

DMS Simulation Toolkit for the Grid of the Future

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Distribution Management Systems (DMS)

- Increased active role of distribution in the future grid
- Advanced automation and control
- Use of distributed renewables in grid operations

There is a need for DMS simulation tools to more easily study new control schemes alongside existing models and systems.



Building Blocks for DMS Simulation

The Open Distribution System Simulator (OpenDSS)

- Open-source and free
- Designed to be customized, scripted, and expanded
- Commonly used for distributed generation interconnection studies

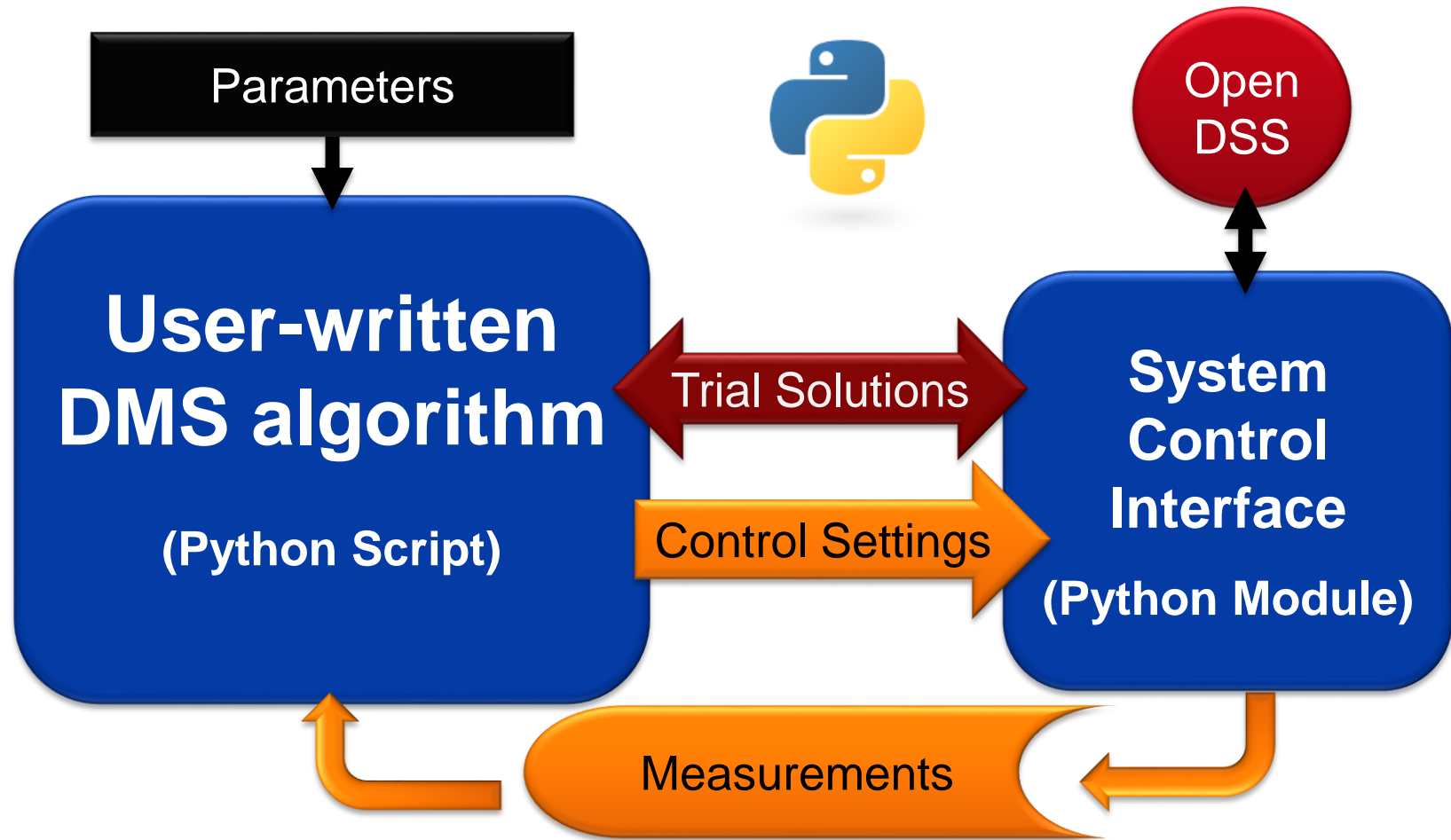


Python scripting language

- Open-source and free
- Popular among engineers for quick scripting applications
- Common Object Model (COM) interface with OpenDSS



DMS Simulation Framework



System Control Interface – Features

Interface with OpenDSS

- Control various distribution equipment
- Measure and monitor system variables

Time Series Simulations

- Follow load shapes and irradiance profile
- Record pertinent data to customized spreadsheet

