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M2 - Master in Electrical Engineering for Smart Grids and Buildings
Research Domain: Electrical Power Systems - Optimization

Optimal Configuration of Distribution Networks under Technical Constraints based on Predictive Methods

Objectives

The work here proposes an algorithm to perform a multi-objective, day-ahead scheduling / optimization for distribution networks based on predicted values of day-ahead DRES production and load consumption.

Methodology

- Modular Algorithm with various replaceable components.
- At 0h, either start with original, or optimal configuration for the networks (best result shown in tables)
- Tested on two networks (urban and rural), with economic criteria.
- Original, and optimized network voltages for each hour shown in results: Minimum, Maximum, and Average voltage in p.u.

Algorithm Components
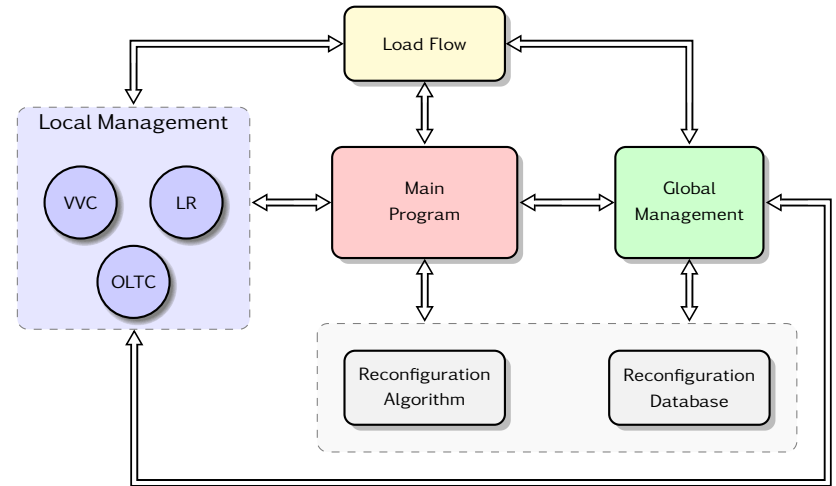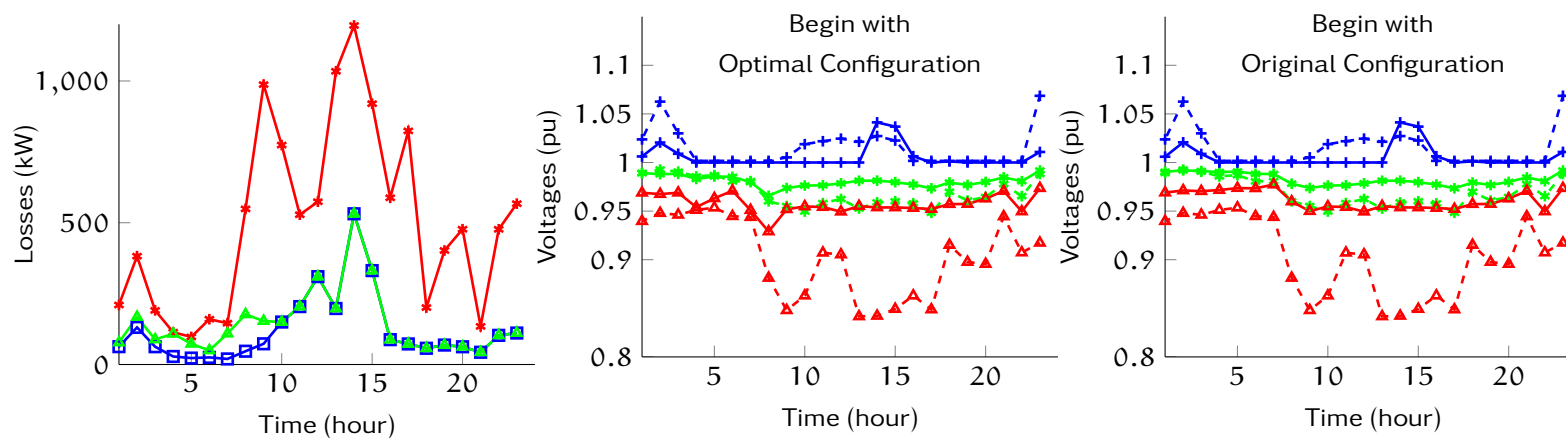

