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Simulation of EV Integration Into The Distribution Generation System For Active Power

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Abstract

Social and economic problems can be omitted but environmental problem cannot be ignored. Increased energy demand and its adverse effects has turned the attention towards renewable energy resources. This comes in the form of wind and solar sources providing clean safe and sustainable energy. But, due to their uncertain nature, it has a knacking of frequency fluctuation at the grid. Electric vehicle (EV) is connected to the microgrid (MG), the batteries provide the regulation for frequency. For its eradication, this research has focused on its regulation. Different techniques about regulation of frequency and its comparison with the optimal one has been discussed. Droop control method, Fuzzy logic (FLC), H∞ and Active power control method are studied. Modified harmony search algorithm (MHSA) is used to tune and calculate the parameters of fuzzy logic system. Modified Harmony search algorithm with Fuzzy logic system is used for regulation of active power.

Keywords: Microgrid, Electric vehicle, Modified Harmony Search Algorithm, Fuzzy Logic

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1. Introduction

Power system generation is transitioning from centralized to distributed energy generation for a safe and reliable power system [1]. This includes the installation/integration of renewable and conventional resources. In dispersed generation, the role of energy management is prominent where the role of micro and smart grids is critical[2]. Owing to the excessive integration of fluctuating natural renewable sources in the islanded microgrid, frequency variation is one of the key concerns of renewable resources system (RSS)[3]. We require an energy storage system (ESS) as an active power reserve for the microgrid to function effectively. As the concentration of electric vehicles (EV's) is growing daily, they are behaving as mobile energy storage units. With the consumption of batteries of EVs, we can regulate the frequency fluctuation of the islanded microgrid by the active power compensation through the discharging of battery storage of electric vehicles [4,5]. In this research work we study Safe, durable, and reliable power system (microgrid), Integration of renewable sources into the microgrid and Operation of batteries power of the electric vehicles (EV's).

2. Methodology

In charging network topology, two operations can be carried out on the flow of energy. One is V2g and the other is G2V.In G2V, when battery bank is needed to be charged then G2V allows charging the EV. It can be charged during the nighttime as it is the time when the demand on the grid is less and per unit cost is low [6].V2G permits selling of the energy from the EV back to the companies when charge is sufficed in the EV as shown in figure 1. It can be sold during the day when vehicle is at home as during the daytime demand on the grid is high along the per unit cost which is also high.V2G helps in regulation of the frequency in microgrid. U-grid comprises of four parts which are diesel generator for power balancing, solar, wind to deliver renewable energy.