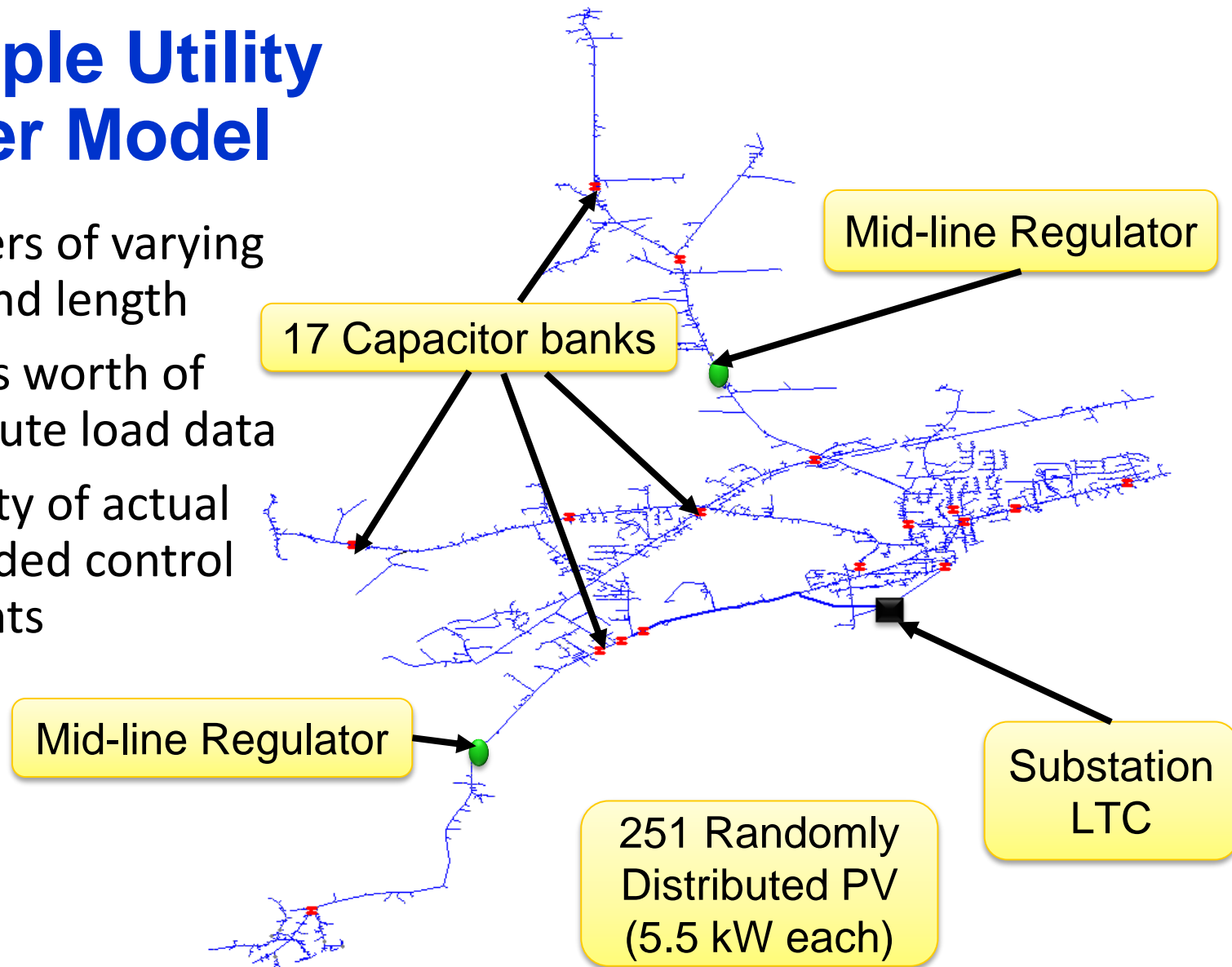
Simulation-based Control Decisions

- Do a trial solution with possible controls
- Restore controls to an earlier state
- Select best of many options



Example Utility Feeder Model

- 4 feeders of varying load and length
- 1 year's worth of 15-minute load data
- A variety of actual and added control elements



