Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

An In-depth Examination of Diverse Industrial Loads and their Impact on a Solar-based Microgrid

By Niloy Sarker, Md Kabiruzzaman & Md Kabiruzzaman

Abstract- Micro grids are expanding and mechanical increases are being introduced, costs decreased, participation seen and advantages recognized in industry sectors, banks and pilot exhibition venues. They are employed to enhance the stability and power of intensity frames, and to cope with increasing renewable, transmitted utilities like the age of wind and sunlight, in places that lack an electrical grid, to mitigate petroleum emissions or electricity. In todays world solar is an important source of renewable energy .In industrial revolution all the countries try to use their existing resource as much efficiently .this paper about the efficient use of solar as a renewable energy and how industrial load behave against the system that proposed. As try to implement maximum power from the photo voltaic cell here use perturb and observe method for constant output.

Keywords: *microgrid, industrial load, ANN.*

GJRE-F Classification: *DDC Code: 332.1 LCC Code: HG1601*

ANINDEPTHEXAMINATIONOFDIVERSEINDUSTRIALLOADSANDTHEIRIMPACTONASOLARBASEDMICROGRID

Strictly as per the compliance and regulations of:

An In-depth Examination of Diverse Industrial Loads and their Impact on a Solar-based Microgrid

Niloy Sarker [α], Md Kabiruzzaman [σ] & Md Kabiruzzaman [ρ]

Abstract- Micro grids are expanding and mechanical increases are being introduced, costs decreased, participation seen and advantages recognized in industry sectors, banks and pilot exhibition venues. They are employed to enhance the stability and power of intensity frames, and to cope with increasing renewable, transmitted utilities like the age of wind and sunlight, in places that lack an electrical grid, to mitigate petroleum emissions or electricity. In todays world solar is an important source of renewable energy. In industrial revolution all the countries try to use their existing resource as much efficiently .this paper about the efficient use of solar as a renewable energy and how industrial load behave against the system that proposed. As try to implement maximum power from the photo voltaic cell here use perturb and observe method for constant output.

Keywords: microgrid, industrial load, ANN.

I. Introduction

This due to greenhouse gas pollution and the scarcity of infrastructure, energy related problems were an issue. While the use of non-renewable electricity is environmental, the use of grids still has its own drawbacks, given that these power grids are both important and time-consuming. The worldwide alternative solution is generally agreed to use solar energy from the smaller, stand alone version of electrical systems known as Micro grid Systems (MG). Micro grids may be preconstructed and set up immediately in communities with a lower environmental impact. Recently the high energy demand, increase in natural strategy, and worldwide dispersion have drawn significant interest from other energy sources. Environmental shifts are responsible for significant variations in electricity generation and demand configuration. The objective was set by various nations to reduce greenhouse gas by 2025. Natural problems led to more sound energy sources, such as PV systems, wind turbines and fuel cells. Certain energy sources, such as changes in sunlight and temperature radiation in photovoltaic systems, depend directly on the environment. The supplied electricity from these sources fluctuates, reversing the main grid. A sharper and sharper frame like a microgrid is the best way to defend this challenge. When power supply outlets are available for local loads, a microgrid operates in island mode. If there is not a main grid supply, a microgrid can also act as a backup power. A standard link point is used to define the relationship between the microgrid and the grid. PV and fuel cells also produce DC, while the infrastructure of the exciting power generation system depends.

Identify applicable funding agency here. If none, delete this. On alternative Current (AC). When these renewable energy systems have been incorporated into the existing configuration, voltage must be converted by using AC converters that require further transition steps leading to an increased loss of power, which will reduce the framework's overall ability. In actual fact, several DC loads such as PCs, servers, cell phones, TVs etc. have to be transferred to DC in order to bear additional losses.

In conventional dc micro grid system there generate electricity by pv fed system and distribute the power in their connected load. In this concept generation is not depends on connected load. When a system various the load the system will change the output of generation power.

Traditionally all the concern about control the micro grid system and its function. From that it has been seen that some stabilized system comes.but its now a concern factor how a stable algorithm work against some variation of heavy load in dc connected system.

The Contribution of that paper is introducing a solar model for stabilizing a standalone dc microgrid against various single load. Where grid is connected with some loads and see the performance is stable or not .besides it also done the issue if any fault happened in the grid connection.