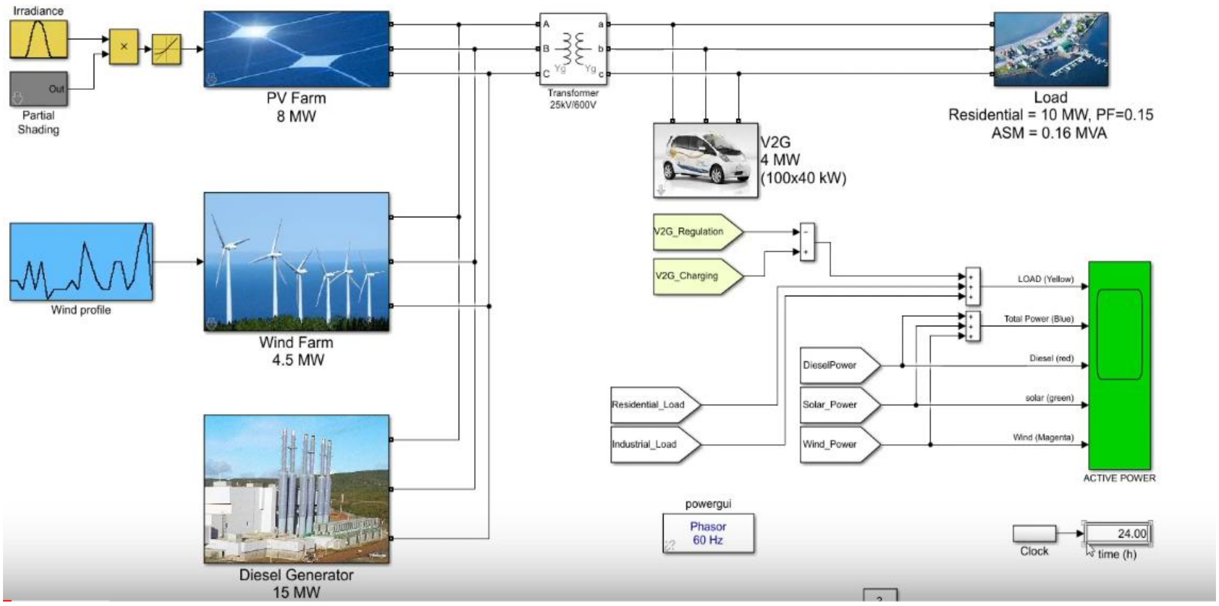

Fig 1: *Design and simulation of E-V2G.*

In the design of the proposed method, considerations have been made that have a prominent role in its practical implementation: -

i. The recommended novel adaptive robust control approach is effortless to execute and can be utilized to a relatively broad set of microgrids.

ii. The anticipated control signals are established just on the existing plant i/p and o/p info and can be determined on-line.

iii. The recommended procedure can be employed in various designs of microgrids, with numerous loads, renewable sources, and grid typologies.

iv. Further value of the intended control approach is its smooth load of calculations which is a crucial piece in the pragmatic operation and available control cases.

v. Embracing a new V2G method, the study uses EVs as a major BESS as a substitute to little batteries in an microgrids and uses the charging and discharging of the EVs through a load frequency control system from one side of the microgrid. Herewith, the senescence of the BESS and the requisite BESS capacity can be diminished to a huge degree.

vi. The study applies General Type 2 FLSs, instead of Type-1 FLSs since the erstwhile has the capability to cope with rule uncertainties unlike the latter whose membership tasks are type-1 fuzzy sets and are thereby unable to do so.

3. SIMULATION / RESULTS

To evaluate the efficiency of the proposed controller, the obtained results are compared with those of some of the latest approaches applied on this problem, including the proportional integral derivative (PID) controller, Fuzzy-PID (FPID) controller and Interval Type II fuzzy based PI (IT2FPI) controller and simulations are run on a personal computer Core i5, 2.4 GHz, with 8 GB RAM.

3.1 OPID VS OFPID VS OGT2FLC

Performance of the controller was examined when load is varied. Grid at the start of the simulation is at steady state with no load. The wind speed and other parameters are given i.e., Pw = 0. Sudden load of 50 MW or PL = 0.02 pu, rated power = 250 MW, speed regulation = 0.05 pu, load variation = 0.08, applied at t = 15 s). we will apply the three techniques and evaluate how these react to the load changes under different conditions, how the frequency deviation will happen using OPID, OFPID and OGT2FLC.

