

**Real-time and short-term forecast assessment of power grid operating Limits  
- SUMO**

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**Abstract**

In order for the transmission system operator to operate the power grid in safe and stable manner the operator needs to be aware of the grid's operating limits at all times. These limits (also referred to as ratings) are the highest allowable power flows through any element of the transmission grid, e.g. power lines, cables and transformers. Since most of the elements of the transmission grid are located in open air, the most important factor in determining their limits is the current weather situation. The limits are traditionally set as static and are based on very conservative presumptions of weather parameters. Studies have shown [1],[2] that in most situations of day-to-day power grid operations weather situation allows for dynamically calculated ratings that are higher than the traditionally set - static ones. This in theory allows for better utilization of existing grid. At the same time it should be noted that in some cases, dynamically calculated ratings can also be lower than the static ones, hence power grid operations, relying on dynamically calculated ratings, have to take these cases into account.

Above mentioned reasons have been the foundations for development of a system for real-time and short-term forecast assessment of power grid operating limits called SUMO. The SUMO system's aim is twofold: first, to improve reliability and safety of operating the network, especially in cases of sudden increases of power flows, i.e. avoid unnecessary load sheds or costly re-dispatching maneuvers, and second to better utilize the existing transmission system infrastructure, especially when new transfer capacities, such as new power lines are difficult to commission, mostly due to rising environmental awareness in developed countries.

The main novelty brought on by the SUMO system is dealing with the problem of defining operating limits (ratings) from the perspective of a power system as a whole. For real-time application SUMO includes live power grid data (measurements and topology from SCADA), live weather data and real-time reliability analyses. For short-term forecast application it includes load flow calculations based on load forecasts, reliability analyses based on these forecasts and detailed weather forecasts. The system is designed in such a way that each task can be fulfilled by a separate subsystem. To facilitate the exchange of data between these subsystems an integration and data exchange platform SUMO BUS was developed.

The uncertainties of algorithms, responsible for calculating the ratings are being continuously evaluated using a custom built outdoor testing site. First results show that standard thermal rating algorithms for power lines are too conservative and need to be revised and improved.

The SUMO system has been introduced into optimization of transmission line grid operation and control at Slovenian TSO ELES where additional on-site experiences have helped to improve and adapt the SUMO system to daily TSO operation. The system has been developed by Elektrotehniko Milan Vidmar in cooperation with ELES and University of Ljubljana, Faculty of electrical engineering; for further integration of SUMO system also energy management provider Solvera Lynx has joined this consortium.

Taking into account positive results of current SUMO application, transmission system operators can integrate the SUMO system into its operating systems of the transmission network and substantially improve performance in unfavorable power system situations, such as contingencies, severe weather and rapid changes of power flows through the power grid. This can result in more stable and safe operation of the power grid.