**Paper 1:** **Optimal Transmission Congestion Management with V2G in**

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* The proposed method is tested on the IEEE 6 bus system and the results are presented. This simulation shows that although the presence of electric vehicles has **no significant effect on reducing or increasing of the operation cost** ***in smart grid*** and **may even reduce the operation cost *in a certain number of EVs***, due to their daily trips and shift from a bus to another bus, they act as a transmission line during the day and **reduce the line congestion**, resulting in a significant **reduction in the local marginal price (LMP) in the peak load hours**, and also **increasing the security of the power system** when the line capacity falls.
* Electric vehicles can be considered as loads and movable storage resources that are distributed in the entire power systems.
* The goal of this paper is to model electric vehicles with V2G technology in large scale as a distributed movable load, energy storage, and power generator and their effects on optimal operation with security constraints in power systems.

**2.3. Model of V2G in Unit Commitment Problem:**

To model the EVs, first, the cost function of each electrical vehicle fleet (V-fleet) is linearized, then the constraints that are used are explained. The cost function of the electrical vehicle fleet is presented as:

**(i) Sending and receiving energy constraint:** The net energy received by the EV can be expressed as the difference between discharge power, and the effective power charged in the battery where ƞ is the efficiency of the battery charging which is considered 85% in this paper.

**(ii) operating modes of EVs**

Three operating modes can be considered for the EVs, charge, discharge, and inactive. If one of the situations above happen, 0, becomes one while if it is zero it means the vechile is not

connected to the grid.

**(iii) Charge and discharge constraints**

To charge and discharge EVs, the charge/discharge power cannot exceed or be less than certain limits.

**(iv) The energy of EVs batteries constraint**

The energy of EVs batteries in a fleet and at a time can be express as The equation above shows the energy in the batteries of vth fleet at time t equals the difference in the available energy at the previous hour with the net exchanged energy at the current time and the energy at the time the vehicle is driven.

**(v) Battery capacity constraint**

The battery life of the EV depends heavily on the discharge level of the battery which means it must not fall below a limit.

* This obviously shows that moving the EVs in the grid reduces line congestion and **consequently reduces the LMPs(Local marginal price) of these buses from hours 10 and 18.**
* Moreover when EVs are present in the network while the congestion of lines increases, the movement of EVs creates less operation cost compared with they are not moving.
* The paper shows **how the smart grid controls the status of charging (SOC) of the EVs battery in 24 hours, in order to operate the network at a minimum cost, and also provide ample energy for the EVs in daily trips.**

**Paper 2: An improved vehicle to the grid method with battery longevity**

**management in a microgrid application**

**What’s been done in this:**

The methodology is improved in two ways. **Firstly, to give an accurate prediction of the available EV battery** capacity in the control time-step for the V2G service, the long short-term memory neural network is developed for the V2G scheduling. **Secondly, this study advances the V2G scheduling by adding the battery lifetime** model in the optimization.

* This paper proposed an improved vehicle-to-grid (V2G) scheduling approach for the frequency control with the advantage of protecting the batteries.
* it comes to the concept of vehicle-to-grid that effectively integrates the aggregated EVs into the microgrid as distributed energy resources to act as controllable generations or loads achieving the benefit of frequency regulating, voltage control, techno-economic operating, etc.
* The trade-off between the V2G service and the battery lifetime degradation is very difficult to reach. In addition, the objective function is usually not simple linear or quadratic, so the regular convex optimization method is not suitable in this case
* Compared with the previous method that without battery lifetime degradation consideration, the proposed method benefits in the reduction in charge/discharge cycles.
* Therefore, this study takes advantage of the real case of the microgrid in Belgium and builds the long-term V2G simulation model based on the real data in the yearly range.
* The V2G schedulable charging and discharging power based on the V2G service is used to train the prediction model. The LSTM algorithm then is used to obtain the V2G schedulable capacity.
* EVs are expected to fulfill main two functions as shown in Fig. 4. First, the EV battery should enable the high penetration of the renewable power as much as possible by mitigating the power fluctuations inside the microgrid. Second, the onboard batteries could also provide frequency response for the main grid by power exchange.
* The pooling-based neural network which could address the over-fitting issue, is used in this study to **make the prediction based on the historical data of the net power.**
* The battery lifetime prediction should meet two key requirements. First, the prediction should be fast enough. Second, the battery lifetime model should be able to quantify the battery lifetime reduction and renew the battery lifetime status to the EV consumer at the end time of daily V2G service.  
    
  The rain-flow cycle is used for the first
* introduced a Mile-to- Age function by which the battery aging effect during the driving mode is calculated based on the increased mileage [56].
* This paper proposed a new V2G scheduling method with the advantage of protecting the onboard battery from overused hence improved the battery lifetime during the V2G service.