Irish Next Generation Network

CIGRE Ireland

Welcome to the CIGRÉ Ireland NGN Newsletter!

Covid-19 has disrupted both our professional and social lives. CIGRÉ Ireland NGN are committed to connecting with our members and sharing recent industry news, upcoming CIGRÉ events and articles to boost the profile of our members! Therefore, for a limited time only, CIGRÉ Ireland is offering 15 months membership (through to end of 2021) for the price of 12 months! If you would like to become a member, please visit cigreireland.ie.

The committee are always looking for new opportunities to engage with young members, so if you are interested in having your work featured in next quarter's newsletter or have an event idea then please contact bill.shannon@esb.ie

Industry News

1) French energy giant EDF has bought Wexford Solar and have ambitious plans which include:
   - Building eight Solar farms around Ireland.
   - Building a wind farm off the coast of Wicklow with an estimated cost greater than € 1 billion.

   See here for more information!

2) Two firms announce multi-million euro strategic investments in the offshore wind farm sector.

   For further information, visit here!

3) Report published by Irish Academy of Engineering (IAE) calls for significant investment in Ireland's electricity grid to meet 70 % renewable energy generation target by 2030.

   Visit here for more information!

Recent Event

CIGRÉ Ireland NGN Presentation Competition took place recently which saw eight presenters showcase recent project work to a panel of distinguished industry judges. The aim of the event was to give young professionals the opportunity to showcase recent projects and to continue to develop communication and presentation skills despite the challenges of remote working! Many thanks to all those who contributed to the event, either as presenters, judges, attendees or through submitting abstracts!

The NGN committee extends our congratulations to the competition winners, James Maher and Anjukan Kathirgamanathan, who took home the prizes which were kindly sponsored by the Irish National Committee.

The event was streamed live and can be re-watched here:

CIGRE Ireland NGN Presentation Competition

Upcoming Events – Q4 2020

1) **CIGRÉ Ireland National Committee:** *CIGRÉ Ireland e-Session Paper Presentations*
2) **CIGRÉ Ireland NGN:** *COVID & The Power System: Challenges and Learning Outcomes* (Further information will be announced soon!)

A Tool to Determine Stability of Pivoted Vee insulator Assembly

Varun Soni

One of the most challenging issues faced by power utilities today in addressing power capacity increase requirements of overhead line transmission networks is in constructing new overhead lines within reasonable timeframe. Difficulties include obtaining the necessary Right Of Way (ROW) and minimising the environmental impact. Thus, electric utilities are increasingly turning to their existing overhead lines and introducing uprating methods such as voltage uprating which increases the overhead line's load transfer capacity and removes the bottleneck from their transmission system. One method of voltage uprate is by compacting existing lines using Pivoted Vee Insulator (PVI) assemblies, which reduce the required spacing between phases and suspension structures allowing for line voltage uprate without significantly increasing the line footprint.

A PVI assembly is able to rotate about its inclined rotational axis in response to unbalanced longitudinal loads acting at the conductor attachment point. This longitudinal imbalance of loads can be caused by a number of scenarios such as unequal ice loading in adjacent spans, high wind etc. High imbalance of longitudinal loading may result in large rotation of the PVI assembly causing clearance violations between the conductor and the structure and may even lead to contact between the conductor and the structure in extreme cases. The ability of the PVI assembly to withstand a given longitudinal load imbalance within acceptable range of assembly rotation is influenced by not only PVI assembly design parameters but also by the overhead line section parameters as longitudinal displacements for each individual span in the same direction accumulate over the section spans. Due to this, study of longitudinal loading stability limit of a PVI assembly is imperative to its design analysis process. The developed tool analyses the effect of a given loading condition on the PVI assembly's longitudinal stability by employing an iterative approach which also accounts for the effect of neighbouring PVI assemblies in the section. The tool determines the equilibrium point for each PVI assembly in the overhead line section by calculating span tensions for given loading conditions from which net longitudinal load for each PVI assembly is calculated. Where longitudinal load imbalance results, the conductor attachment point is displaced by an incremental displacement value determined by the tool. This is done for each PVI assembly, with the entire process iterated until the solution converges (see Figure 1). The tool therefore not only provides the ability to assess the dimensions of a proposed PVI assembly, it also allows to optimise the PVI assembly and line design parameters to be able to withstand defined environmental conditions by determining the maximum allowable number of spans before instability, which then requires a tension tower or redesign to be introduced.