This section shows a standalone DC solar pv microgrid system. A PV system with gradual conductance of MPPT, a DC-DC boost converter, a bidirectional DC-DC converter and controller and a battery bench are included. The proposed system The proposed converter decreases part failure and increases overall system performance. The whole scheme is shown in a simple diagram and built and implemented in Matlab/Simulink.

Author α σ ρ: e-mail: engrniloysarker@gmail.com

II. Solar Pv Technology

Solar cells, also called photovoltaic cells, are a renewable energy technology which turns sunlight into power directly. A semi-directed material with at least a positive and a negative layer (mostly silicone) is developed to absorb the light photons. Electrical current can be produced by sending electrons from the negative layer to the positive layer. A PV cell generating approximately 1 to 2 watts of power is typically small. They are attached to large units named modules or panels in series or parallel to optimize the energy output of photovoltaic cells. A range of 60, 72 or 96 cell PV units is available in PV modules are: multi crystalline/monocrystalline, thin film, organic PV, and photovoltaic. A dilated solar cell is generated by placing thin layers on a substrate like glass, plastics or CdTe metal or copper indium gallium selenide (CIGS). The silicone crystalline cells consist of silicone atoms bound to them, and form a crystal lattice. This organized grid makes it possible to turn light into electricity more efficiently. An organic solar cell or plastic solar cell is a form of pv composed of carbon rich polymers with organs to absorb light and transport energy from sunlight. Crystalline technologies that cost less for a long life, while the thin film does not have shadow sensitivity, give the most conversion effectiveness). Polymer solar cells can produce electricity with reduced quality, technically disposable and affordable production, which is molecularly adjustable, or possibly less detrimental to the environment in contrast with crystalline silicone and film. The method of silicone purity makes multi crystalline PV panels less efficient than monocrystalline PV panels: "The more silicone molecules align, the more energy is transformed by the solar cells". Sunlight was converted to dc energy by solar cells. Sun power is produced by the solar photovoltaic cell. The solar or photons become electric power as panels of photovoltaic systems become apparent at dawn. The PV array is a parallel and sequential mixture of photovoltaic cells. The sun/solar energy can quickly be increased by this cluster as the temperature variations shift. PV systems are composite with a DC-DC panel MPPT algorithm that increases PV voltage to rated voltage and, finally, links the inverters to charges.

a) Pv Modeling

To generate energy from solar, the PV arrays use a series of P-N junction diodes. To depict a solar cell, a single diode circuit model with a PV and a diode with series-parallel resistance is the simplest and most widely used. In order to distinguish the I-V and P-V characteristic curves, a diode is used. Poor design or manufacturing flaws might result in a diode with a lower P-V or I-V output. To create current, a shunt diode resistance is linked in series with a diode. The PV module's output current is shown.

$$
\begin{aligned}
I_{PV} &= N_{pc}I_{pc} - N_{pc}I_{rsc} \\
&\quad \times \left[\exp\left(\left\langle \frac{q}{F_c k T_s}\right\rangle \left\langle \frac{V_{PV}}{N_{sc}} + I_{PV}R_{\text{series}}\right\rangle\right)\right], \\
I_{pc} &= \left(I_{scc} + k_{tc}\langle T_s - T_{ref}\rangle\right) \times \frac{S_{rr}}{1000}, \\
I_{rsc} &= I_{T_{ref}}\left(\frac{T_s}{T_{ref}}\right)\exp\left(\left\langle\frac{qE_{bg}}{kF_c}\right\rangle \times \left\langle\frac{1}{T_{ref}} - \frac{1}{T_s}\right\rangle\right)
\end{aligned} \quad (1)
$$

Table 1 shows the notations and calculated parameters of the PV system. Therefore, these values are calculated by utilizing real-world criteria so that the researched photovoltaic system may function in a realistic setting.

