International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.14, pp 207-212, 2017

Optimization of hybird PV-Wind Renewable energy system using robust algorithm

K.Thenmalar[1]* and S.Mownisha[1]

[1]Department of Electrical and Electronics Engineering, Vivekananadha college of engineering for women,Tiruchengode, Nammakal, Tamil Nadu, India

Abstract : Hybrid renewable energy system consisting of photovoltaic, wind generator with battery, fuel cell and inverter. An optimized hybrid energy system is the combination of two or more energy sources which is used to supply the targeted load. In the energy system, one of the most important applications is the installation of well design hybrid energy system in remote areas where grid extension is very difficult and costly. But the proper design of the system is the challenging task as the coordination between different energy sources; energy storage and load are very complicated. The process of hybrid renewable energy system is selecting suitable components, its sizing and control strategy to provide efficient, reliable power and minimum cost. The system has been optimized by using robust optimization technique. Finally, the simulation result has been derived in MATLAB Simulink with the required formulation.
Keywords : Robust algorithm, solar energy, wind power, hybrid system.

Introduction

Nowadays no one can imagine life without electricity. The role of energy generation is one of the most important factors for the development of any country. The main sources of electrical energy now depleting and conventional systems have failed to provide reliable electricity and minimum cost in rural areas which away from the grid [2].

Hybrid renewable energy system is the combination of two or more energy resources to supply the load. Hybrid energy system consists of photovoltaic, wind generator, inverter, while the battery and fuel cell are used as backup units[1] [8].

A hybrid renewable PV and wind energy system is a combination of solar PV, wind turbine, inverter, battery, and fuel cell components. A number of models are available in the literature of PV–wind combination as a PV hybrid system, wind hybrid system, and PV–wind hybrid system, which are employed to satisfy the load demand. Once the power resources (PV and wind flow energy) are sufficient excess generated power is fed to the battery until it is fully charged. Thus, the battery comes into play when the renewable energy sources (PV–wind) power is not able to satisfy the load demand until the storage is depleted.

The operation of hybrid PV–wind system depends on the individual element. In order to evaluate the maximum output from each component, first the single component is modeled, thereafter which their combination can be evaluated to meet the require dependability. If the electric power production, though this type of individual element, is satisfactory the actual hybrid system will offer electrical power at the very least charge. The hybrid renewable energy source consists of a 10 to 60 kW for wind generation and 1 to 50 kW

(peak) PV array as primary energy sources. The excess energy with respect to the load requirement has considered be either storing or injecting to grid [5].

Proposed Block Diagram

A photovoltaic system uses one or more solar modules or solar panels to convert solar energy into electrical energy. The power generated by the PV panels depends on solar irradiation and ambient temperature. The PV generated as 100KW and the wind generated as 65KW. A fuel cell is a device that generates power by a chemical reaction (H_2).Every fuel cell has two electrodes, one positive and another one negative, that is anode and cathode. The reactions that produce electricity take place at the electrodes. It generates as 50KW. In this hybrid operation of PV-wind system strategy of operation depends on different situations. If the total energy or current generated by PV and wind is greater than the required energy or current by the load, in this case the excess energy is stored in the battery and battery put in the charge condition. When the battery SOC (State of charge) reaches the maximum value, the control unit stops the charging process. Then if total energy generated by PV and wind is less than the energy required by the load, the energy deficiency is covered by the storage system. In such case controller puts the batteries in discharging condition. If the battery charge decreases to its minimum state of charge, the controller unit disconnects the load and in such situation system is under the energy shortage. For the robust optimization of control strategy wished to try both load following and cycle charging. A voltage source converter is used to converts dc to ac voltage and to supply the targeted load.

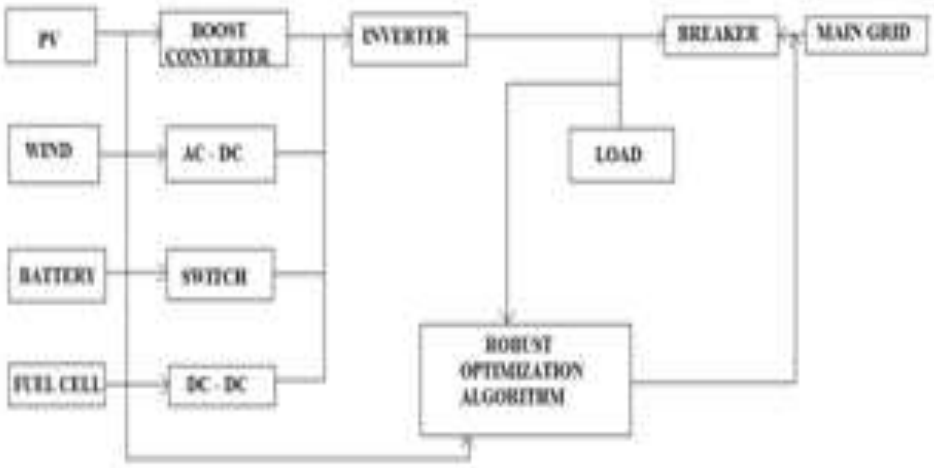

Fig 1: Hybrid energy system

A. Solar energy

Solar energy is gets energy by the radiation of the sun. It is present on the earth continuously, it is pollution free. One problem of solar energy system it cannot produce energy in bad weather condition. The solar energy generated as 100KW.

