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Automated Network Planning Including an Asset Management Strategy

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Changes in the Power Infrastructure

The challenges of the energy transition are expected to lead to large investments in the electrical infrastructure. Coordinating both reinforcement and renewal of this infrastructure in an automated way offers great saving potentials.

Automated Expansion Planning and Asset Management

Fraunhofer IEE and University of Kassel developed an automated expansion planning tool based on the open source software pandapower. This tool finds an optimal set of reinforcement measures based on various load and generation scenarios (Figure 1).

Besides the grid expansion, an important planning task is the maintenance and renewal of electrical equipment. For this task asset value and reliability are important parameters. To account for these objectives in the automated expansion planning tool, the cost term is extended by a residual value for replacement measures (Figure 1).

Tests on a Medium Voltage Grid

This integrated approach was tested on a real MV grid (Figure 2a) and compared to the normal reinforcement approach (solutions in Figure 2b). The results in Figure 3 show that the integrated approach

- Finds solutions with only slightly increased investment cost;
- Leads to a larger increase of the asset value;
- Replaces older rather than new lines, thus reducing the failure rate more than the reinforcement approach.

With the integrated cost model the automated expansion planning can consider aspects of asset management at only slightly increased investment cost.

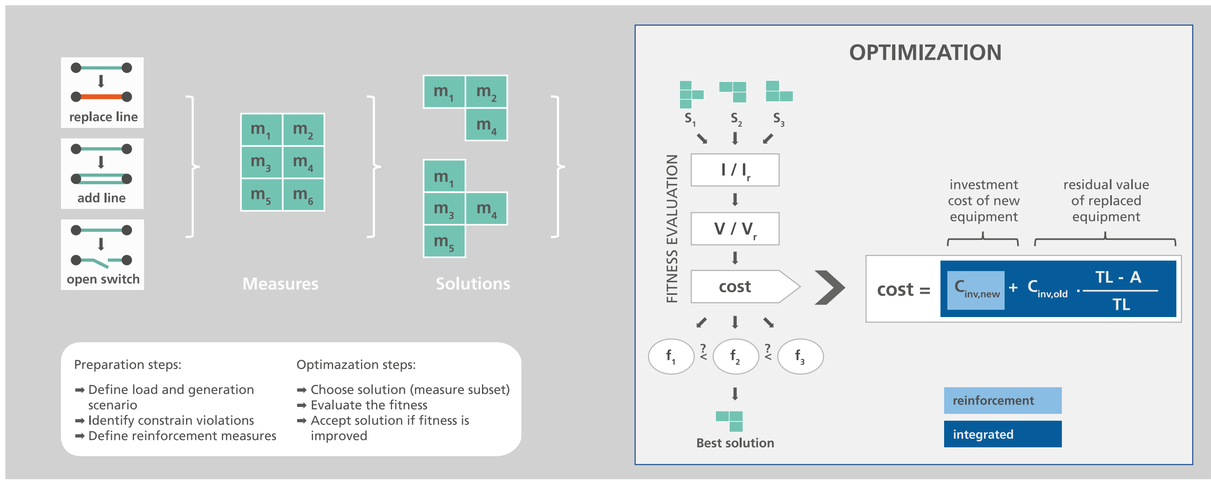

Fig. 1: Steps of the automated expansion planning tool with two cost models, one for the reinforcement and one for the integrated approach. In this cost model, C_{inv} is the investment cost of a new asset, TL is the technical life and A is the age.