Table 1: Model parameter for PV module

Description	Symbol	Value
Npc	Number of parallel cells	10
Nsc	Number of series cells	40
Ipc	Photocurrent	—
Irsc	Reverse saturation current	—
q	Charge of an electron	1.602 × 10−19C
Fc	Ideality constant	1.5
k	Boltzman constant	1.38 × 10−23K
Ts	Surface temperature	350 K
Rseries	Series resistance of PV cells	—
Rparallel	Parallel resistance of PV cells	—
Iscc	Short-circuit (SC) current	3.27A
Ktc	Temperature coeff of SC current	$1.7e^{-3}$
Tref	Reference temperature	301.18K
Srr	Solar radiation range	0
ITref	Reverse saturation current at Tref	$2.0793e^{-}6$A

III. Concept of Microgrid

A small grid system can run free of charge or with the country's main power grid. The microgrid is a small enclosed plant with energy, power supply and loads and measurable minimum limits. It is an important step for microgrid desirability to ensure that advanced renewables often work more directly at their source rather than connected to the main electricity grid. The ideal example is a PV unit.

Today, more houses and buildings are linked to solar power grid frames in the tiny community which can only serve one property. Moreover, as solar engineering decreases in cost and becomes more viable, a few characteristics can actually be advantaged through a smaller scale economy: simple solar cells in usable areas can

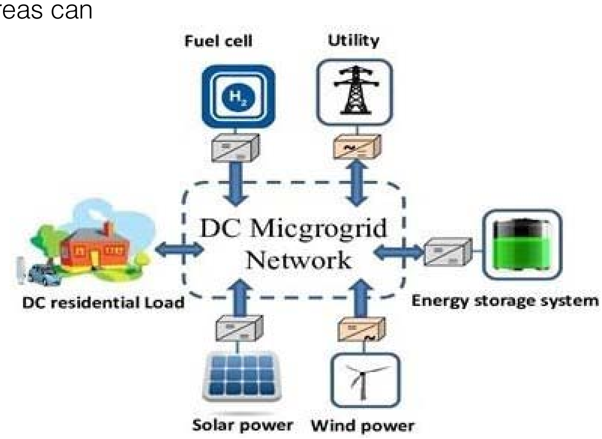

Fig. 1: Schematic of a conventional microgrid system

take free, ordinary sunshine and change it to electric power to operate particular machinery or warming and cooling frameworks. A small grid which successfully manages the electricity exchange between connected charges and remote generation sources such as photovoltaic systems is called a microgrid. Micro grids can be provided as backup power supply or service to the main grid in mid-20 cycles of significant demand. As a way of consolidating sustainability, microgrids often provide multiple energy sources. Different objectives include reducing costs and improving reliability. Two essential forms are the DC microgrid and the AC microgrid.

a) DC Micrgrid

A local power grid is a microgrid that provides a small community with a central generator with power. The company will provide power from renewable sources including solar, wind and hydro. A microgrid may be connected to a conventional grid or operate independently in a so-called isolated mode. Different configurations are available based on the power used (AC or DC voltage). The DC-microgrid provides many advantages over traditional AC grids, including lower conversion losses, cheaper electronics, better power performance and reliability. Several modules, including inverters, battery storage and converters, are used to connect the microgrids to renewable energy sources. After local usage excess power can be sold on the grid. The efficiency of a PV system can be increased by combining buildings with different load profiles. Furthermore, solar cells in different solar angles can be changed by the PV generation.

IV. MPPT

A few solutions were proposed for dealing with the issue of poor output of the PV system, including a second recommendation on high power point monitoring (MPPT). The two MPPT techniques are designed to maximize PV output by controlling the optimum power working conditions. Various methods have been developed, such as Perturb and Observe (PO), gradual conduct (IC), liquid logic, etc. The most popular formulas are the PO and IC algorithms. The PofO algorithm, however, varies from the maximal power point (MPP) and thus deteriorates considerably in its efficient execution.

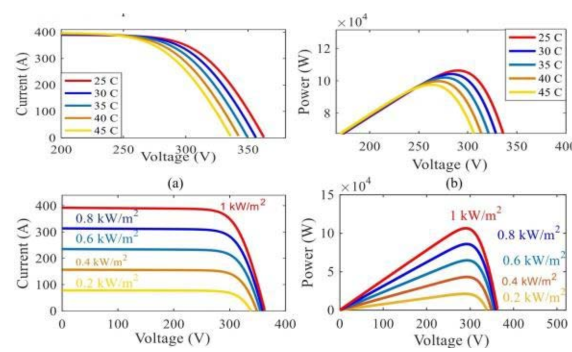

Fig. 2: (a) I-V, and (b) P-V characteristics curve for different temperature level and (c) I-V, and (d) P-V characteristics curve for different irradiance[6]