Example DMS Specifications

Priorities

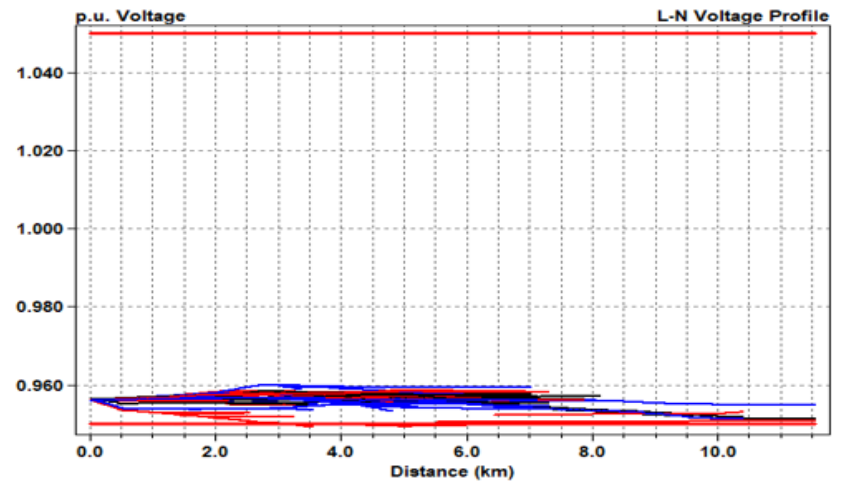
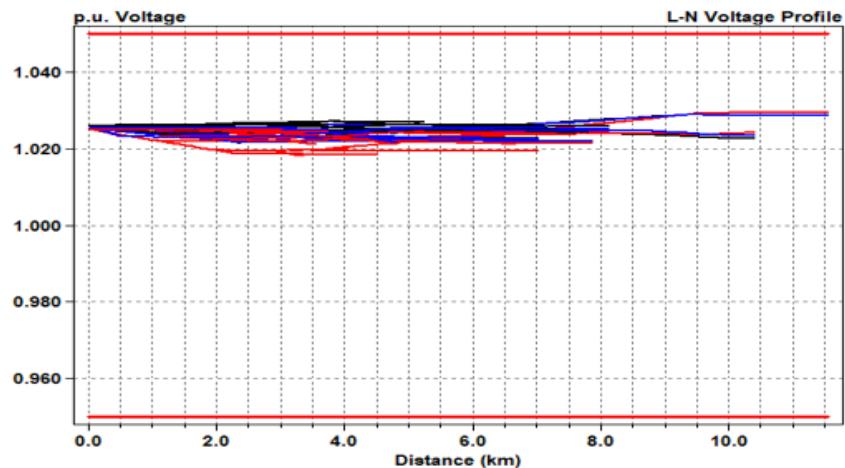
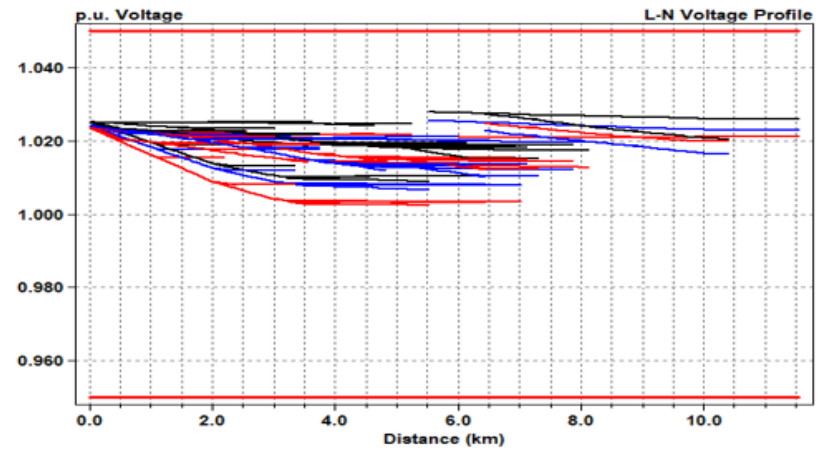
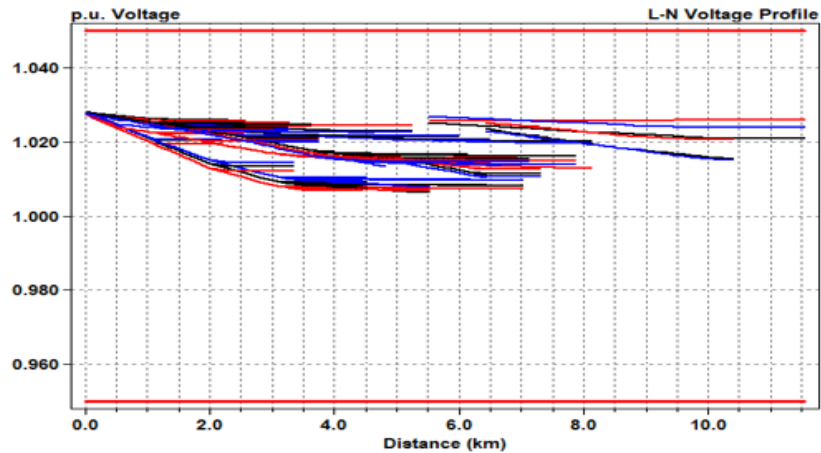
1. Keep all voltages within ANSI standards $\pm 10\%$.
2. Reduce regulator tap changes and capacitor switching actions.
3. Flatten and lower voltage profile for conservation voltage reduction (CVR).

