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AN ADAPTIVE TECHNIQUE FOR GRID FREQUENCY CONTROL WITH RENEWABLE ENERGY SOURCES AND EV CHARGING CONTROLS

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ABSTRACT

The use of electronic cars (EVs) has grown in recent years as a result of the rising cost of natural fuels, their depleting resources, and environmental contamination. New demands have been placed on electricity networks by EV charging. Along with the liberalization of power systems, which adds new grid risks, these new and significant burdens have created new difficulties for the frequency management and security of power systems. One approach to solving this issue is to use electric vehicles as mobile storage. This technique regulates EV charging and, when required, discharges EV batteries into the grid. This idea is known as "vehicle to grid." (V2G). In this study, the V2G idea is used to manage a clever unregulated grid frequency. Artificial neural network controller is implemented in this project ton enhance the performance and to reduce the deviations in the frequency regulation loop A three layer neural network is implemented in the system to reduce the fluctuations in the frequency loop

INTRODUCTION

Renewable energy sources are becoming an increasingly important part of the energy system as a direct result of global concerns such as climate change, energy security, and environmental degradation. A significant number of nations' policies at the national level have established lofty goals for the development of renewable energy sources. It has been determined that the European Union (EU) should aim to generate 35% of its electricity from renewable sources by the year 2020 [1]. At this time, renewable energy accounts for 14% of the total energy supply across the globe [2, 3]. The output powers of some of these resources are dependent on the conditions of the surrounding environment and shift during the day. Including a significant amount of variable generation into the operation and control of the power system has a number of significant effects, one of which is on frequency control. As a result of the unpredictability that is brought into the

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power system by renewable energy sources, a greater amount of spinning reserve is required to compensate for the imbalance between generation and demand. Batteries can be employed inplace of other types of storage systems to make up for this kind of imbalance.

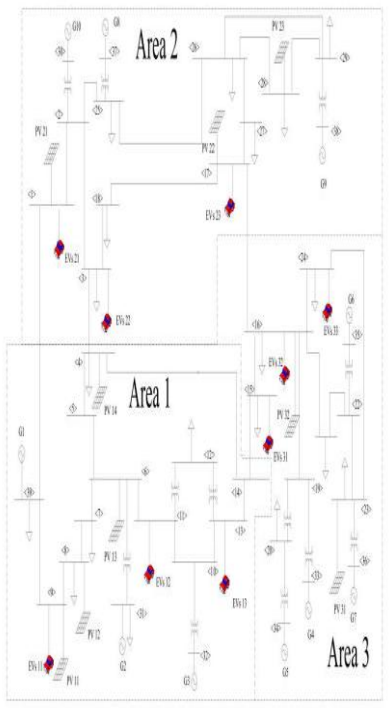

Fig 1 Proposed circuit topology

Yet, the high cost of batteries is one of the challenges that this system faces. In addition to the uncertainties discussed above, new uncertainties have been brought into power systems as a result of the transformation of traditional power systems into deregulated power systems in the early decades of this century. Generation, transmission, and distribution are all owned by the same company in a conventional power system. This company is known as a vertically integrated utility (VIU), and it sells electricity to customers at prices that are regulated by the government. It is up to the discretion of the generation firms, often known as Gencos, to take part in the LFC job in an open energy market. On the other hand, a distribution company (Disco) may contract independently with a generator company (Genco) or an independent power producer (IPP) for the supply of electricity in various regions [4]. Hence, frequency regulation is more difficult in a power system that has been deregulated. Over the past few years, electric vehicles (EVs) have seen a resurgence in interest in the research and manufacturing communities all around the world. The ability of electric vehicles to provide transportation that is free of

pollution and emissions is one of the primary factors that is driving the push for their further adoption [1]. This is a requirement that must be met if the world is to have a sustainable future. According to, the percentage of electric vehicles in use in the United States will reach 35% in the year 2020, 51% in the year 2030, and 62% in the year 2050, respectively. The International Energy Agency (IEA) has forecasted that the sales of passenger light-duty EVs and plug-in hybrid EVs will increase beginning in 2020 and could reach more than 100 million EVs and plug-in hybrid EVs sold per year worldwide by 2050 [1]. A significant amount of load is being placed on the grid as a result of the charging of so many plug-in electric vehicles. Due to the presence of this significant load, the frequency regulation and stability of the power system are subject to additional issues.

