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Analysis of Total Harmonic Distortion Using Neuro Fuzzy in Renewable Energy Systems

Vinothini[1],

P.G. Student, Department of Electrical Engineering, K.Ramakrishnan Engineering College, Samayapuram, Trichy, India[1]

ABSTRACT: Photovoltaic system is increasingly important as a renewable energy source. It offers many advantages compare to other sources. Some of the advantages are no fuel costs, not being polluting, requiring little maintenance, no noise and easily available. Photovoltaic modules have relatively low conversion efficiency. Therefore implementing maximum power point tracking (MPPT) for the solar array is essential in a PV system. MPPT is a technique used in power electronic circuits to extract maximum power from the PV system. To improve the energy efficiency we have to operate the PV system always at maximum power point. Here fuzzification of the conventional hill-climbing method has been done to eliminate its drawbacks. The fuzzy logic improves the dynamic characteristic, while the conventional hill-climbing technique improves the static characteristic of the system. The inputs used are change in power and change in current while the output taken is the change in duty cycle. This method enables fast and accurate convergence to maximum power point under steady state and under changing weather condition. The Neuro-fuzzy logic improves the dynamic characteristic, while the conventional technique improves the static characteristic of the system. By considering the objective functions as minimization of THD.

KEYWORDS: Neuro fuzzy; photo voltaic; total harmonicdistortion; maximum power point tracking;

I. INTRODUCTION

Conventional proportional–integral (PI) controllers have been well developed and are extensively used for industrial automation and process control today. The main reason is due to their simplicity of operation, ease of design, inexpensive maintenance, low cost, and effectiveness for most linear systems. However, it has been known that conventional PI controllers generally do not work well for nonlinear systems, higher order and time-delayed linear systems, and particularly complex and vague systems that have no precise mathematical models. The controller is designed based on the classical discrete PI controller, from which the fuzzy control law is derived.Membership functions are simple triangular ones with fuzzy logic IF–THEN rules. The resulting control law is an explicit conventional formula, so the controller works just like a conventional PI controller.Photovoltaic modules have relatively low conversion efficiency. Therefore controlling maximum power point tracking (MPPT) for the solar array is essential in a PV system. This work presents a new fuzzy-logic controller for MPPT of PV system. Here fuzzification of the conventional hill-climbing method has been done to eliminate its drawbacks. The fuzzy logic improves the dynamic characteristic while the conventional hill-climbing technique will improve the static characteristic of the system. The inputs used are change in power and change in change in current while the output taken is the change in duty cycle.

Related work

[1] H. Gu, X. Guo, D. Wang, and W. Wu, "Real-time Grid Impedance Estimation Technique for Grid-Connected Power Converters ", IEEE International Symposium on Industrial Electronics (ISIE), pp. 1621-1626, Hangzhou, 28-31 May 2012.[2] F. Wang, J. L. Duarte, M. A. M. Hendrix and P. F. Ribeiro, "Modeling and Analysis of Grid Harmonic Distortion Impact of Aggregated DG Inverters," in IEEE Transactions on Power Electronics, vol. 26, no. 3, pp. 786-797, March 2011.[3] Sung-Wook Kang and Kyeong-Hwa Kim, "Sliding mode harmonic compensation strategy for power quality improvement of a grid-connected inverter under distorted grid condition," in Power Electronics, IET, vol. 8, no. 8, pp. 1461-1472, 8 2015.

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[4] A. Z. Albanna and C. J. Hatziadoniu, "Harmonic Modeling of Hysteresis Inverters in Frequency Domain," in IEEE Transactions on Power Electronics, vol. 25, no. 5, pp. 1110- 1114, May 2010.[5] F. Filho, L. M. Tolbert, Y. Cao and B. Ozpineci, "Real time selective harmonic minimization for multilevel inverters connected to solar panels using Artificial Neural Network angle generation," 2010 IEEE Energy Conversion Congress and Exposition, Atlanta, GA, 2010, pp. 594-598.[6] M. Castilla, J. Miret, A. Camacho, J. Matas and L. G. de Vicuna, "Reduction of Current Harmonic Distortion in Three-Phase Grid-Connected Photovoltaic Inverters via Resonant Current Control," in IEEE Transactions on Industrial Electronics, vol. 60, no. 4, pp. 1464-1472, April 2013.[7] A. Kulkarni and V. John, "Mitigation of Lower Order Harmonics in a Grid-Connected Single-Phase PV Inverter," in IEEE Transactions on Power Electronics, vol. 28, no. 11, pp. 5024- 5037, Nov. 2013.

II. PROPOSED ALGORITHM

A. *Design Considerations:*

- Pulse width modulation (PWM).
- Voltage source inverter.
- Converter.
- Controller.
- Cuk converter

B. *Description of the Proposed Algorithm:*

Neural networks commonly have three layers: input, hidden, and output layers. The number nodes in each layer vary and are user-dependent. The output is usually one or several reference signals.
Using this method it can able to implement the partial shading. It can also use in fast varying weather condition.

