

Australian MV feeder with associated LV feeders

This document describes the main features of a realistic data set based on a real-world power distributed network. Though the data set is constructed carefully, and sanity tests have been performed for both the topology and the impedance values in the data set, there was no further validation performed as part of this work, e.g. as one could do through distribution state estimation and residual analysis.

Description of the dataset

The medium voltage feeder data originates from suburban part of Australia. It is an 11 kV feeder with a variety of residential LV feeders underneath, with an operational voltage of 400/230 V +/-10%. Table 1 lists the key features of the MV feeder.

Table 1: Key features of the MV feeder

<i>Name</i>	<i>#Bus</i>	<i>#Lines</i>	<i>#TF Buses</i>	<i>Voltage</i>	<i>Total Line Length</i>
<i>MV21_328bus</i>	328	327	32	11 kV	8.29 km

We note the following information has been obtained by tracing the data from the GIS:

- Operational topology, which is radial
- Construction codes or cable properties
- Line lengths
- Customer service points
- Switch locations
- Transformers and their electrical properties

An OpenDSS model containing this data has been constructed. To make the data realistic for the Australian context, we have also made a number of additions to the data set based on engineering rules of thumb and best practice:

- Added neutral grounding points at the Wye side of the MV/LV transformers
- Added neutral grounding points at the customer sides
- Mapped line/cable information to approximate impedances through the modified Carson's equations
- Customers in all of the networks have been assigned a single-phase connection phase-to-neutral, with connections assigned mod 3 to the phase wires, i.e. a b c a b c ...

- Open and closed switches have been kept in the model

Table 2 Lists the key features of the LV feeders. The number of buses ranges between 14 and 316, the number of residential customers between 0 and 151. Total line lengths are up to 7.8 km. All networks except for one have a 433/250V nominal transformer.

Table 2: Key features of the LV networks

Name	#Bus	#Lines	#Load Buses	TX Voltage	Total Line Length (km)
LV1_14bus	15	14	2	0.433	0.01504706
LV2_43bus	44	43	7	0.433	0.92111777
LV3_55bus	56	55	12	0.433	0.99678669
LV4_36bus	37	36	1	0.433	0.62909549
LV5_14bus	15	14	2	0.433	0.0985123
LV6_17bus	18	17	1	0.433	0.11522638
LV7_29bus	30	29	5	0.433	0.37979515
LV8_14bus	15	14	2	0.433	0.27721467
LV9_258bus	259	258	123	0.433	5.12812476
LV10_223bus	224	223	94	0.433	4.71365538
LV11_216bus	217	216	110	0.433	3.79686623
LV12_248bus	249	248	121	0.433	7.82423767
LV13_58bus	59	58	11	0.433	0.85353655
LV14_13bus	14	13	0	0.433	0.00224929
LV15_137bus	138	137	46	0.433	3.63879142
LV16_12bus	13	12	1	0.433	0.0817141
LV17_279bus	280	279	141	0.433	5.83836082
LV18_12bus	13	12	1	0.433	0.09681684
LV19_13bus	14	13	0	0.433	0.00227818
LV20_26bus	27	126	4	0.433	0.34496264
LV22_80bus	81	80	21	0.433	1.81652654
LV23_13bus	14	13	1	0.433	0.0673844
LV24_246bus	246	245	121	0.433	4.63476582
LV25_232bus	233	232	112	0.433	4.7016843
LV26_205bus	206	205	94	0.433	3.82175361
LV27_23bus	24	23	1	0.433	0.32349489
LV28_25bus	26	25	3	0.415	0.59114053
LV29_90bus	91	90	41	0.433	1.22530087
LV30_315bus	316	315	151	0.433	5.46833111
LV31_15bus	16	15	3	0.433	0.28930523
LV32_100bus	101	100	22	0.433	3.21363744

<i>LV34_20bus</i>	21	20	1	0.433	0.76004483
<i>Sum</i>	3112	3180	1255	13.838	62.667759

Network operation at expected simultaneous peak demand.

We construct an integrated power flow model in OpenDSS, that can solve the power flow at both MV and LV levels simultaneously.

Next we solve a power flow for the expected peak demand (4kVA/customer contribution to the annual peak), and look at the voltages and transformer loading.

Figure 1 illustrates the relative and absolute loading of the transformers in the network. Exceedances of the transformer rating are acceptable at times of peak demand.