The suggested technique involves filling or draining batteries while taking grid cadence and battery state of charge into consideration. To explore the suggested method, an adapted IEEE 39- bus system in the presence of sustainable energy supplies is considered. For the frequency study, this system is then changed into a three-area system. In a separate section of the report, the effectiveness of the suggested technique for fueling EVs is examined. Simulations are run in the MATLAB/SIMULINK environment, and the findings show that the suggested approach performs well for both EV charging and frequency management of unregulated systems.

The conversion of solar radiation occurs by the photovoltaic effect which was first observed by Becquerel. It is quite generally defined as the emergence of an electric voltage between two electrodes attached to a solid or liquid system upon shining light onto this system. Energy conversion devices which are used to convert sunlight to electricity by the use of the photo-voltaic effect are called solar cells. Single converter cell is called a solar cell or more generally photovoltaic cell and combination of such cells designed to increase the electric power output is called a solar module or solar array and hence the name 'Photovoltaic Arrays'. Solar cells can be arranged into large groupings called arrays. These arrays, composed of many thousands of individual cells, can function as central electric power stations, converting sunlight into electrical energy for distribution to industrial, commercial and residential users. Solar cells in much smaller configurations are commonly referred to as solar cell panels or simply panels. Practically, all photovoltaic devices incorporate a P-N junction in a semiconductor across which the photo voltage is developed. The solar panels consist mainly of semiconductor material, with Silicon being most commonly used.

The cell's short circuit current intersects the Y-axis at point B and the open circuit voltage intersects the X-axis at point C. To achieve maximum energy transfer, systems powered by solar cells should be designed to transfer energy to the load at point A on the I-V curve. No energy should be delivered at points B and C, and most of the energy should be delivered as the operating point approaches point A. In a solar panel array, it is even more important that load impedance and source impedance are well matched. Once the cells are matched by their I-V characteristics, they can be grouped into individual arrays and each array is then made to operate at its maximum energy transfer point.

The Membership Function Editor is used to define the shapes of all the membership

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functions associated with each variable. The Rule Editor is for editing the list of rules that defines the behavior of the system.

The Rule Viewer and the Surface Viewer are used for looking at, as opposed to editing, the FIS. They are strictly read-only tools. The Rule Viewer is a matlab-based display of the fuzzy inference diagram shown at the end of the last section. Used as a diagnostic, it can show (for example) which rules are active, or how individual membership function shapes are influencing the results. The Surface Viewer is used to display the dependency of one of the outputs on any one or two of the inputs that is, it generates and plots an output surface map for the system.

The five primary GUIs can all interact and exchange information. Any one of them can read and write both to the workspace and to the disk (the read-only viewers can still exchange plots with the workspace and/or the disk). For any fuzzy inference system, any or all of these five GUIs may be open. If more than one of these editors is open for a single system, the various GUI windows are aware of the existence of the others, and will, if necessary, update related windows. Thus if the names of the membership functions are changed using the Membership FunctionEditor, those changes are reflected in the rules shown in the Rule Editor. The editors for any number of different FIS systems may be open simultaneously. The FIS Editor, the Membership Function Editor, and the Rule Editor can all read and modify the FIS data, but the Rule Viewer and the Surface Viewer do not modify the FIS data in any way.

The Rule Viewer displays a roadmap of the whole fuzzy inference process. It's based on the fuzzy inference diagram described in the previous section. You see a single figure window as shown in fig.10 with 10 small plots nested in it. The three small plots across the top of the figure represent the antecedent and consequent of the first rule. Each rule is a row of plots, and each column is a variable. The first two columns of plots (the six yellow plots) show the membership functions referenced by the antecedent, or the if-part of each rule. The third column of plots (the three blue plots) shows the membership functions referenced by the consequent, or the then-partof each rule. If you click once on a rule number, the corresponding rule will be displayed at the bottom of the figure. Notice that under food, there is a plot which is blank. This corresponds to the characterization of none for the variable food in the second rule. The fourth plot in the third column of plots represents the aggregate weighted decision for the given inference system. This decision will depend on the input values for the system.