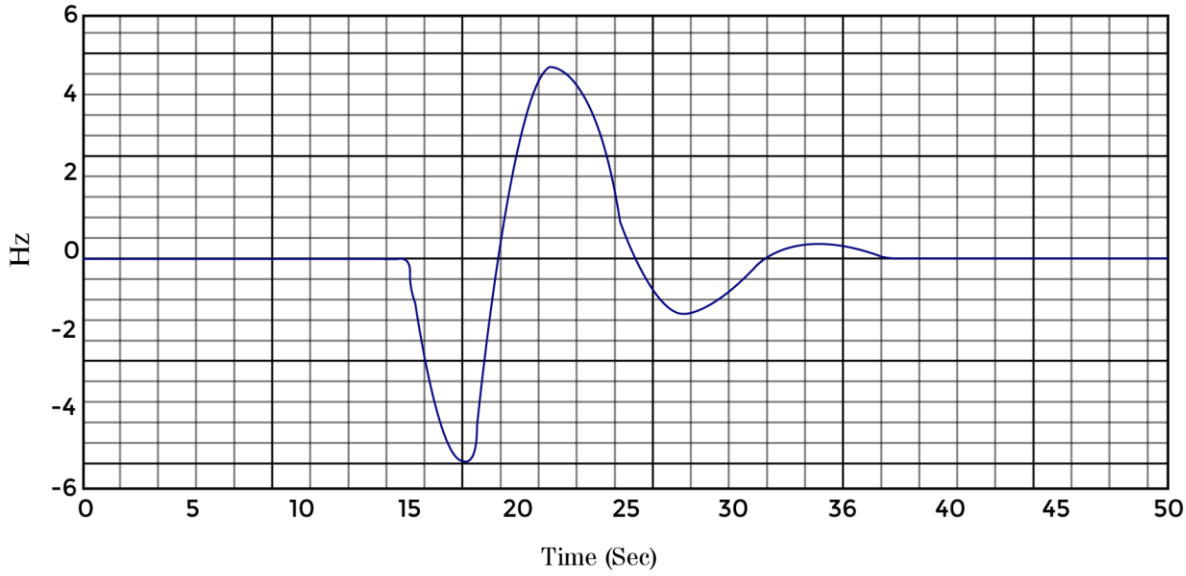

Fig 2*: Frequency deviation using OPID method*

3.2 Frequency Deviation for WPGS using different techniques

Wind power source was added Pw and applied to the system. It is noted that the load is taken constant for understanding purpose. The wind source fluctuation is due to the uncertainty of the weather conditions especially the speed of the wind or breeze. The wind fluctuation is shown in the figures 4.Again, comparing the results implies the method OGT2FLC can substantially improve the performance of the load frequency control particularly when overshoots are involved. In the fig 5. It can be understood from the simulation results that when electric vehicles are considered then OGT2FLC method is not only efficient but also does not permit fluctuations of the frequency and outworks the other processes when damping is involved [8,9,10].