Table 2: Qualitative comparison between the ANN, IC and PO based MPPT

Reason	P&O	IC	ANN
Convergence Speed	Average	Low	High
Support Scalability	No	No	Yes
Oscillation around MPP	Yes	Yes	No
Reliability under partial shedding conditions	Low	Medium	High
Algorithm complexity	Medium	Medium	Low
Drifting problem	Yes	No	No

a) Perturb and Observe Method

This technique is one of the easiest online approaches found by many researchers. PO may be performed using reference voltage disturbances or the current reference solar panel signal. MPPT is widely used for the P and O solution. It uses a panel voltage V and the panel current I as the output value for the desired a micro processors as input values. The PWM Input Vector d in dc-to-dc conversion can also be directly monitored with the microprocessor. This eliminates the feedback loop for additional voltage control. Any MPPT loop with a microprocessor algorithm disturbs the working voltage V. V bounces around the optimum Vmp voltage as the MPP is reached. This causes a lack of control according to the phase gap of a single disruption. If the step width is high, the MPPT algorithm quickly responds to sudden changes in operating conditions by compensating increased loads under constant or constantly shifting conditions. If the phase width is very small, losses can be reduced in the course of a steady or gradual transition, but only very slowly can the system react to abrupt changes in temperature. The procedure is measured experimentally and depending on the value of the optimized stage width. If the system swings around the MPP, it can be found that an ongoing disturbance in one direction leads to a distance from the actual MPP. This procedure goes on until sunrise rises or ends.

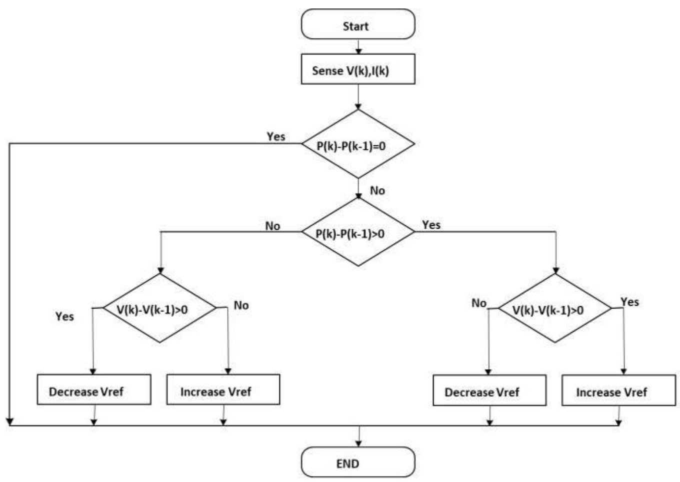

Fig. 3: Flow chart perturb and observe method

b) *Artificial Neural Network Method*

In technology, an artificial neural network is a model that simulates the biological neural network For instance, one neuron evaluates inputs linearly before using a nonlinear activation function (AF) to add them up and sending the findings to the next neuron. Basic to the ANN is a directed graph where the nodes and edges are the neurons and synapses respectively. Feed-forward neural network (FNN) and recurrent neural network (RNN) are the two primary types of ANN structure based on how the neurons are linked to each other (RNN).

Over the past few years, Artificial Neural Networks (ANNs) have made great strides, both theoretically and practically. Input, hidden and output layers make up a typical ANN, It's possible to use PV array characteristics such as PV voltage and current or environmental data like as irradiance and temperature for MPPT. A duty cycle signal, for example, is utilized to drive the electronic converter to run at or near the MPP. A model-based simulation is used to generate the input and output data. ANN was utilized in several research to approximate nonlinear functions.

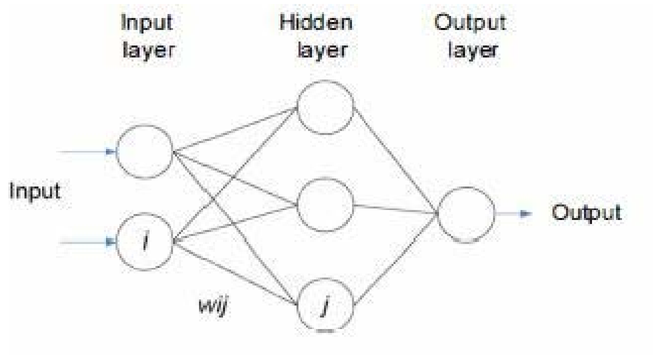

Fig. 4: ANN model [3]