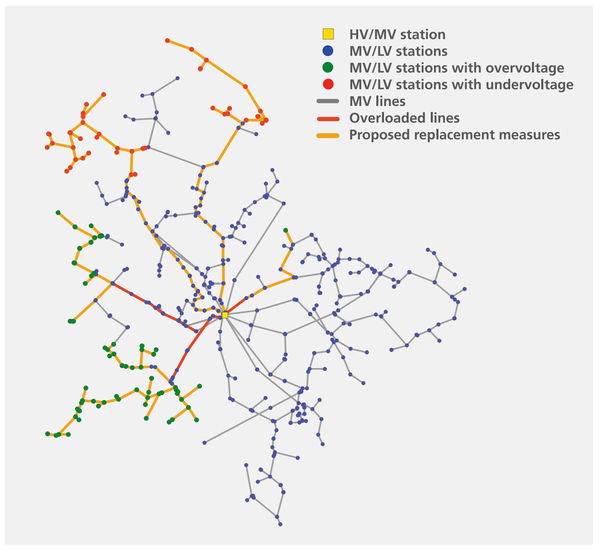

Fig. 2a: Analyzed MV grid with current and voltage constraint violations. Orange lines are proposed to be replaced to eliminate the violations.

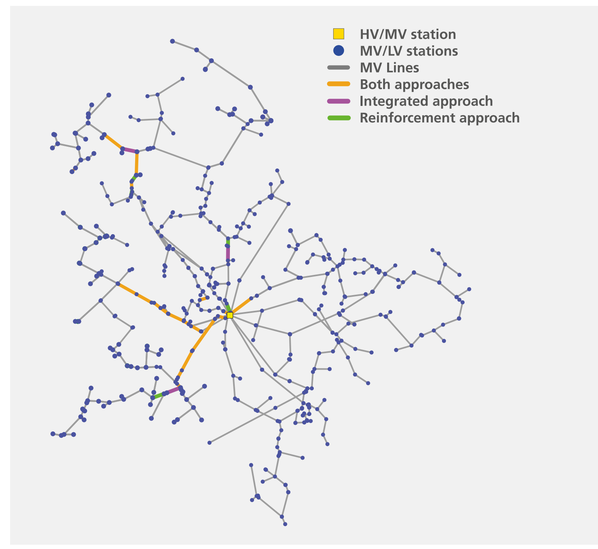

Fig. 2b: MV grid with optimized results of the two approaches. The two approaches identify different replacement measures. Some measures are found with both approaches.

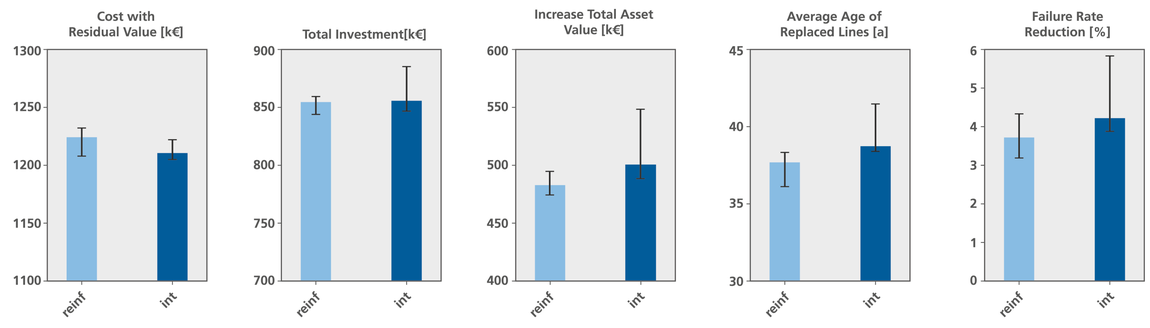

Fig. 3: Results of 10 optimizations for reinforcement (reinf) and integrated (int) approach. The median is shown as bar and the variance as error bar. With the integrated approach objectives of asset management can be considered, as it increases the total asset value and replaces rather old lines, thus reducing the failure rate.

Outlook

Currently a more sophisticated model is developed at Fraunhofer IEE that considers

- Condition and importance of electrical equipment using a realistic ageing model and a reliability analysis;
- Both OPEX and CAPEX for different maintenance and renewal strategies.

The aim is to create an integrated planning tool that can identify an optimized investment strategy for a large time scale.

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