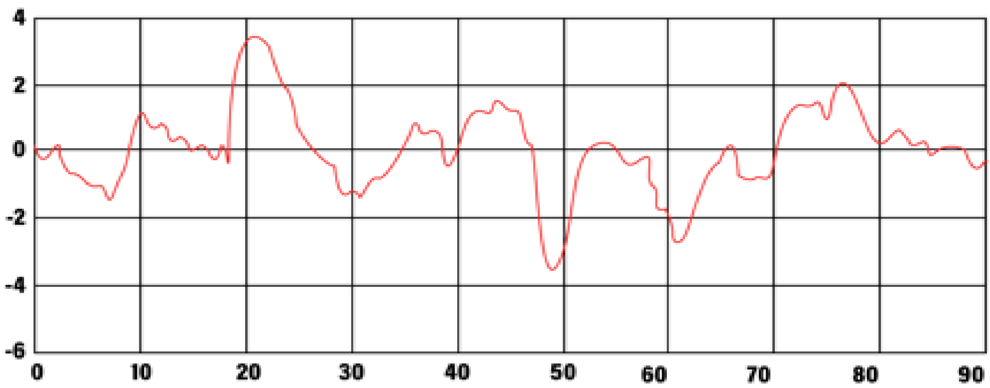

Fig 3: *Frequency deviation for wind using OPID*

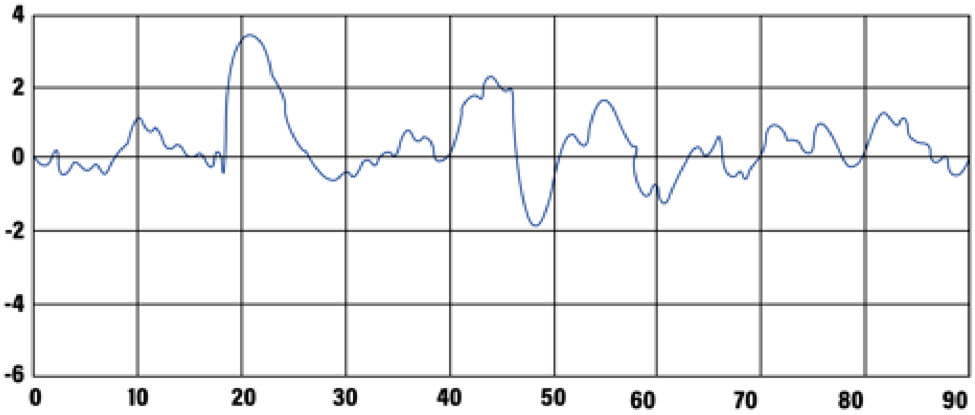

Fig 4: *Frequency deviation for wind using OFPID*

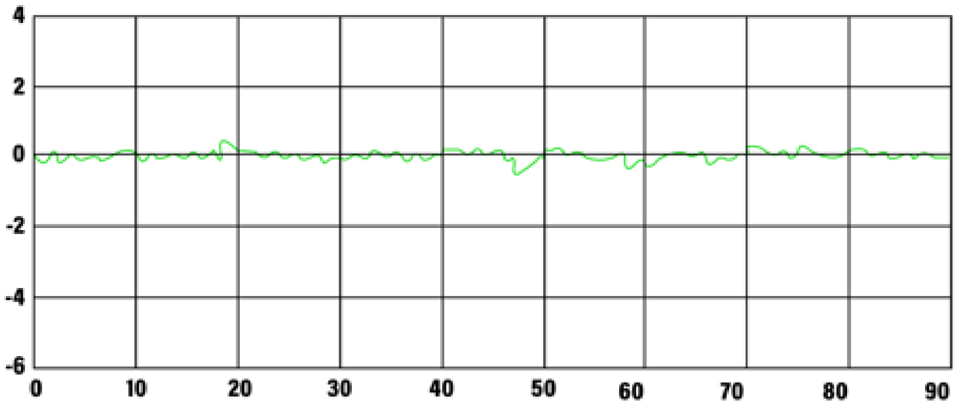

Fig 5: *Frequency deviation for wind using OGT2FPI (Least damping)*

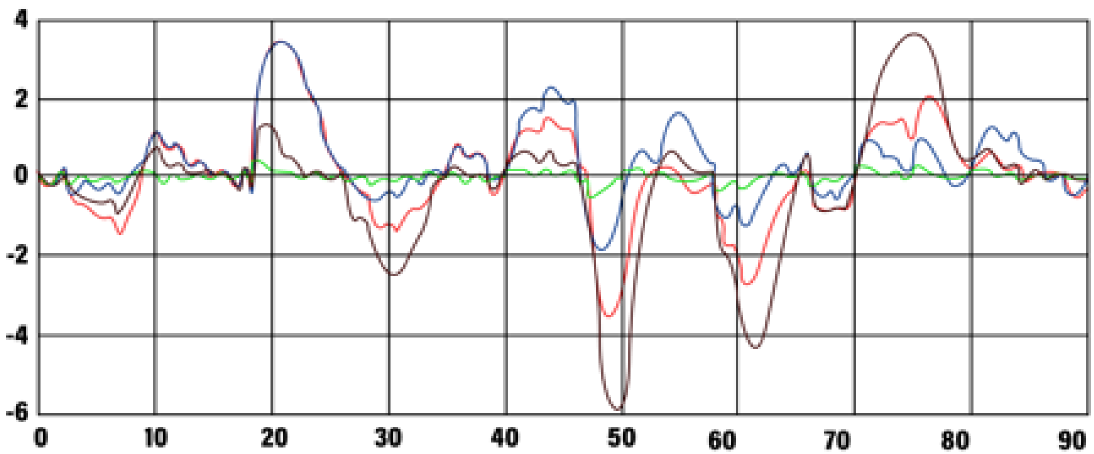

Fig 6: *Frequency deviation with Wind power generation*

Simulations are performed on a model to analyze the impact of V2G and WPGS in different cases. The cases are compared with the basic condition of deviation in both areas without V2G and WPGS. Case 1 results are shown where frequency deviation in area-1 with V2G, with WPGS, and both are represented, respectively. Results obtained are using MATLAB/Simulink. Similar cases are simulated to observe deviation. Communication channels between AGC and EVs are simplified and designed as an aggregated EVs model for secondary frequency control.

The State of Charge (SOC) of electric vehicles is noted at every instant to have the correct accumulated capacity of all available EVs for frequency regulation. Therefore, EVs are basically used as reserve capacity to cater at the time of sudden demand in power system, and this would be the case in peak hours during a load cycle. The inputs are