V. Converter

The bi-directional buck boost transformer is in phase-up mode with a greater RMS value than the bi directional buck booster, the actual value of the inducer, and control switches. Furthermore, 1/3 of the performance present in the former example is indeed excellent for the RMS condenser. Hence, in the bidirectional buck boost converter, the voltage changes, inductor and condenser run at more thermal or electrical stresses compared to the buck boost converter, resulting in increased power loss and core saturation. The buck boost converter needs more powerful control devices that achieve higher voltage on the MOSFET and the diode. Higher RMS-current results in higher driving losses and thus poorer average efficiency of bidirectional converters. The number of buck boost converters used in the bidirectional buck boost converter, though, is twice as many. This problem is addressed by the Half Bridge DC-DC bidirectional converter. It does not have the same equipment as the bidirectional buck boost converter. Instead of the two-way buck boost transversal, it can also be applied for applications that need boost only in 1 direction and the buck in the other direction. In comparison to the bidirectional and buck the main benefits are that one and no more than two inductors are available. Furthermore, half the value of the latter and the power switches needed to transform a bidirectional half-bridge is much smaller than the cuk. In addition, the output of a half-bridge converter is higher than the cucumber due to the reduced inductor current and thus the lower conduction and lower switching losses.

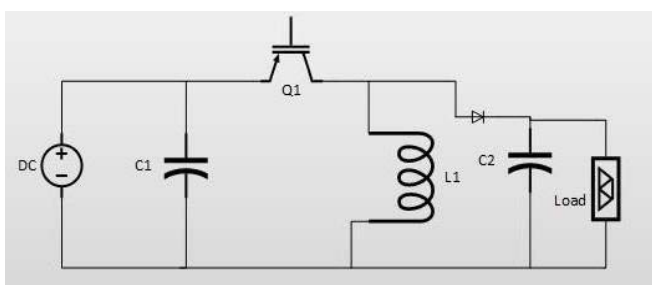

Fig. 5: Buck boost Converter

In Figure 5 a buck boost converter designed for the system. In input Dc solar voltage is coming and by mppt algorithm output is coming across the load.

VI. Energy Storage Device

The grid is a very complex structure in which supply and demand of electricity should be equal at all times. In order to satisfy anticipated demand variations including everyday human behavior and sudden changes in system overload, natural calamities, and so on, continuous supply acclimatization is essential. Energy storage systems play a vital role in this balancing act and enhance the flexibility and confidence of the grid system. For instance, if the production is greater than demand, storage equipment will even power the excess energy during the night when low cost power plants are in service. The grid is a very complex structure in which supply and demand of electricity should be equal at all times. In order to satisfy anticipated demand variations including everyday human behavior and sudden changes in system overload, natural calamities, and so on, continuous supply acclimatization is essential. Energy storage systems play a vital role in this balancing act and enhance the flexibility and confidence of the grid system. For example, if the supply exceeds demand, the surplus electricity may be powered as effectively as possible during the night, while minimal cost power plants proceed. The efficacy of the battery charge/discharge impacts the overall performance ultimately.

VII. Control Modeling of Network

Let I_L, be the current passing through the SN inductor as

$$I_L(s) = \frac{V_L(s)}{sL_t} = \frac{V_m(s) - V_{ng}(s)}{sL_i}$$

vhere Vsw(s) is the inverted switching voltage multiplied with the (s) duty ratio and the input DC bus voltage VDC(s). Now the SN oltage through the capacitor can be obtained by using (Eq. 2).

$$\frac{dV_{rq}}{dt} = \frac{1}{C_t} I_c$$

Where Ic represents the capacitor current. Now the state-space presentation of proposed system with disturbance can be written as the system output equation is:

$$y = [V_{n_2}] = [0 \quad 1] \begin{bmatrix} I_L \\ V_{n_g} \end{bmatrix}$$

Here, $A = \begin{bmatrix} 0 & \frac{1}{L_t} \\ \frac{1}{C_t} & 0 \end{bmatrix}$ is the system matrix, the input matrix $B = [\overline{C_t} \quad 0] \begin{bmatrix} \frac{1}{C_t} \\ 0 \end{bmatrix}$, $C = [0 \quad 1]$ presents the output matrix, and the transition matrix $D = 0$ and the term $\begin{bmatrix} 0 \\ \frac{1}{C_t} \end{bmatrix} L_g$ indicates the uncertainty added with the system output rom the input. The parameters for SN are chosen in a way that it a act like a real-time mini-grid which takes power from the: 1DC bus and supply it to the SN load 1 mises An LC ilter with a value of 2mH and 15μF is used to remove the noises rom the supply voltage. The controller is designed for the voltage control of a secondary network of PV based hybrid AC-DC microgrid plant by eliminating the nonlinear disturbance grid current Ig in the state space representation of the system.