There are also the now familiar items like the status line and the menu bar. In the lower right there is a text field into which you can enter specific input values. For the

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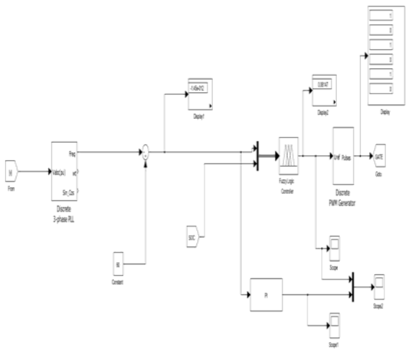
two-input system, you will enter an input vector, [9 8], for example, and then click on input. You can also adjust these input values by clicking anywhere on any of the three plots for each input. This will move the red index line horizontally, to the point where you have clicked. You can also just click and drag this line in order to change the input values. When you release the line, (or after manually specifying the input), a new calculation is performed, and you can see the whole fuzzy inference process take place. Where the index line representing service crosses the membership function



line "service is poor" in the upper left plot will determine the degree to which rule one is activated. A yellow patch of color under the actual membership function curve is used to make the fuzzy membership value visually apparent. Each of the characterizations of each of the variables is specified with respect to the input index line in this manner. If we follow rule 1 across the top of the diagram, we can see the consequent "tip is cheap" has been truncated to exactly the same degree as the (composite) antecedent--this is the implication process in action. The aggregation occurs down the third column, and the resultant aggregate plot is shown in the single plot to be found in the lower right corner of the plot field. The de-fuzzyfied output value is shown by the thick line passing through the aggregate fuzzy set.

The Rule Viewer allows you to interpret the entire fuzzy inference process at once. The Rule Viewer also shows how the shape of certain membership functions influences the overall result. Since it plots every part of every rule, it can become unwieldy for particularly large systems, but, for a relatively small number of inputs and outputs, it performs well (depending on how much screen space you devote to it) with up to 30 rules and as many as 6 or 7 variables.

The Rule Viewer shows one calculation at a time and in great detail. In this sense, it

Fig1. simulation circuit

presents a sort of micro view of the fuzzy inference system. If you want to see the entire output surface of your system, that is, the entire span of the output set based on the entire span of the input set, you need to open up the Surface Viewer.

SIMULATION CIRCUIT

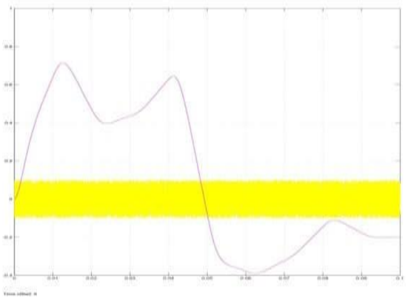


Fig 2. Frequency of the system

CONCLUSION

In this paper, in order to grid frequency control in the presence of EVs in a smart deregulated power system, a new V2G method was proposed. In this method, EVs are controlled by an optimized fuzzy logic controller. Two variables of SOC of batteries and grid frequency deviation are considered as inputs of optimized fuzzy controller. With respect to these inputs and the considered membership functions and fuzzy rules, charge or discharge power of EVs is determined. To investigate the proposed controller in control of grid frequency, deregulated

modified IEEE 39-bus system in the presence of EV charging stations and solar energies was assumed. For frequency analysis, this system was converted into a three area system. Simulations were carried out in MATLAB/SIMULINK environment. The results of the simulations illustrated that by using the proposed method, frequency and tie line power deviations of system were reduced considerably. To make a comparison, the proposed method was compared with the V2G controller of Ref. It was illustrated that the proposed method had better performance in the control of frequency deviations than V2G controller of Ref. [8]. In another section of the paper, performance of the proposed controller in control of SOC of batteries in steady state was discussed. It was shown that, by applying step load in all the areas, EVs batteries with the initial SOC of higher than 50% began to discharge, batteries with the initial SOCof less than 50% began to charge, and EVs with the initial SOC equaling 50% had no significant change. To verify the performance of the proposed method for the charging of EVs with different desired final SOCs, a two area system was considered and it was shown that attaining the desired final SOCs can be possible by employing different fuzzy rules. Moreover, the proposed method was compared with an optimized PI controller in terms of charging EVs. For this case, a two area system was considered with EVs with different initial SOCs. It was illustrated that the proposed method could control the SOC of EVs batteries properly, while the optimized PI controller could not.

