A Digital Twin of Electrical Distribution Grid: the Netlab n-Bus Dataset

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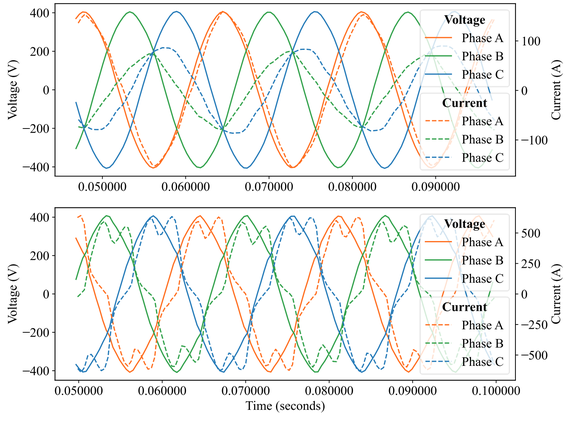
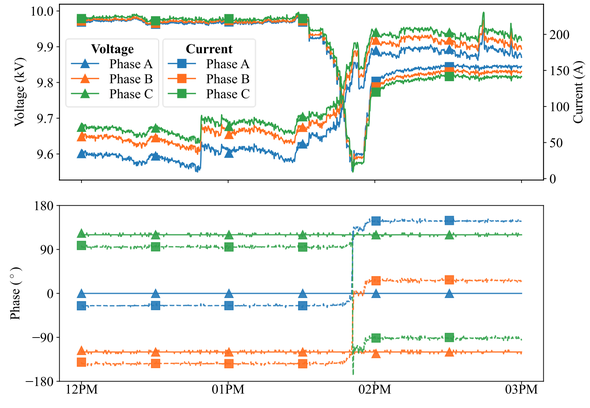
Dataset

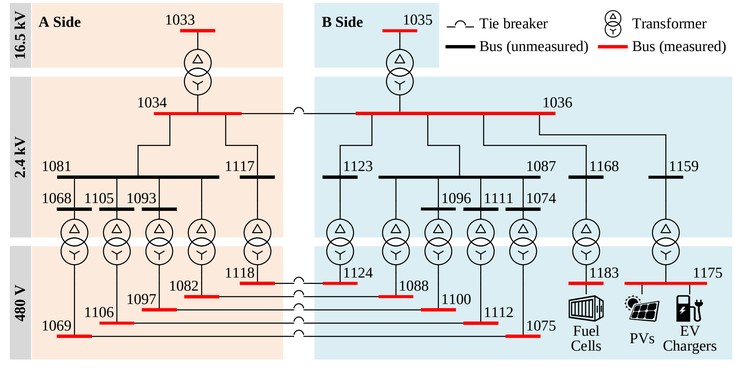
Synchro-waveforms



Synchro-phasors



Topology and parameters

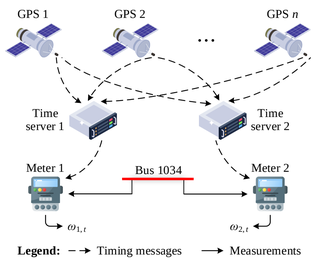


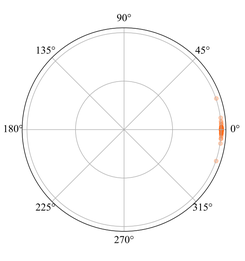
Dataset access

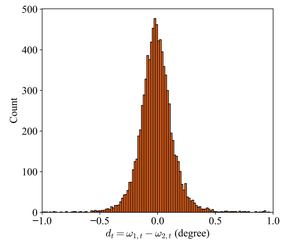
github.com/caltech-netlab/digital-twin-dataset

Measurement Error

Synchronization







Sensor Error

Meters: Certified to <0.5% error (ANSI C12.20)

Current & Potential Transformers: Generally certified to <1% error. Rare cases of large current errors due to oversized current transformers.

Topology and Parameter

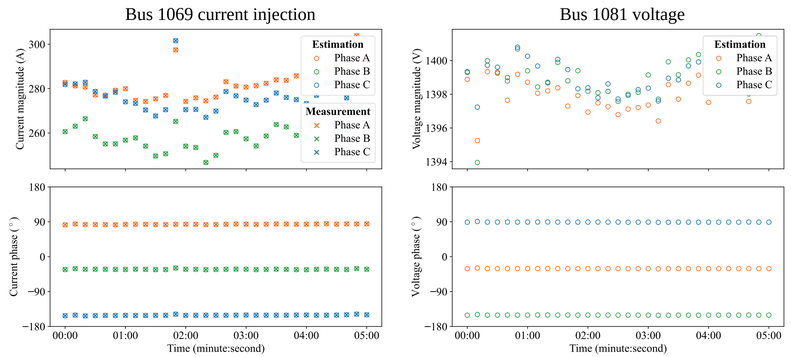
Lines: Conductor thickness and material are from engineering drawings. Insulation material and thickness are estimated. Lengths are estimated. Lines are generally underground with unknown cross-sectional arrangement.

Transformers: Series impedance (z%) and ratio are obtained from nameplates. Tap positions are unknown but usually nominal. Earth grounding typically occurs on the secondary side of Delta-Wye transformers.

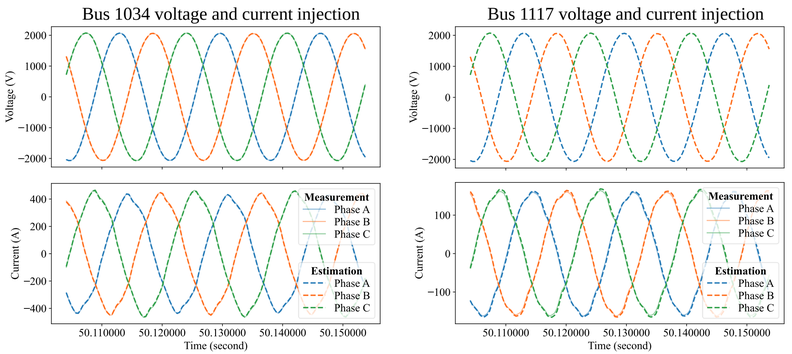
Switch status: Time-varying switching events are verified via state estimation.

Example Applications

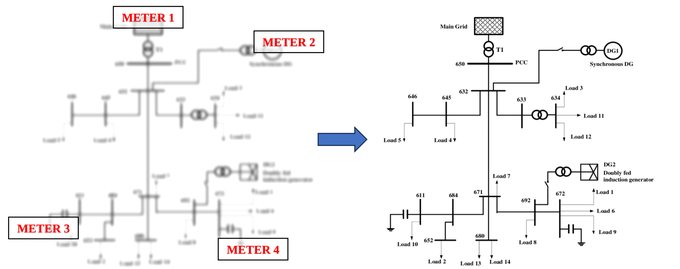
State Estimation (Phasor)



State Estimation (Time Domain)



Topology & Parameter Estimation



Step 1: Estimate Kron-reduced admittance matrix $\bar{Y}$

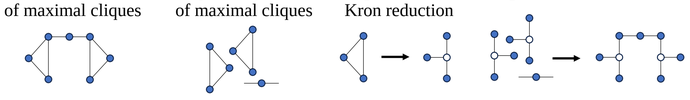
Step 2: Reverse Kron reduction

Step 2.1 identification of maximal cliques

Step 2.2 separation of maximal cliques

Step 2.3 reverse Kron reduction

Steps 2.4 & 2.5 combine



Acknowledgements

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