Study Committee B2

Overhead Lines

10580_2022

PREPARATORY ANALYSIS STEPS TO ESTABLISH A SAFE AND EFFICIENT DYNAMIC LINE RATING (DLR) SYSTEM

Bálint NÉMETH, Gábor GÖCSEI, Levente RÁCZ and Dávid SZABÓ

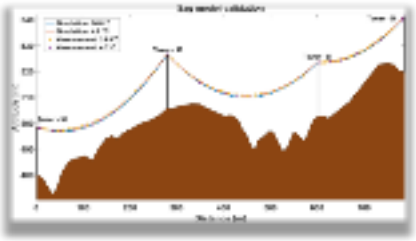
Budapest University of Technology and Economics

Motivation

- Present the preparatory to steps of DLR system implementation in order to achieve a reliable and safety system.
- Combination of theoretical approaches and practical experiences from EU-funded Horizon projects in DLR system implementation.

Method/Approach

- Power line selection methodology based on multi-criteria approach.
- Innovative models for determining sensor installation locations:
  - BME's critical span identification algorithm based on sag-clearance simulation,
  - BME's risk-based, distributed sensor installation concept.
- DLR system implementation with low-cost sensors:
  - Monitoring the longitudinal conductor temperature profile of power line with cost effective sensors.

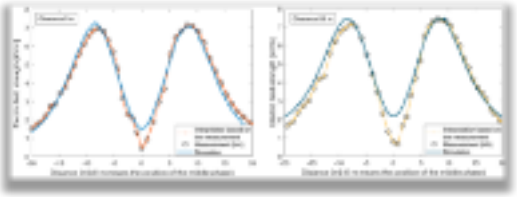


Objects of investigation

- Installation and integration of DLR system components based on the proposed preliminary steps.
- 8 transmission lines are involved in the project from 4 countries:
  - APG (Austria),
  - HOPS (Croatia),
  - IPTO (Greece),
  - MAVIR (Hungary).

Experimental setup & test results

- Installation and integration of DLR system components in the framework of EU-funded FARCROSS project based on the methods developed by BME.



Discussion

- DLR system implementation with low-cost sensors:
  - Thermal monitoring of power lines in every tension section,
  - Longitudinal conductor temperature profile → avoiding local thermal overloads,
  - Development of „low-cost" sensor in order to reduce the capital expenditure of the system,
  - Cost-effective DLR sensor with only one functionality, namely conductor temperature measurement,
  - The monofunctionally is implemented with A-type temperature sensor with high accuracy.

Conclusion

- In the initial steps of a DLR system implementation various challenges have to be considered which are assessed in this article:
  - Justification of power line selection both from an economic and a technological point of view,
  - Different sensor allocation strategies which can be adapted to the given TSO's requirements.

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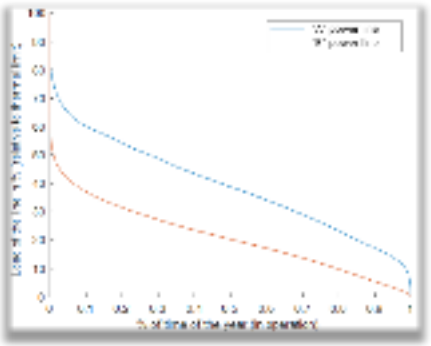
continued

Power line selection methodology for DLR system implementation



- Investigation of load duration curves:
  - Focus on relative load instead of absolute,
  - Analysis of several years data to filter out outliers,
  - Load limits should be taken into account according to the TSO's capacity allocation method (e.g.: seasonal line rating).

- Investigation of limiting elements in the substations:
  - DLR can be applied cost-effectively if the conductors are the bottleneck of the given line,
  - Transfer capacity of substation equipment (such as circuit brakers, disconnectors, current transformers, wave traps, power transformers, etc.) should be examined for this purpose.

- Line role from strategic point of view:
  - Congestion management possibilities and density of the electricity network,
  - Generation side changes, such as investment on renewable energy sources and their intermittent and peak generation capacities.

- Historical events:
  - BME's complex DLR-based line management system also includes icing alert function,
  - System implementation is beneficial on areas exposed to extreme weather conditions.

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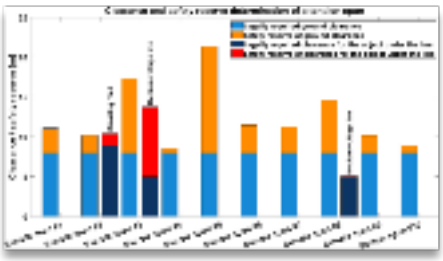
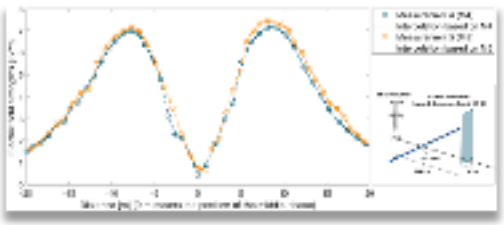
continued

Innovative models for determining sensor installation locations

- BME's critical span identification algorithm based on sag-clearance simulation:
  - Eliminate the deviation caused by weather parameters,
  - Determination of ground clearance level and clearance from any object located under the line for all the spans,
  - Sensors should be installed on the spans with the lowest clearance reserves.



- BME's risk-based, distributed sensor installation concept:
  - The spatial distribution of weather parameters are considered with Monte Carlo sampling,
  - Electric and magnetic field distribution under the line at sag level caused by maximum operational temperature,
  - Tension sections are ranked based on the minimum temperature causing a sag or annealing problem.



- DLR system implementation with low-cost sensors:
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