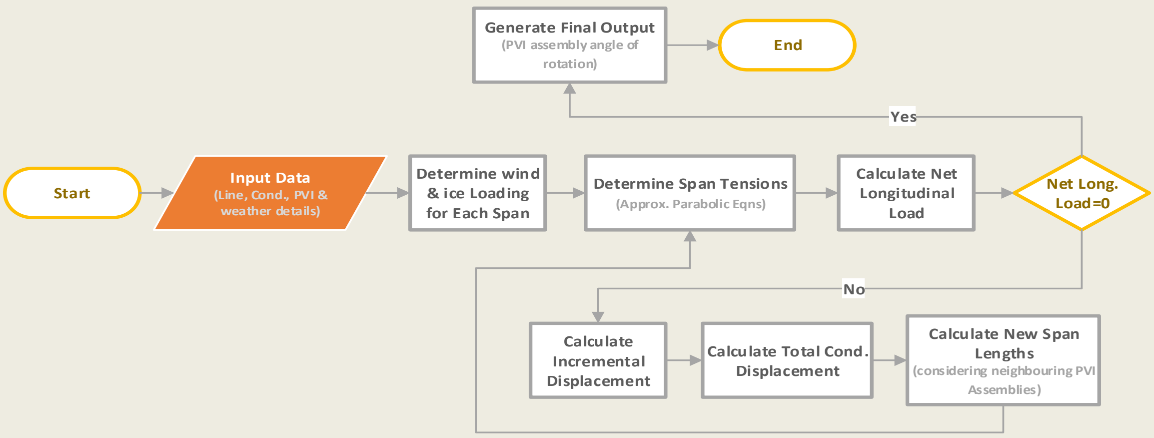

Figure 1: Process Map of developed Tool

With this tool an initial stability analysis of a PVI assembly can be conducted without the need of detailed line modelling. It can simplify the process of stability analysis of PVI assemblies and provide guidance towards selecting line parameters such as number of spans in the section and span lengths.

A DEEP Reinforcement Learning Approach to District Demand Side Management Through CityLearn

Anjukan Kathirgamanathan

Buildings account for about 40% of the global primary energy consumption and yet it is highly challenging to make them more active players in the smart grid in a demand side management context due to their heterogenous nature. In this work, a centralised 'Soft Actor Critic' based deep reinforcement learning agent is proposed as a model-free and adaptive controller for district level demand side management. The results are presented of the algorithm that was submitted for the CityLearn Challenge which was hosted in early 2020. The aim of the challenge was designing and tuning a reinforcement learning agent to flatten and smooth the aggregated curve of electrical demand of a district of diverse buildings.

Reinforcement learning is a promising scalable model-free technique for building energy management, mitigating the need to develop engineering intensive physics-based control-oriented building models. Deep reinforcement learning has gained significant interest and traction in recent years, although it has often been limited to discrete and low-dimensional action spaces. The Soft Actor-Critic algorithm, an off-policy maximum entropy actor-critic algorithm has emerged in recent years as one of the algorithms capable of operating over continuous action spaces. In addition, the majority of studies applying reinforcement learning to building energy management to date have focussed on single building systems with demand-independent pricing signals. To tackle the aforementioned research gap, the Soft Actor-Critic was applied to a multi-agent building energy coordination problem utilising CityLearn, an OpenAI Gym based simulation environment.

The proposed centralised agent has oversight of all nine buildings (featuring both commercial and residential use types) in the district. In designing the agent, the problem of reward shaping, state space design, learning speed and hyperparameter tuning are all considered. The plug and play adaptability of the agent is evaluated through deploying on different datasets from those the agent was trained on, featuring different climates and building characteristics. Preliminary results, as submitted to the CityLearn Challenge, suggest that the agent is able to flatten and smooth the district electricity consumption profile when compared to a predefined manually tuned rule based controller (see Figure 1). The preliminary results also suggest that the agent is able to adapt to new climates and building characteristics when deployed to these new environments. These results highlight the potential application of deep reinforcement learning as a plug-and-play style controller, that is capable of handling different climates and a heterogenous building stock, for district demand side management of buildings.