Step 1: Calculation Of NET Input Using Matrix Multiplication Method
If the weights are given as W=(w_{ij}) in a matrix form, The net input to output unit y_j is given as the dot product of the input vectors x=(x_1, … x_i … x_n) and w_j (jth column of the weight vector matrix).

$$y_{inj} x_i w_j \quad (1)$$

$$n$$

$$y_{inj} x_i w_{ij} \quad (2)$$

Hence net input can be calculated using Matrix Multiplication Method.

Step 2: Bias

A bias acts exactly as a weight on a connection from a unit whose activation is always 1. Increasing the bias increases the net input to the unit (b=w_0).The bias improves the performance of the Neural Network. Similar to initialization of weights, bias should also be initialize either to 0, or to any specified value, based on the Neural Net. If bias is present then net input is calculated as, $Net\ b\ x_i\ w_i$ (3)

Where, Net – net input b – bias
x_i – Input from neuron *i* w_i– Weight of the neuron *i*tothe output neuron.

$$f(Net) = \begin{cases} +1; & \geq 0; \\ -1; & < 0; \end{cases} \quad (4)$$

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Step 3: Calculating Cuk converter:

The Cuk converter has two modes of operation. The first mode of operation is when the switch is closed (ON), and it is conducting as a short circuit. In this mode, the capacitor releases energy to the output. The equations for the switch conduction mode are as follows

$$\left.\begin{aligned} v_{L1} &= V_g \\ v_{L2} &= -v_1 - v_2 \\ i_{c2} &= i_2 \end{aligned}\right\} \quad i_{c1} = i_2 \qquad \text{eq.(5)}$$

III. LAYERS OF NEURAL NETWORK

Layer 1: The activation functions of this layer are fuzzy logic membership function.

Layer 2: The minimum value of input is choosing in this layer.

Layer 3: The normalization of each input with respect to other input is carried out here.

Layer 4: This layer sums the entire input signal. The i^{th} node output of this layer is a linear function of i^{th}node output of third layer and ANFIS input signal.

The ANFIS structure is tuned by least square estimation (for output membership functions) and a back propagation algorithm (for output and input membership functions).This layer generates torque, flux and angle estimated from flux torque estimator.

IV. SIMULATION RESULTS

Simulations are carried out by using Matlab Simulink. It includes the simulation blocks of solar panel, Boost DC-DC converter, and Cuk DC-DC converter. The MATLAB software is used in entire system simulation.Simulink is the simulation tool in the MATLAB, which can provide us with the function block. So the simulation analysis time can be saved and the design work can be reduced. In this project the model of the PV panel is created, and then the control algorithm using fuzzy logic is created. After that Cuk and Boost converter is designed and fuzzy logic control algorithm is implemented on it and compared.

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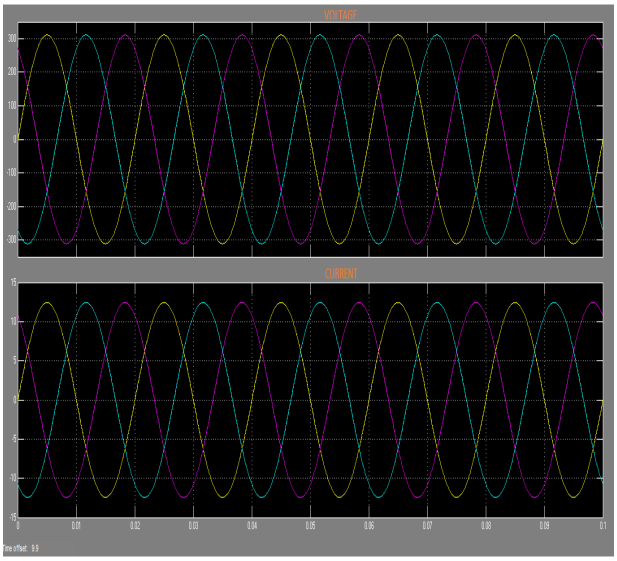