VIII. Perfomance Evaluation

a) Case Study 1

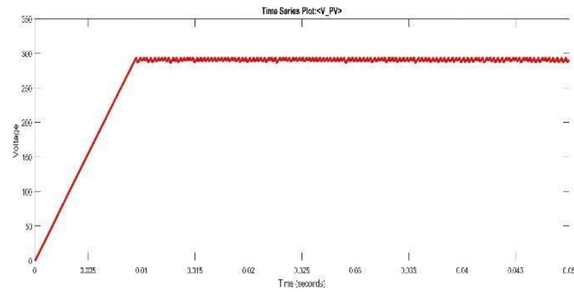

Fig. 6: Power output from solar

In this figure a pv panel output is showed. At the early stage of graph it can be seen that when temperature input is 23 and irradiance 1000w/m^2 the value is shown highest value. After few moment when temperature and irradiance change output power graph is showed some change. so It can be say that system is work properly. The output depends on solar cell number and temperature with irradiance.

b) Case Study 2

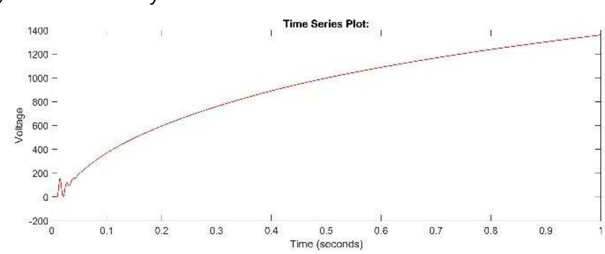

Fig. 7: Resistive load voltage output

In this 10k resistive load is used across the system to see how the system output comes. Here it's seen that reactive power is 0 because of resistive load but in active power initial stage it found that there some saw teeth type wave diffraction after a certain time the curve goes up linearly and its seem that stable against load.

c) Case Study 3

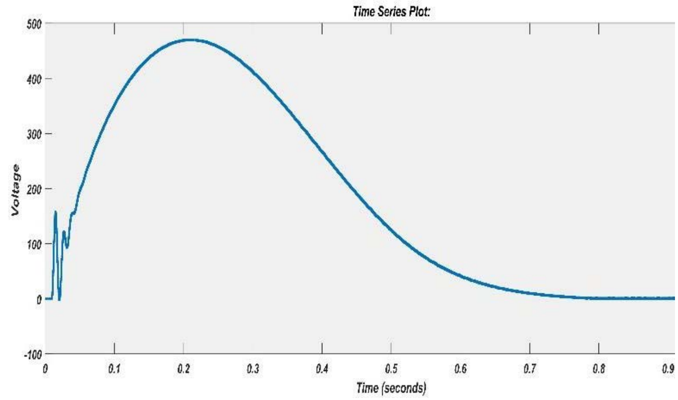

Fig. 8: 2 against inductive load

In this graph it seen that a semi parabolic curve is showing. it actual show active power output against 250H inductive load. Some small wave fluctuation seen in the graph (Indicated). At first the graph grown like a sine wave after 0.3s the graph downs, from 0.5s the graph is shown stabilized value, this the nature of inductive load against built system.

d) Case Study 4

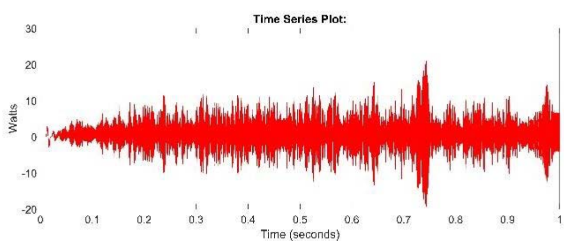

Fig. 9: Capacitive load output

In this graph there so many distortion can seen. As a capacitive load it always charge and discharge in the system, at early stage its more like sine wave but after 0.2s the graph is shown random spike. In 2.5s, 3.5s, 7s there some big spike shown. this happened because solar does not give same output, For that its shown different value in active power graph.

