

Developing Synthetic Distribution Models Using Open-Source Data Sets

Aadil Latif and Sara Farrar
National Renewable Energy Laboratory

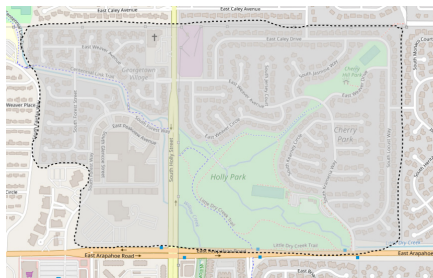
The need for synthetic distribution models

The deployment of distributed generation resources at scale with the distribution side of the power system network over the last two decades has spurred a lot of research interest in distribution networks. Given, the sensitive nature of power system data sets, utilities are still reluctant to open-source distribution networks. Although some open-source data sets are available, they may not cover the region of interest. In this paper, we introduce the Synthetic Distribution Network Generator (SING), new software that allows users to develop synthetic distribution models, using open-source data sets, in any region of interest within the continental US.

Leveraged datasets

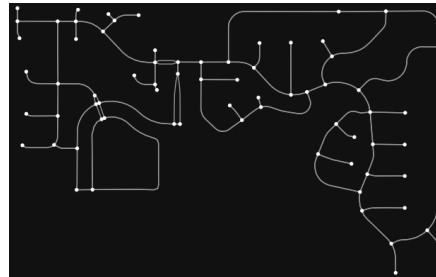
In this paper, we introduce SING a software tool that generates synthetic distribution models for a selected region. The developed software makes use of open-source data sets to generate realistic distribution models

1. Homeland Infrastructure Foundation-Level Data (HIFLD) <https://hifld-geoplatform.opendata.arcgis.com/datasets/electric-substations> is leveraged to locate substation locations.
2. OpenStreetMaps have been leveraged for
 - a) the road infrastructure and
 - b) building meta data<https://osmnx.readthedocs.io/en/stable/installation.html>
3. ResStock and ComStock datasets are leveraged for load profiles



The figure shows a snapshot from the SING dashboard. A region of interest can be selected using the lasso option on the dashboard

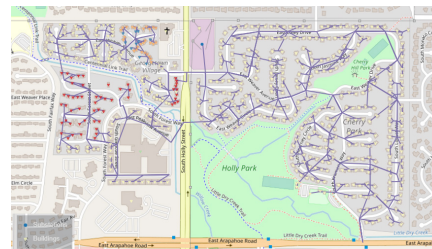
Building the model



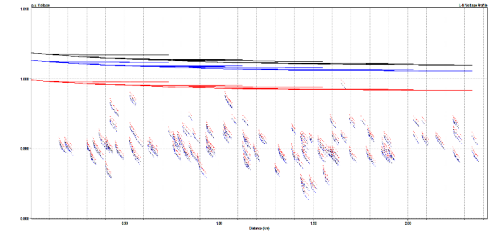
Road infrastructure graph queried from OSMnx for the user-defined region on the SING dashboard

The build process

1. Defining a region of interest
2. Querying Road Infrastructure and Building Data
3. Identifying Substation Service Regions
 - a) Creating distribution transformers
 - b) Creating loads and sizing the distribution transformers
 - c) Creating secondary lines
5. Creating network primaries
 - a) Creating primary lines
 - b) Creating the substation transformer
6. Building the complete model



The complete graph for the distribution model generated by SING for the selected region. Triangles denote end customers, and the color denotes building types (yellow: residential, red: commercial, orange: unknown)



The plot shows a voltage drop plot for the generated model using the OpenDSS simulation software.

Next steps

1. Extend algorithms to develop unbalanced distribution models
2. Extend algorithms to account for multiple distribution feeders
3. Improve algorithms to automatically size conductor for both distribution primaries and secondaries
4. Add distribution voltage regulation equipment in an automated manner (this currently being done post model creation)

Package installation

Source code : <https://github.com/NREL/SING>

Installation :

```
git clone https://github.com/NREL/SING.git
```

```
pip install -e .
```

References

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