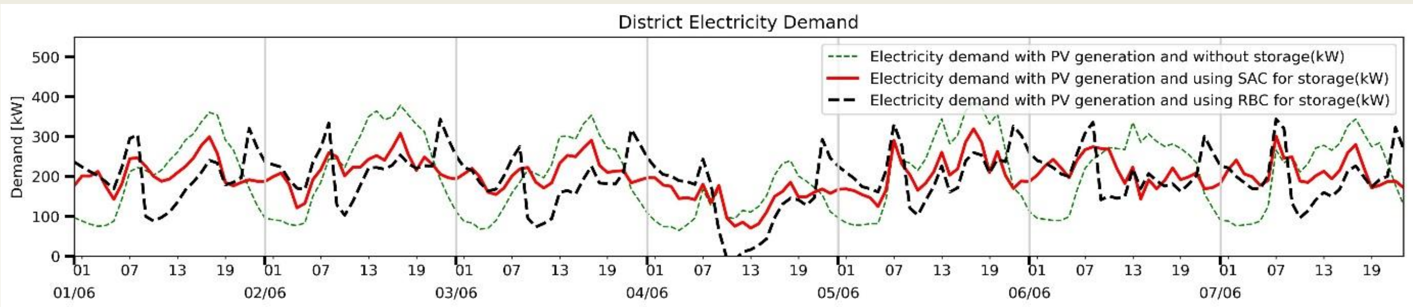

Figure 1: A comparison of district electricity consumption for (i) no load shifting, (ii) predefined Rule-Based Controller (RBC) and (iii) Soft Actor Critic (SAC) Reinforcement Learning agent

Dynamic Line Rating (DLR)

David Monahan

EirGrid is seeking to increase the number of transmission options which have reducing environmental and social impact while maintaining deliverability, cost and to a higher extent utilise existing infrastructure. A field to look into is to implement new technologies onto the transmission grid to allow a higher degree of utilisation with minimum new infrastructure needed. There is currently a project underway, as a pilot project for installing Dynamic Line Rating (DLR) on an 110kV overhead line circuit on the Irish Transmission Network.

Dynamic Line Ratings maximise the available current for a given overhead line by measuring in real-time thermal rating parameters and then providing a calculated current related to the lines design operating temperature. Therefore, static standard ratings will not be used to determine the lines available ampacity. DLR systems have a unique benefit of allowing a TSO to uprate an overhead line by availing of a conductor's current capacity without having to upgrade any of the structural elements of the line. In this way the cost to uprate an overhead line is low as construction costs are minimal (in comparison to other uprating methods) and outage times are also minimal. The DLR system is typically a line mounted device, as seen in Figure 1.

Figure 3. DLR System (Manufacturer Ampacimon.)

There are a variety of techniques to achieve DLR such as monitoring ambient temperature, wind speed and tension measurement systems, vibration measurement systems, and fibre optic measurement systems. Some manufacturers of such system provide a combination of such monitory techniques.

DLR is currently used by various transmission system operators, for example, Elia the TSO of Belgium; which at the moment has implemented DLR on more than 30 transmission lines feeding data into their day-to-day operation.

Conservative estimates suggest that circuit ratings can be increased by up to 30% with DLR. It is therefore anticipated that DLR could be very compatible for integrating wind generation given the correlation between wind output and higher circuit ratings.

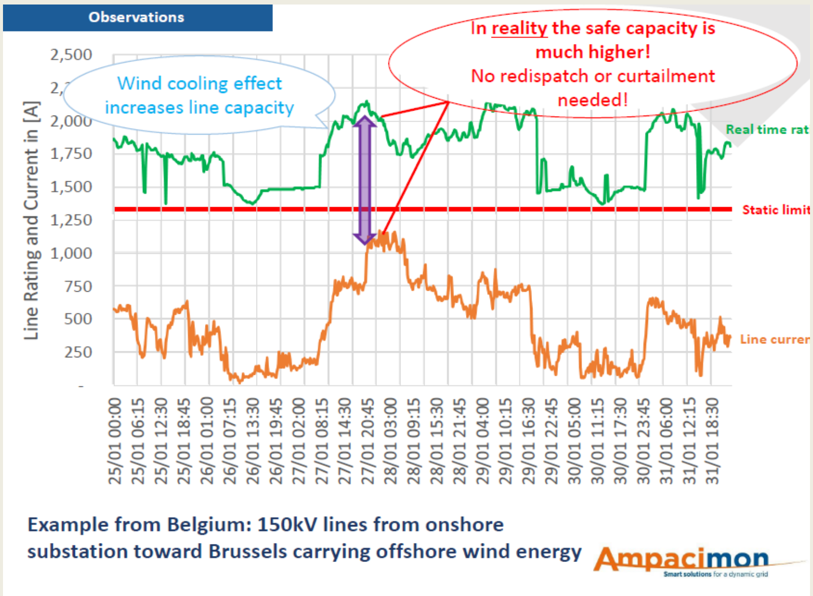

Figure 2. Differences between real-time DLR and Static Line Rating on Belgian Transmission Line. (Rena Kuwahata. Ampacimon 2020)

The above graph, Figure 2, is an example of a transmission line in Belgium and demonstrates the impact of wind cooling on an overhead line and also outlines the significant differences between using static limits and real-time monitoring via DLR.