Fig.1. Output Of Voltage And Current Graph

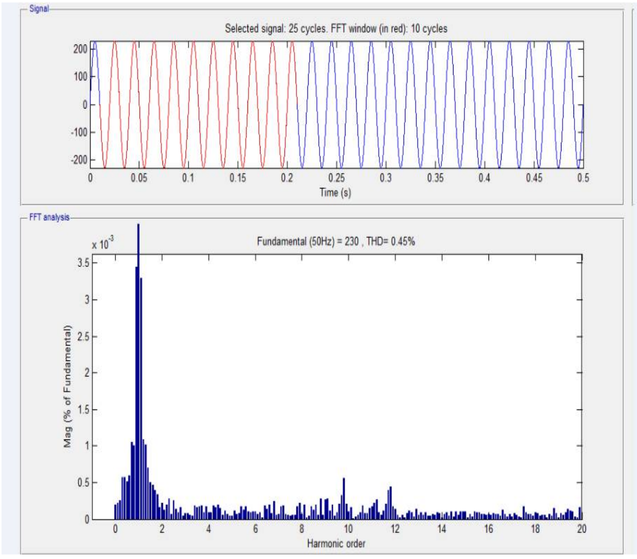

Fig. 2. Calculation of THD Rating of Neuro Fuzzy

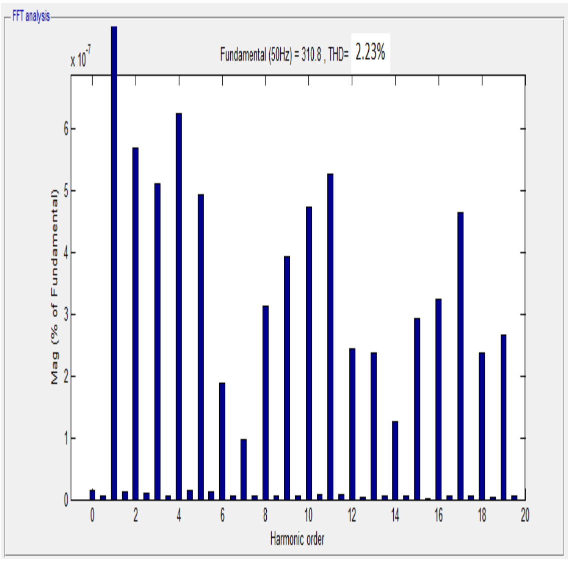

Fig. 3. Calculation of THD Rating of Fuzzy

V. CONCLUSION AND FUTURE WORK

In this project the maximum power point tracking algorithm is created to extract the maximum power from the DC source. The MPPT algorithm here controls the duty cycle of DC-DC converter. In this paper the MPPT algorithm controls the two DC-DC converters and compares them. Thus by comparison of the two converters Boost and Cuk it was found that the Cuk converter voltage produces the less oscillation and more voltage. The implementation of MPPT is simple and can be easily constructed to achieve an acceptable efficiency level of the PV modules. The results also indicate that the proposed control system is capable of tracking the PV array maximum power and thus improves the efficiency of the PV system and reduces low power loss and system cost. The parameters for the Neural Network are

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extracted from the Fuzzy Logic Controller. This controller eliminates the drawbacks of system with standalone Neural Network or Fuzzy Controller logic.

REFERENCES

1.Yafaoui., A. B. Wu and R. Cheung 2nd Canadian Solar Buildings Conference Calgary, June 10 – 14, 2007 Department of Electrical & Computer Engine implementation of maximum power point tracking algorithm for residential photovoltaic systems"IEEE Transactions on power electronics, vol. 27, no. 11,november 2012 4711.

2.AzevedoG. M. S, M. C.Cavalcanti, K. C. Oliveira, F. A. S. Neves, Z. D.Lins, 2008, "evaluation of maximum power point tracking method for grid connected photovoltaic systems," in *Proc*. IEEE PESC, pp. 1456-1462.

3.TrishanEsram, Patrick L. Chapman, JUNE 2009, "Comparison of photovoltaic array maximum power point tracking techniques" IEEE Transactions on energy conversion, vol. 22, no. 2,.,Page 439-449.

4.Seok-Il Go*, Seon-JuAhn*, Joon-Ho Choi†, Won-Wook Jung**, Sang-Yun Yun and Il-KeunSong"Simulation and analysis of exsisting MPPT control method in a PV generation system.

5."Advance contro scheme and operating modes for large capacitycentralised PV-gridsystems to overcome penetration issues"Rupesh G. Wandhare and VivekAgarwa 1 Senior Member, IEEE Indian Institute of Technology- Bombay, Powai, Mumbai-400.april 2009.

6."MayssaFarhat and LassâadSbita National Engineering school of Gabes, Electrical and Automation Department, University of Gabes, Tunisia Correspondence should be addressed to MaissaFarhat"Advanced fuzzy MPPT control algorithm for photovoltaic systems".2010 april.

7. Kulkarni A. and V. John, "Mitigation of Lower Order Harmonics in a Grid-Connected Single-Phase PV Inverter," in IEEE Transactions on Power Electronics, vol. 28, no. 11, pp. 5024- 5037, Nov. 2013.

8. Wang. X, F. Blaabjerg and Z. Chen, "Synthesis of Variable Harmonic Impedance in Inverter-Interfaced Distributed Generation Unit for Harmonic Damping Throughout a Distribution Network," in IEEE Transactions on Industry Applications, vol. 48, no. 4, pp. 1407-1417, July-Aug. 2012.

9. MunirS. and Y. W. Li, "Residential Distribution System Harmonic Compensation Using PV Interfacing Inverter," in IEEE Transactions on Smart Grid, vol. 4, no. 2, pp. 816-827, June 2013.

10. Q. Liu, Y. Deng and X. He, "Boost-type inverter-less shunt active power filter for VAR and harmonic compensation," in IET Power Electronics, vol. 6, no. 3, pp. 535-542, March 2013.

11. Young C. m. and S. f. Wu, "Selective harmonic elimination in multi-level inverter with zig-zag connection transformers," in IET Power Electronics, vol. 7, no. 4, pp. 876-885, April 2014.

12. Xu,J. T. Tang and S. Xie, "Research on low-order current harmonics rejections for grid-connected LCL-filtered inverters," in IET Power Electronics, vol. 7, no. 5, pp. 1227-1234, May 2014.