Forecasting of corona losses based on machine learning methods

Summary

The objective of this PhD research position is to develop methods and tools for forecasting corona losses in transmission systems. In modern power systems there are many new sources of real time measurements, e.g. PMU, PQ, etc., that can be used as an input to estimate the corona losses. In this project the suitability of machine learning methods is assessed together with determining the corona losses dependency on weather conditions, type of measurements and age of infrastructure.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Prof. Dr. Jako Kilter Kaur Tuttelberg
Availability:	This position is available.
Offered by:	School of Engineering Department of Electrical Power Engineering and Mechatronics
Application deadline:	Applications are accepted between November 16, 2020 00:00 and December 16, 2020 23:59 (Europe/Zurich)

Description

For a transmission system operator (TSO), it is desirable to be able to monitor and forecast corona losses. This is especially important for TSOs who operate in deregulated energy markets. Such TSOs are required to cover the energy lost in transmission at the least possible cost. This is achieved by forecasting transmission losses and procuring them on the day ahead market. While the methods for forecasting overhead resistive losses are well established, corona losses are a lot more difficult to forecast. Corona losses are very difficult to model, they are difficult to measure, and they have a complex dependence on weather conditions.

For the problem of measuring and monitoring corona losses, the deployment of wide area monitoring systems (WAMS) and other real-time monitoring systems, e.g. power quality

measurements, have offered new opportunities. Based on the synchronized phasor measurement technology used in WAMS it is possible to continuously monitor corona losses on operating transmission lines without additional dedicated equipment [1, 2]. This makes it possible to monitor corona losses on multiple transmission lines across the power system over long periods of time and gain a more detailed understanding of the phenomenon. In addition, dependency between different type of measurements and line conditions is of interest.

In order to understand corona losses even better, it is possible to combine the system wide longterm measurement results with weather monitoring data. Corona losses are largely dependent on weather conditions, but the dependence is complex and not well modeled [3]. With this type of problem and with the possibility of gathering large amounts of monitoring data, the problem could be approached with machine learning methods. Machine learning tools can be suitable if enough data is available and other modeling methods do not perform well. One of the aims of the PhD project is to use machine learning to analyze the weather dependence of corona losses. Machine learning models can be extended from analyzing weather dependence to forecasting of corona losses based on weather forecasts. Weather forecasts are readily available, and the possibility of

forecasting corona losses based on this data would offer new opportunities for TSOs. The second and primary goal of the project is to develop corona loss forecasting tools. Such tools would provide valuable information for TSOs to improve the accuracy of loss forecasting, which in turn would allow them to decrease spending on transmission loss energy.

[1] Tuttelberg, K.; Kilter, J. (2018). Estimation of transmission loss components from phasor measurements. International Journal of Electrical Power & Energy Systems, 98, 62−71

[2] Tuttelberg, K.; Loper, M.; Kilter, J. (2019). Correcting Systematic Errors in Corona Losses Measured with Phasor Measurement Units. IEEE Transactions on Power Delivery, 34 (6), 2275−2277

[3] F. J. Sollerkvist, A. Maxwell, K. Rouden, and T. M. Ohnstad, “Evaluation, verification and operational supervision of corona losses in Sweden,” Power Delivery, IEEE Transactions on, vol. 22, no. 2, pp. 1210–1217, April 2007.

Responsibilities and tasks

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This is a full time PhD position and student is expected to do research 90% of the time. Other 10% is related to teaching, i.e. supporting lectures and course works in courses related to power system calculations and optimization. Research results shall be presented through publications and presentations. In minimum, two journal papers and one conference paper shall be published during PhD studies.

Qualifications
The applicants should fulfill the following requirements:

- Holds a master's degree in Electrical Engineering or Data Analysis/Management or a similar degree with an academic level equivalent to a master's degree
- Have obtained excellent study results and has knowledge on different mathematical analysis methods related to machine learning
- Have knowledge on power system operation and corona phenomenon
- Have knowledge on power system monitoring solutions and their applicability
- Have experience with programming languages, e.g. MATLAB
- Is able to understand, speak and write texts in English language with high profiency

Requirements for motivation letter
It is expected that the motivation letter included to the application should include information about the applicant background, reasoning why she/he is interested in this topic and discussion about the development of this topic.

To get more information or to apply online, visit https://taltech.glowbase.com/positions/160 or scan the the code on the left with your smartphone.

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