Results

PREDIS (Urban) Network

Parameter	Original Network	Optimized Network
Losses(kWh)	11720.8	2990.9
Money Spent(€)	41057.7	14096.3
Violations	79	12

- Significant loss reduction
- Significant violation reduction

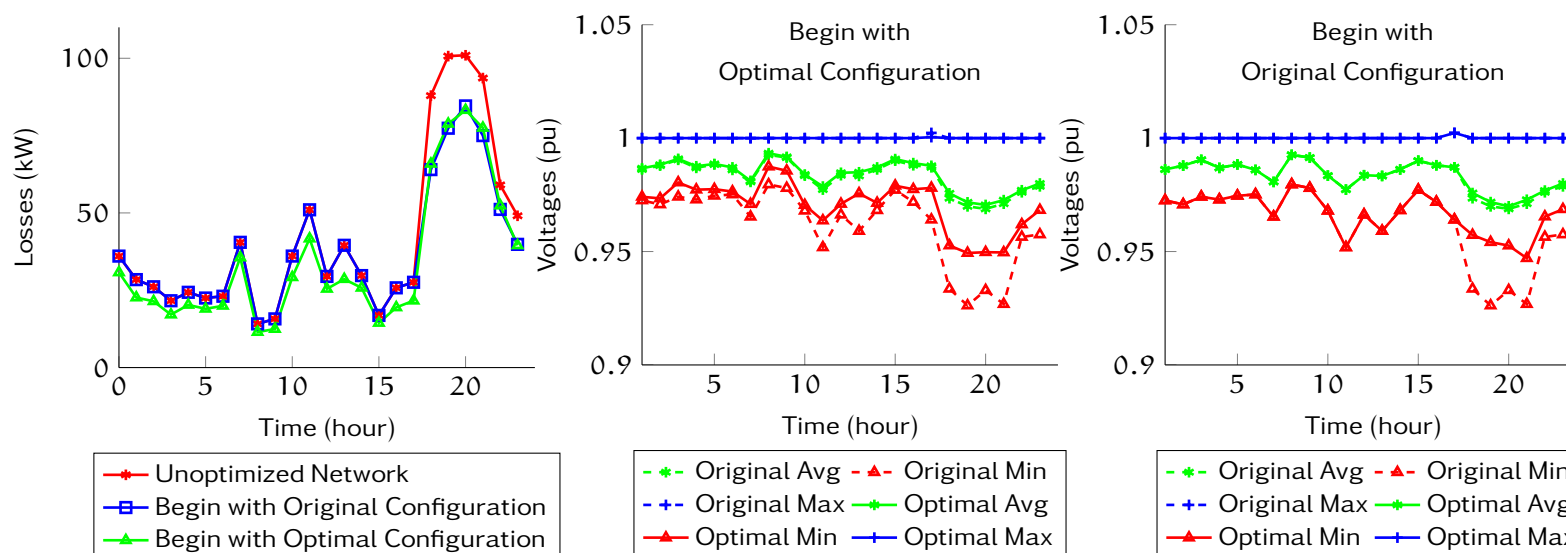Figure - Losses and Voltage Profiles for the PREDIS (Urban) Network

Rural Network

Parameter	Original Network	Optimized Network
Losses(kWh)	999.8	900.5
Money Spent(€)	17132.9	5245.7
Violations	34	3

- Significant violation reduction
- Noticeable difference between the two approaches

Figure - Losses and Voltage Profiles for the Rural Network

Conclusions

There is a significant improvement in the condition of the two networks, based on the predicted values of DRES and loads.

Most of the current literature: focuses on optimization considering only a "snapshot" (static loads and DRES production). Here, the conditions vary.

This work improves over the rest which consider varying conditions.

Future Work

Future developments have been envisaged, as a part of work leading to a PhD:

- A novel state-of-the-art reconfiguration function.
- A multi-objective constrained optimization function for deciding between various methods for violation management.
- Development of an economic model that considers all the real-world factors.
- Development of a day-ahead market-based purchase scenario for flexibilities.