controller output and change in frequency to the aggregated model of EVs for V2G.The prime purpose of having EVs grouped together is that they represent a virtual large energy storage plant with a sufficient capacity to support AGC at the time of peak demand or sudden demand during power supply at any other time.

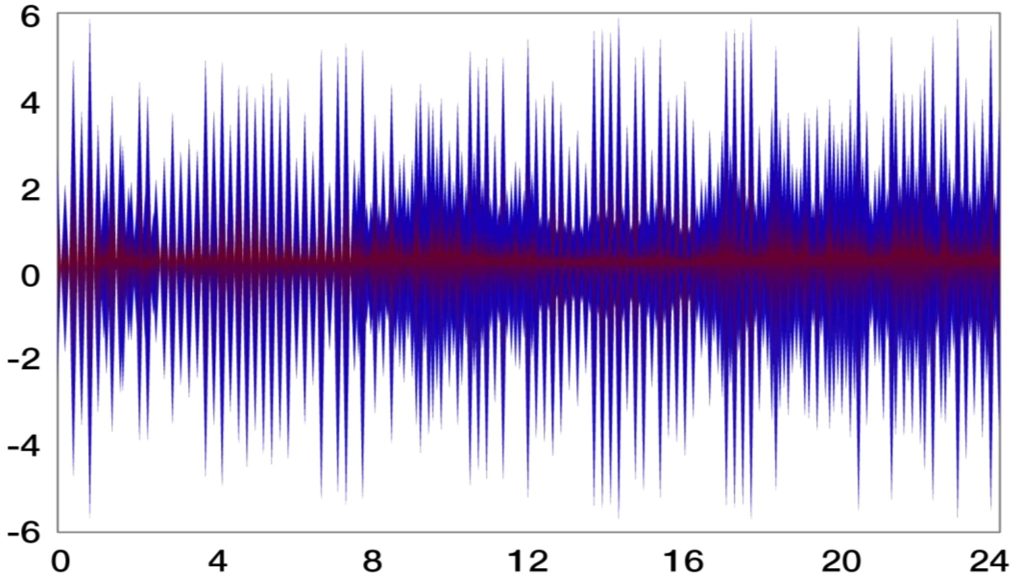

Fig 7: *Frequency deviation with only V2G and WPGS*
Blue: Without wind and EV, Maroon: With EV and Wind source

4. Conclusion

Frequency stability control in a working isolated grid is an obvious issue. This research focused on a method for regulating the frequency fluctuation in an efficacious way. The examination was carried out on the integration of electric vehicle batteries in a microgrid for stabilization of frequency. Various parts used in the simulation and programming were assembled in Power Factory, Simulink, MATLAB, and Verilog. When load changes then V2G ensures swift and instant stabilization by emphatically charging and discharging the Electric vehicle batteries. By reduced system inertia, frequency fluctuations are overwhelmed in wind-based grids often. Thus, V2G is proving a smart and suitable alternative to traditional power generation sources.

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