Algorithm

1. Execute dozens of trial simulations, seeking to meet objectives.
2. At each time step, implement the best trial settings for the next 15-minute segment.

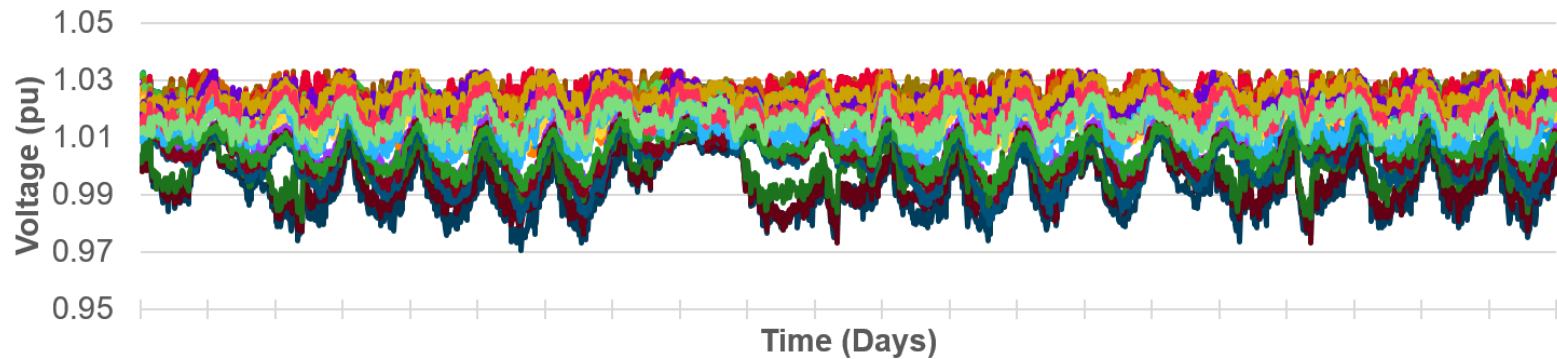


Example Results – Voltage Profile

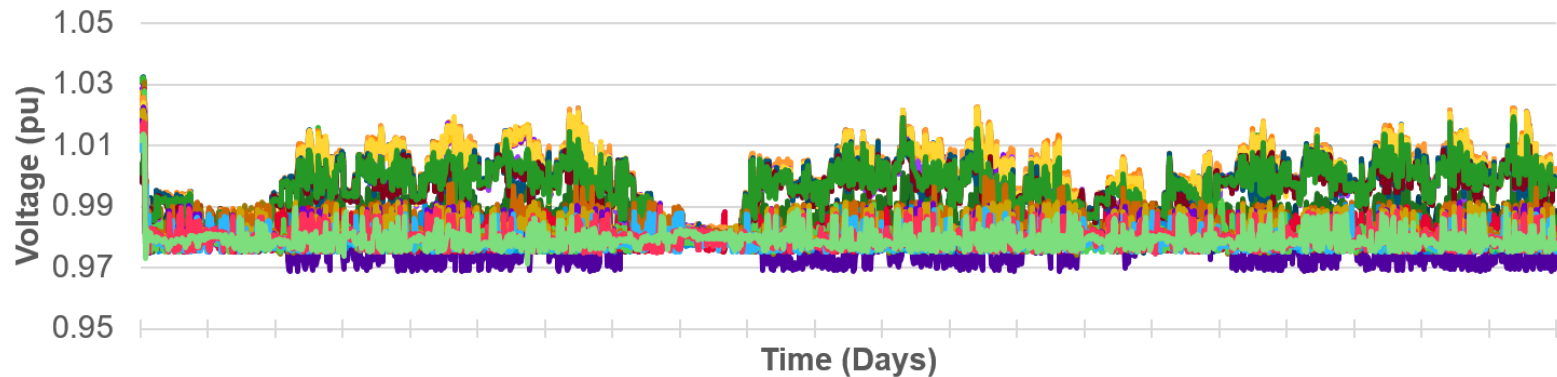


Example Results – Time Series

Normal Operation



With DMS



Recap: DMS Simulation Toolkit

- Uses open-source, free platform to provide tools for DMS simulation
- Allows existing models and conventional controls to be simulated along with experimental schemes
- Time-series simulations, trial-based decisions, output monitoring, and low-level control are all built-in features

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