause BSD License.

Step 3: Load a matpower case. For instance, for the rural network sets:

```
mpc=matpower_rural;
```

Step 4: Execute the function `make_matpower_powerflow` to run the case and draw some figures.

```
results=make_matpower_powerflow(mpc);
```

Step 5: Analyze results

After step 4, Matlab/Matpower will show the power flow summary.

```
MATPOWER Version 5.1, 20-Mar-2015 -- AC Power Flow (Newton)

Newton's method power flow converged in 4 iterations.

Converged in 0.82 seconds
================================================================================
|     System Summary                                                           |
================================================================================

How many?                How much?              P (MW)            Q (MVAr)
---------------------    -------------------  -------------  -----------------
Buses              6921     Total Gen Capacity    1000.0       -1000.0 to 1000.0
Generators            1     On-line Capacity      1000.0       -1000.0 to 1000.0
Committed Gens        1     Generation (actual)     30.8             11.9
Loads              6615     Load                    28.3              8.5
  Fixed            6615       Fixed                 28.3              8.5
  Dispatchable        0       Dispatchable          -0.0 of -0.0     -0.0
Shunts                0     Shunt (inj)             -0.0              0.0
Branches           6929     Losses (I^2 * Z)         2.56             3.38
Transformers        153     Branch Charging (inj)     -               0.0
Inter-ties            0     Total Inter-tie Flow     0.0              0.0
Areas                 1

                          Minimum                      Maximum
                 -------------------------  --------------------------------
Voltage Magnitude   0.938 p.u. @ bus 5269       1.067 p.u. @ bus 6717
Voltage Angle      -6.17 deg   @ bus 5345       0.00 deg   @ bus 1
P Losses (I^2*R)             -                  0.45 MW    @ line 6807-6793
Q Losses (I^2*X)             -                  1.18 MVAr  @ line 1-6793
```

It also plots the following figures. Fig 1 represents the bus voltages in the interval 0.93..1.07 p.u.

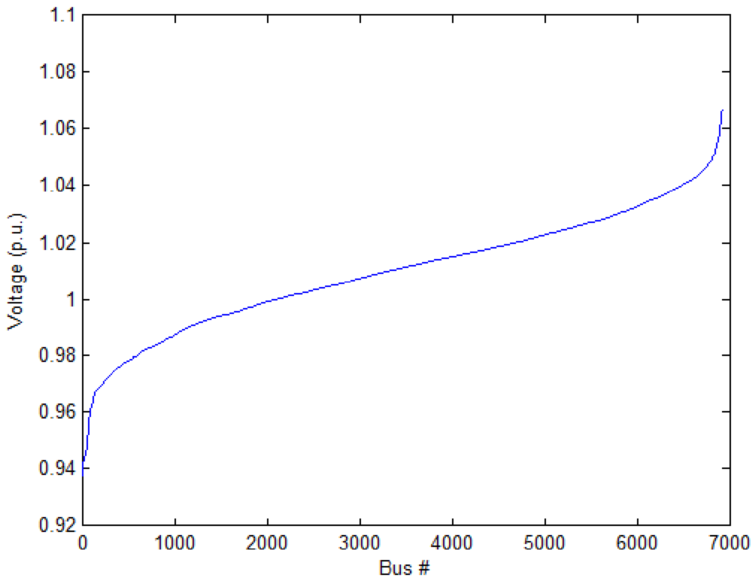

Fig.1 Voltages in p.u. at each bus

Fig. 2 shows the branch use factor, i.e. the power through the branch divided by the branch capacity.

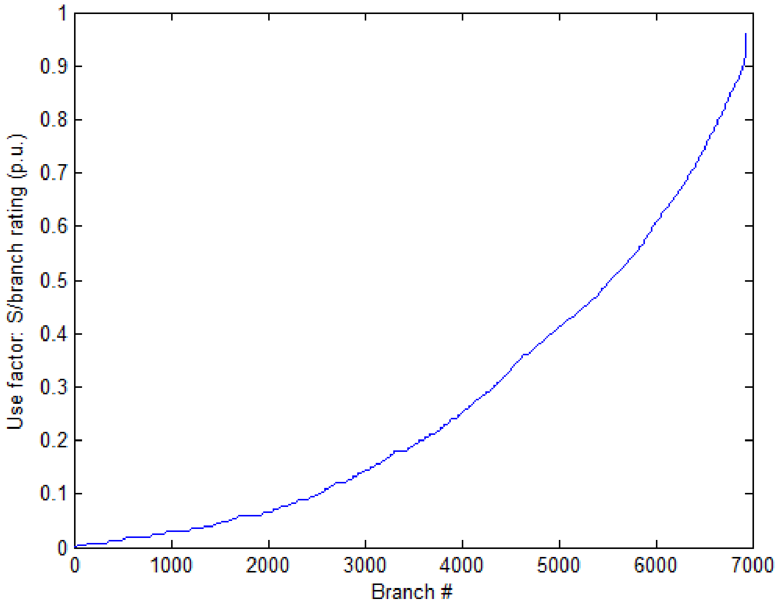

Fig. 2 Branch use factor

Variable `results` contains the bus and branch Matlab/Matpower tables, including the voltages in each bus and the power though every branch.

What explained so far represents only a basic example of how to use the 9 available models. Each of them can be used standalone or be used as a part of bigger simulations which want to take into account the physical constraints of a distribution network.

How to cite:

Prettico G., Gangale F., Mengolini A., Lucas A. and Fulli G.; DISTRIBUTION SYSTEM OPERATORS OBSERVATORY: From European Electricity Distribution Systems to Representative Distribution Networks; EUR 27927 EN; 10.2790/471701

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