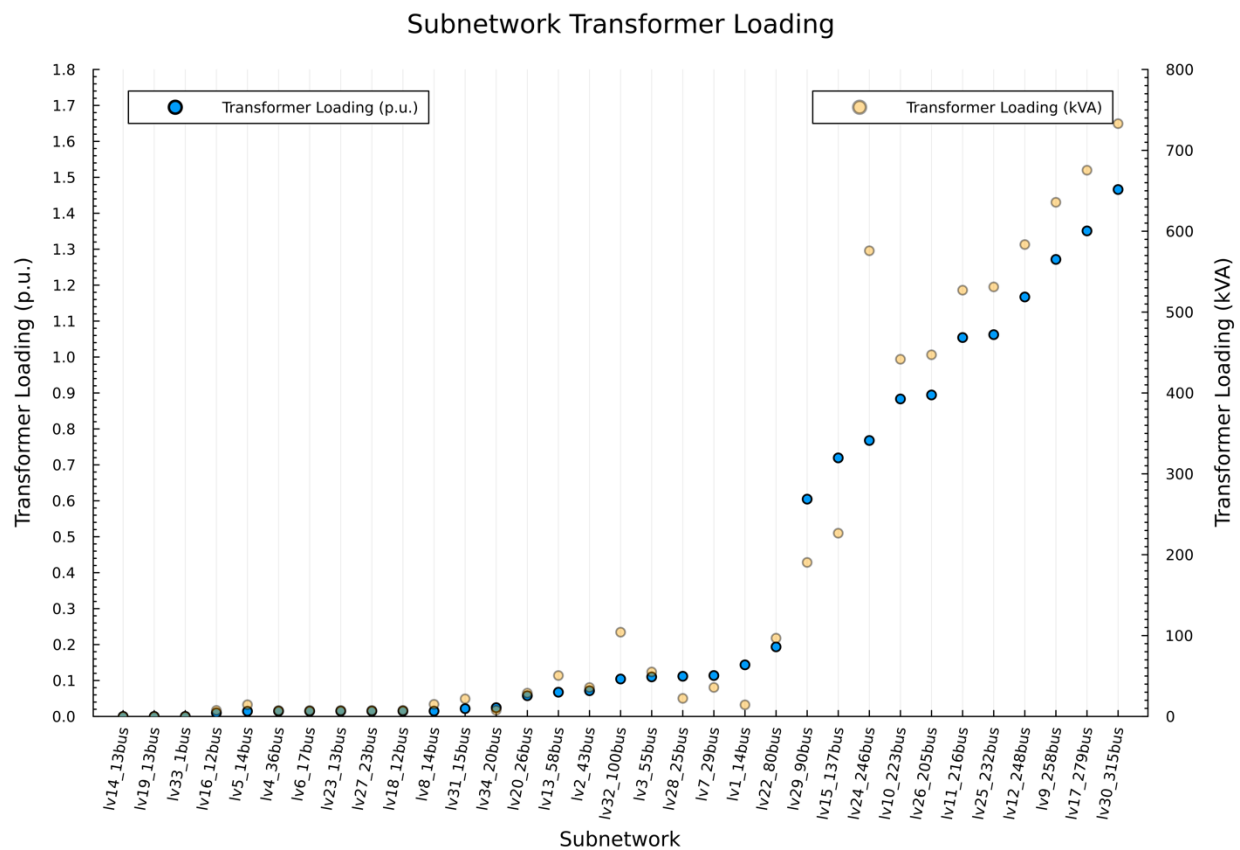


Figure 1: The relative loading of the transformers at the simultaneous peak.

Figure 2 Shows the voltage range for all customers grouped by LV feeder, at the time of peak demand. We don't observe any undervoltage. Slight overvoltages occur due to unbalanced loading and untransposed lines with unbalanced impedances.