e) Case Study 9

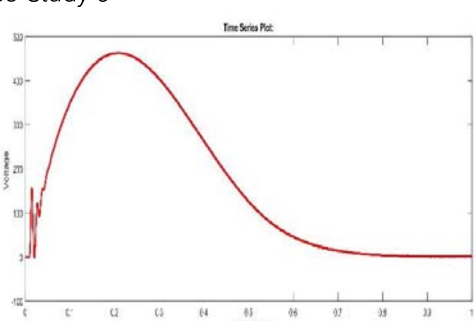

Fig. 14: Parallel RLC load output

In this graph chart a parallel resistive inductive capacitive load added at a time. From 0.1 to 0.3 s graph goes parabolic than it goes linearly down. From 0.5s to 0.8s graph is showing stable but downwards, this is shown the performance of RLC load.

IX. Conclusion

This study presents the recognized a control solution for the use of renewable energy sources such as PV sources against the number of industrial loads. A microgrid system associated the prime mover for driven the industrial loads. A DC bus technology is used to integrate all of the sources in a single network so as the output voltage can be fed directly to the industrial loads. For the balance operation, the output of the DC bus needs to be stable over the variation of temperature, irradiance and consumer demand. This paper carries the design of various load through the combination of an ANN and a PID controller. The validation of studied by varying the consumer demand and the meteorological factors of the PV source. Results obtain from this study confirms that the proposed system has the ability to provide the stable input voltage for the network. The operation of the network is subjected to the variation load dynamics that may change the operating environment and confirms the low tracking performance.

References Références Referencias

1. M. T. Rizi and H. Eliasi, “Nonsingular terminal sliding mode controller for voltage and current control of an islanded microgrid,” Electric Power Systems Research, vol. 185, p. 106354, 2020.
2. M. Babazadeh and H. Karimi, “A robust two-degree-of-freedom control strategy for an islanded microgrid,” IEEE transactions on power delivery, vol. 28, no. 3, pp. 1339–1347, 2013.
3. S. K. Sarkar, M. H. K. Roni, D. Datta, S. K. Das, and H. R. Pota, “Improved design of high-performance controller for voltage control of islanded microgrid,” IEEE Systems Journal, vol. 13, no. 2, pp. 1786–1795, 2018.