REFERENCES

[1] J. R. Pillai, “Electric vehicle based battery storages for large scale wind power integration in Denmark,” Ph.D. dissertation, Dept. Energy Technol., Univ. Aalborg, Aalborg, Denmark, Dec. 2010.

[2] A. Dán, C. Farkas, and L. Prikler, “V2G effects on frequency regulation and under-

ISSN2454-9940
www.ijsem.org
Vol 11, Issuse.2 May 2019

frequency load shedding in a quasi-islanded grid," in Proc. IEEE Grenoble PowerTech, 2013, pp. 1–6.

[3] R. Garcia-Valle and J. A. P. Lopes, Electric Vehicle Integration into Modern Power Networks. New York, NY, USA: Springer, 2013.

[4] H. Bevrani, Robust Power System Frequency Control, 1st ed. New York, NY, USA: Springer, 2009.

[5] W. Kempton and S. E. Letendre, "Electric vehicles as a new power source for electric utilities," Transp. Res. D. Transp. Environ., vol. 2, no. 3, pp. 157–175, Sep. 1997.

[6] W. Kempton and J. Tomic, "Vehicle-to-grid power fundamentals: ´ Calculating capacity and net revenue," J. Power Sources, vol. 144, no. 1, pp. 268–279, Jun. 2005.

[7] Y. Ota et al., "Autonomous distributed V2G (vehicle-to-grid) satisfying scheduled charging," IEEE Trans. Smart Grid, vol. 3, no. 1, pp. 559–564, Mar. 2012.

[8] A. Micallef, M. Apap,and J. M. Guerrero, "Singlephase microgrid with seamless transition capabilities between modesof operation," IEEE Trans. Smart Grid, vol. 6, no. 6, pp. 2736– 2745, Nov. 2015.

[9] J. Chan, J.Milanovic, and A. Delahunty, "Generic failure-risk assessment of industrial processes due tovoltage sags," IEEE Trans. Power Del., vol. 24, no. 4, pp. 2405–2414, Oct. 2009.

[10] P.Prasanna, E. Mohammad, K. G. Masoud, A. K. Sayed, "Fault Ride-Through Capability ofVoltage-Controlled Inverters," IEEE Transactions on Ind. Electron., vol. 65, no. 10, pp. 7933-7943, Oct. 2018.

[11] J. A. Laghari, H. Mokhlis, M. Karimi, A. H. A. Bakar, and H. Mohamad,"Computational intelligence based techniques for islanding detection of distributed generation indistributionnetwork:Areview,"EnergyConvers.Manag.,vol.88,pp.139–152,Dec.2014.

[12] W. Wan, M. A. Bragin, B. Yan, Y. Qin, et al, "Distributed and Asynchronous Active FaultManagement for Networked Microgrids," IEEE Trans. Power System, vol. 35, no. 5, pp. 3857-3868, Sep. 2020.

[13] A. Camacho, M. Castilla, J. Miret,

[14] W.F. Wan, Y. Li, B. Yan, et al., "Active Fault Management for Microgrids,"AnnualConferenceoftheIEEE IndustrialElectronicsSociety(IECON),pp.1-6,2018.

[15]S.A.Gopalan,V.Sreeram,H.H.C.Iu,"Areviewofcoordinationstrategiesandprotectionschemes for microgrids," Renewable and Sustainable Energy Reviews, vol. 32, pp. 222-228,April2014.

[16]R.Li,L.Xu,Y.Yao,"DCFaultDetectionandLocationinMeshedMultiterminal HVDC SystemsBased on DC Reactor Voltage Change Rate," IEEE Trans. PowerDel.,vol.32, no. 3, pp. 1516–1526,

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