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**EC601 Sprint 1**

**Github link:** https://github.com/jtsui1

**Project**: Modelling the impact of Dynamic Line Ratings (DLR’s)

**Target Users:**

* Entities that maintain and regulate the power grid – ISO and RTO’s, reliability councils, government entities
* Suppliers of power – utilities and developers
* Other entities that operate in the power sector – consultants and R&D companies specializing in energy

**User Stories**

* I want to be able to send more power with our existing transmission lines
* I want to lower energy costs for the public
* I want to make the power grid more stable and reliable
* I want to add more renewable energy into the power grid

**Minimum Value Product:** A simulation and analysis of a part of the power grid (ex: an existing transmission line) under different scenario assumptions (using worst-case scenario conditions vs DLR conditions)

**Papers Reviewed:**

* <https://ieeexplore.ieee.org/abstract/document/7097387>
* <https://ieeexplore.ieee.org/document/8592213>
* <https://ieeexplore.ieee.org/document/9322810>
* <https://ieeexplore.ieee.org/document/7286604>
* <https://ieeexplore.ieee.org/document/10667135>

**Literature Review:**

The papers I focused on were mostly case studies that evaluated the efficiency of different approaches to Dynamic Line Rating (DLR’s). Most of the case studies were based on measurements from existing transmission lines, although one study used a distribution line, and another used an overhead conductor. However, there were many similarities among all the case studies. All the papers begin with an overview of DLR’s and the potential benefits and advantages they have over traditional static line ratings (SLR’s). SLR’s often rate lines based on worst-case scenarios, but the conditions that affect a line’s capacity are dynamic and often fluctuate. This can lead to inefficiencies when the actual rating is higher, or it can cause overheating and outages when the actual rating is lower. With DLR’s, the line ratings are based off real-time readings and measurements, and thus will be more reflective of the actual conditions affecting the line. The main parameters that affect a line’s capacity are wire temperature, operating current, ambient temperature, wind speed and illumination. Many of the papers considered weather-based parameters such as wind to be the most influential in affecting a line’s capacity and they based their studies on historical real-time weather data.

The heat balance equation Ploss+Qsolar=Qconvection+Qradiation formed the basis for many of the studies and from there, the authors further broke down the parts of the equation depending on the scope and goals of the study. Most of the papers used equations from IEEE standards for their calculations, and many from other papers were also referenced.

The calculations were done by external software, and data such as weather data and load data were retrieved from public sources. Although the equations behind the models and simulations are given, none of the papers note how the equations and data was used in the software to produce their results. The DLR’s that were calculated were compared to existing SLR’s, and any difference between them is indicative of overloading or underutilization of the line. Some papers focused on developing new methods and approaches for using DLR’s rather than searching for advantages over SLR’s. In this case, the results were compared to results from existing DLR’s methods, and a high correlation implies the method is accurate and has the potential to be implemented. All the papers found DLR’s showed improvements over SLR’s and that there is potential for new methods of DLR’s to be created and applied to the grid.

Some papers here and many others not cited here also go into the economical implications of DLR – they can be financially beneficial for suppliers of power and for consumers. By making more efficient use of existing lines, suppliers can avoid the more costly alternatives of building more lines or upgrading the existing lines. This also makes electricity less costly to deliver and results in lower costs being billed to consumers.

**Plan for Sprint 2:**

My goals for sprint 2 are to learn more about how line ratings, how they are calculated and how they are related transmission line parameters. To that end, I also plan to learn how to use software that is specifically designed for power flow analysis, such as PSS/E or PowerWorld. I also plan to do more research into what has already been accomplished with DLR’s. By the end of sprint 2, I hope to become familiar enough with a power flow software to design general diagrams with it, and to understand the general ideas and equations behind DLR’s and line ratings in general.