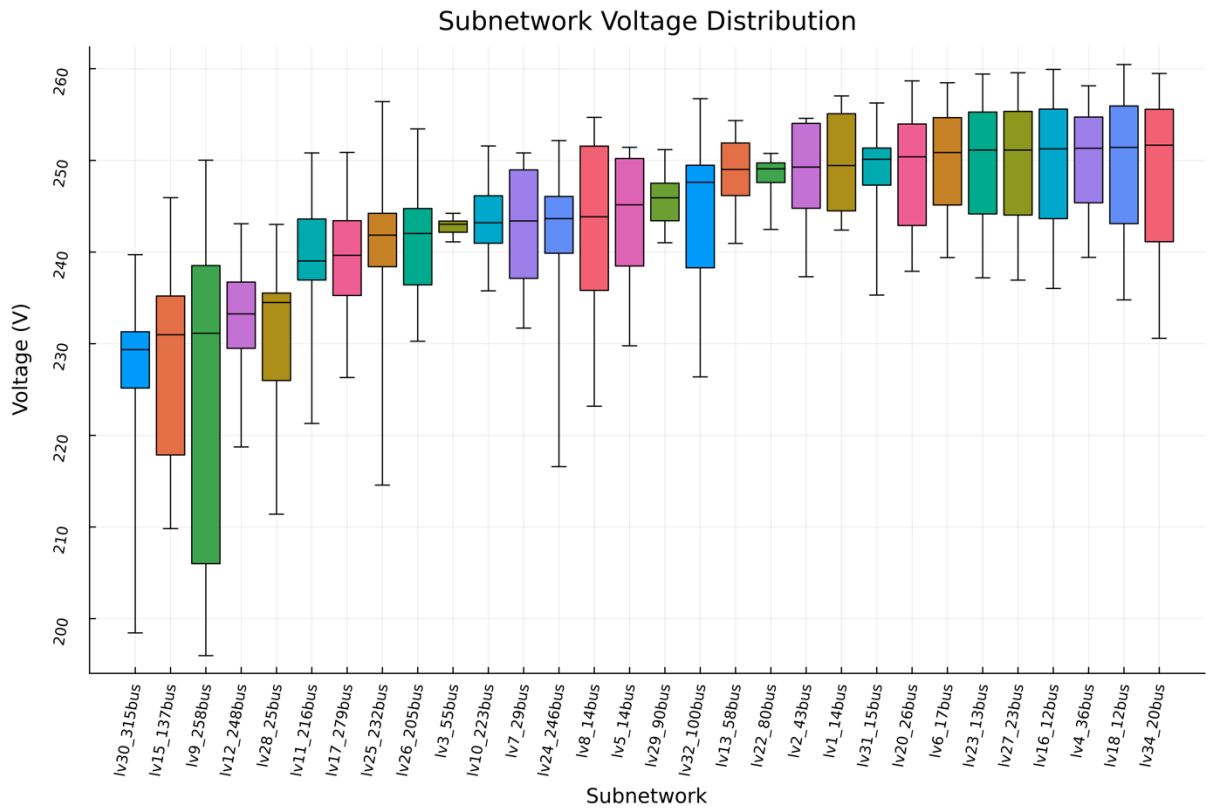


Figure 2: Phase-to-neutral voltage distribution per LV feeder at the maximum simultaneous demand peak. Note that most transformers have a no-load voltage of 250V. Slight voltage rise occurs due to unbalanced load and untransposed lines with unbalanced impedances.

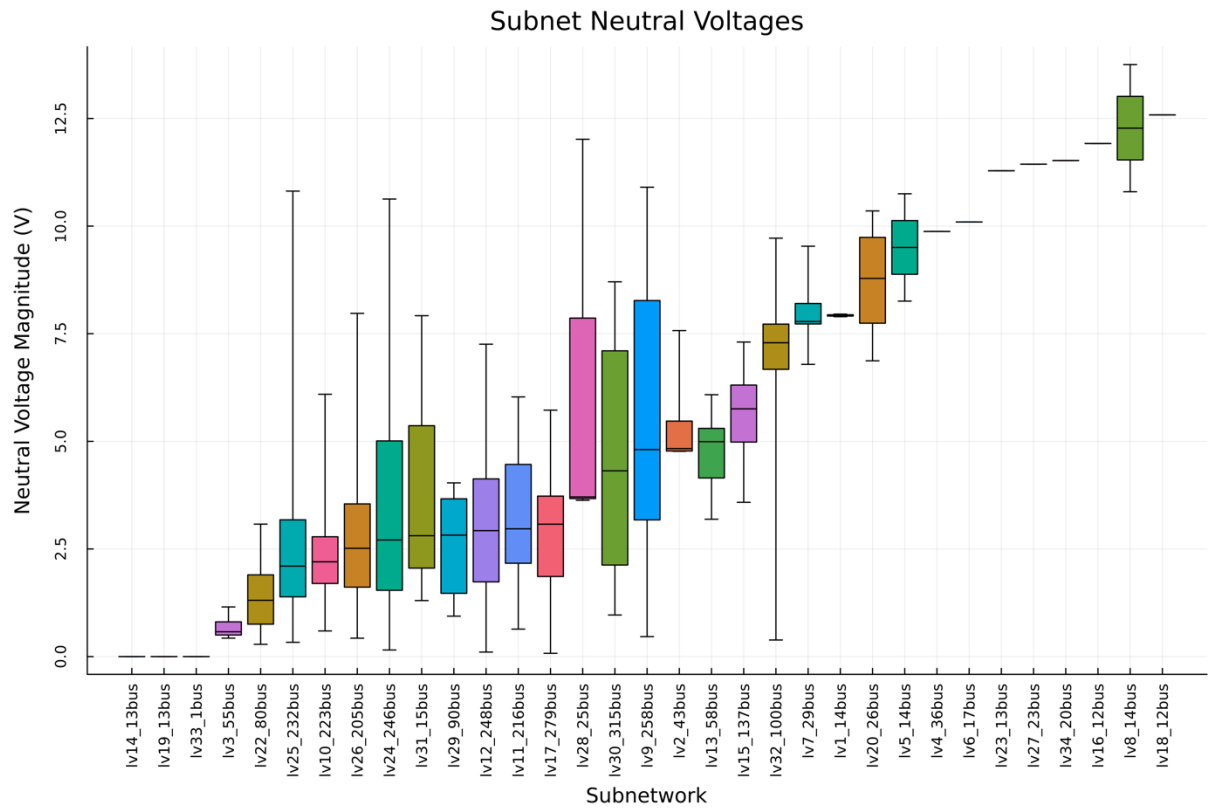


Figure 3: Neutral Voltage Magnitude Distribution per subnetwork at maximum simultaneous demand peak.