

Partitioned Non-Synthetic European Low Voltage Test System

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Summary

This set of models is based on the models of Arboleya et al [1], described in detail in [2]. As compared to that full network model-plus-AMI data, a number of changes have been made.

1. The major change is that the LV systems have been partitioned into separate LV networks. As-is, this makes little difference to the solution as the only MV-level coupling in the original model was at the source bus.
2. The source impedance has been reduced significantly (by increasing I_{sc3} , I_{sc1}) to force the source voltage to be approximately fixed (i.e., closer to a conventional slack bus seen in traditional power systems modelling). This change in source impedance results in the solutions from the partitioned model being identical to the full model (as validated below).
3. Loadshapes for all loads have been removed (the AMI data is not included).
4. A number of versions of the model are provided.
 - a. Three-phase loads can be modelled as a three-phase load, or three one-phase loads with equal power.
 - b. Both 4-wire (Arboleya et al's original) and 3-wire kron-reduced networks are also provided.

This disaggregation speeds up the use of these models in OpenDSS substantially. However, this also changes the functionality and structure of the models.

- a. The voltage drop at the voltage source is no longer seen.
- b. Out of the box, only a snapshot load flow is run, with all loads 1 kW with power factor 0.95 (three-phase loads converted to single phase each have 1/3 kW).
- c. The 'LV system' is no longer possible to model explicitly (i.e., the reconfigurable links included in the original system model are not included in these models).
- d. If a kron reduced model is used then the neutral is not modelled explicitly.

Notes

- If the original source impedance is to be preferred, then this has been left in the master file and can be commented in.
- The 29th system model has no loads connected to it (as in the original full model).
- Bus coordinates are in `buscord_indexed.txt` – replace `_buscoord_directory_here_` in the master files with the name of the directory the networks are if the bus coordinates are wanted for plotting.
- The model was created by looping through branches (rather than looping through each of lines, transformers, shunts). Therefore, all branch elements from the original model are in a 'branches' file, rather than having been split into branch type categories.

Validation

The models have been validated by solving the load flow with the full model and determining the line-neutral voltage magnitudes at all buses. The 30 individual LV models are then solved in-turn, with the voltage magnitudes also calculated for all loads. The solution from the full model and 30

individual LV models are then cross-checked to ensure there is a good fit. The relative error (in the voltage magnitude vectors using the 2-norm) is 1.32×10^{-6} . The maximum absolute difference between any two voltage magnitudes across all loads was 3.3×10^{-4} V. Figure 1 plots these vectors.

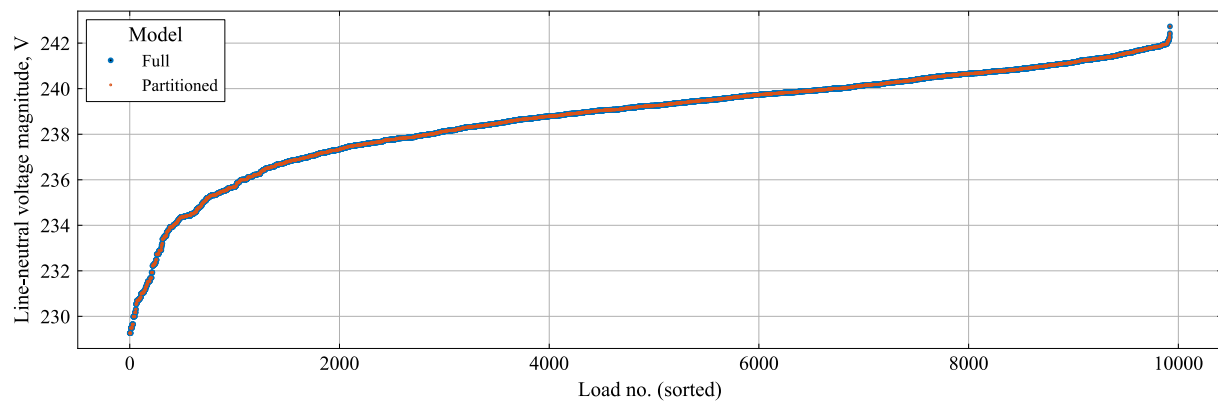


Figure 1: Line-neutral voltage magnitudes (from OpenDSS), comparing the full model to results at the loads of the 30 partitioned models. On this plot, it can be seen that by-eye the results are indistinguishable.

References

- [1] Arbolea, Pablo; Koirala, Arpan; Suárez-Ramón, Lucía; Mohamed, Bassam (2019), "Non-Synthetic European Low Voltage Test System", Mendeley Data, V1, <https://doi.org/10.17632/685vgp64sm.1>
- [2] Koirala, Arpan, et al. "Non-synthetic European low voltage test system." *International Journal of Electrical Power & Energy Systems* 118 (2020): 105712. <https://doi.org/10.1016/j.ijepes.2019.105712>