4. S. K. Sarkar, F. R. Badal, and S. K. Das, “A comparative study of high performance robust pid controller for grid voltage control of islanded microgrid,” International Journal of Dynamics and Control, vol. 6, no. 3, pp. 1207–1217, 2018.
5. H. R. Baghaee, A. Parizad, P. Siano, M. Shafie-khah, G. J. Osorio, and´ J. P. Catalao, “Robust probabilistic load flow in microgrids considering˜ wind generation, photovoltaics and plug-in hybrid electric vehicles,” in 2018 IEEE 16th International Conference on Industrial Informatics (INDIN). IEEE, 2018, pp. 978–983.
6. M. Marzband, E. Yousefnejad, A. Sumper, and J. L.Dom´ınguez-Garc´ıa, “Real time experimental implementation of optimum energy management system in standalone microgrid by using multi-layer ant colony optimization,” International Journal of Electrical Power Energy Systems, vol. 75, pp. 265–274, 2016.
7. R. Viral and D. K. Khatod, “An analytical approach for sizing and siting of dgs in balanced radial distribution networks for loss minimization,” International Journal of Electrical Power Energy Systems, vol. 67, pp. 191–201, 2015.
8. M. Mokhtar, M. I. Marei, and A. A. El-Sattar, “An adaptive droop control scheme for dc microgrids integrating sliding mode voltage and current controlled boost converters,” IEEE Transactions on Smart Grid, vol. 10, no. 2, pp. 1685–1693, 2017.
9. S. H. Sikder, M. M. Rahman, S. K. Sarkar, S. K. Das, M. A. Rahman, and M. Akter, “Implementation of nelder-mead optimization in designing fractional order pid controller for controllingvoltageof islanded microgrid,” in 2018 International Conference on Advancement in Electrical and Electronic Engineering (ICAEEE). IEEE, 2018, pp. 1–4.
10. M. Ghafouri, U. Karaagac, H. Karimi, S. Jensen, J. Mahseredjian, and S. O. Faried, “An lqr controller for damping of subsynchronous interaction in dfig-based wind farms,” IEEE Transactions on Power Systems, vol. 32, no. 6, pp. 4934–4942, 2017.
11. C. A. Hans, P. Braun, J. Raisch, L. Grune, and C. Reincke-Collon,¨ “Hierarchical distributed model predictive control of interconnected microgrids,” IEEE Transactions on Sustainable Energy, vol. 10, no. 1, pp. 407–416, 2018.
12. J. Hu, Y. Xu, K. W. Cheng, and J. M. Guerrero, “A model predictive control strategy of pv-battery microgrid under variable power generations and load conditions,” Applied Energy, vol. 221, pp. 195–203, 2018.
13. M. Liserre, R. Teodorescu, and F. Blaabjerg, “Multiple harmonics control for three-phase grid converter systems with the use of pi-res current controller in a rotating frame,” IEEE Transactions on power electronics, vol. 21, no. 3, pp. 836–841, 2006.
14. U. K. Kalla, B. Singh, S. S. Murthy, C. Jain, and K. Kant, “Adaptive sliding mode control of standalone single-phase microgrid using hydro, wind, and solar pv array-based generation,” IEEE Transactions on Smart Grid, vol. 9, no. 6, pp. 6806–6814, 201.
15. P. Li and Z.-Q. Zheng, “Robust adaptive second-order sliding-mode control with fast transient performance,” IET control theory applications, vol. 6, no. 2, pp. 305–312, 2012.
16. M. F. Firuzi, A. Roosta, and M. Gitizadeh, “Stability analysis and decentralized control of inverter-based ac microgrid,” Protection and Control of Modern Power Systems, vol. 4, no. 1, pp. 1–24, 2019.
17. S. Zhang, Y. Mishra, and M. Shahidehpour, “Fuzzy-logic based frequency controller for wind farms augmented with energy storage systems,” IEEE Transactions on Power Systems, vol. 31, no. 2, pp. 1595–1603, 2015.
18. S. A. Mohamed and M. Abd El Sattar, “A comparative study of po and inc maximum power point tracking techniques for grid- connected pv systems,” SN Applied Sciences, vol. 1, no. 2, p. 174, 2019.
19. M. D. Bagewadi and S. S. Dambhare, ”A single switch two stage elementary converter based topology for hybrid standalone microgrid applications,” 2016 IEEE Region 10 Conference (TENCON), Singapore, 2016, pp. 322-326.
20. K. Ni, Z. Wei, H. Yan, K. Xu, L. He and S. Cheng, ”Bi-level Optimal Scheduling of Microgrid with Integrated Power Station Based on Stackelberg Game,” 2019 4th International Conference on Intelligent Green Building and Smart Grid (IGBSG), 2019, pp. 278-281, doi: 10.1109/IGBSG.2019.88863 14.
21. Y. Khayat et al., ”Estimation-based Consensus Approach for Decentralized Frequency Control of AC Microgrids,” 2019 21st European Conference on Power Electronics and Applications (EPE’19 ECCE Europe), 2019, pp. 1-8, doi: 10.23919/EPE.2019.891 4758.
22. M. S. S. Danish, H. Matayoshi, H. R. Howlader, S. Chakraborty, P. Mandal and T. Senjyu, ”Microgrid Planning and Design: Resilience to Sustainability,” 2019 IEEE PES GTD Grand International Conference and Exposition Asia (GTD Asia), 2019, pp. 253-258, doi: 10.1109/GTDAsia.2019.8716010.
23. M. N. Mojdehi and J. Viglione, ”Microgrid Protection: A Planning Perspective,” 2018 IEEE/PES Transmission and Distribution Conference and Exposition (TD), 2018, pp. 1-9, doi: 10.1109/TDC.20 18.8440389.
24. K. Minemura et al., ”Study of a microgrid using a private power generator during a utility grid failure,” 2019 IEEE Third International Conference on DC Microgrids (ICDCM), 2019, pp. 1-6, doi: 10.1109/IC DCM45535.2019.9232677.