B. Wind energy

Wind energy is gets energy by extracted from wind. For extraction we are use wind mill. Then the wind energy needs less cost for generation of electricity. Wind energy maintenance cost also less. Electricity generation from wind is depends on speed of the wind flowing. The wind system generated as 65KW.

Robust Optimization

Robust optimization allows for the modeling of an uncertainty set and ensures that the select solution can handle any possible realization based on this uncertainty set. The technique is divided into two types; the first type discusses the effect of robust corrective topology control on system reliability and renewable

integration. The second type deals with the application of robust optimization for the security constrained unit commitment problem.

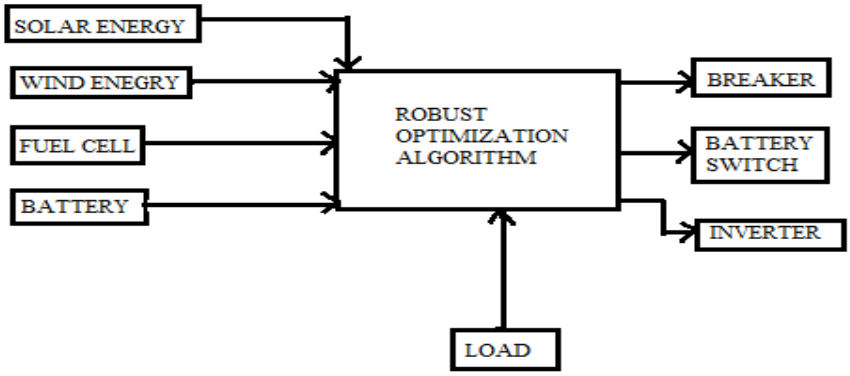

Fig 2: Robust optimization

In robust technique gets input from solar energy, wind speed, fuel cell and battery SOC. Then robust optimization, to provide reliable power is supply the targeted load. And the excess energy passed through the main grid, the breaker will be off and to connect the main grid.

A Flow Chart of Robust Algorithm

This research also examined the determination of uncertainty sets prior to a robust formulation. The output source of robust algorithm is breaker, battery switch and inverter. It gets the reliable power from the inverter and it passed through the load. The excess power will be there breaker gets off, the power supplied to main grid. And the power will be demand the breaker gets on, the power supplied main grid to load.

This algorithm work studied two-step robust unit commitment with uncertainty set. The optimization experiments suggest the selection rule of uncertainty sets for different confidence levels. Thus the robust algorithm result gives better cost reduction with less iteration.

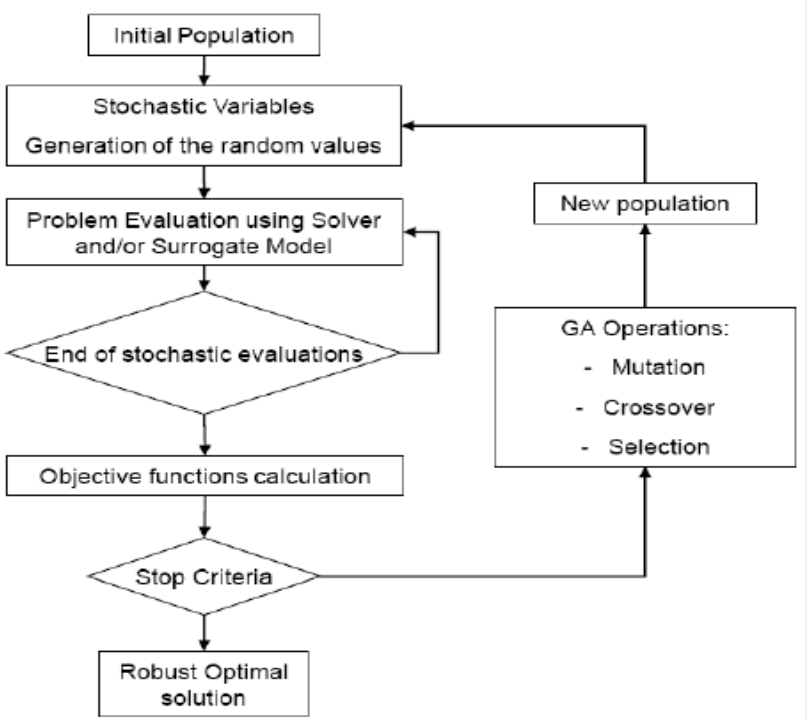

Fig 3: flow chart of robust algorithm

Simulation Results

In order to demonstrate the high performance of the proposed technique, the complete system is simulated with MATLAB/Simulink model. The Simulink implementation of proposed system is shown in fig 3. The nonlinear loads which consists of 3 loads totally of 60 KW.

At t=0.01 sec, 10 KW load is connected to grid. At t=1.8 sec 60 KW of load is shared by power grid which is shown in fig 5. The operation of hybrid PV–wind system depends on the individual element. In order to evaluate the maximum output from each component, first the single component is modeled, thereafter which their combination can be evaluated to meet the require dependability.

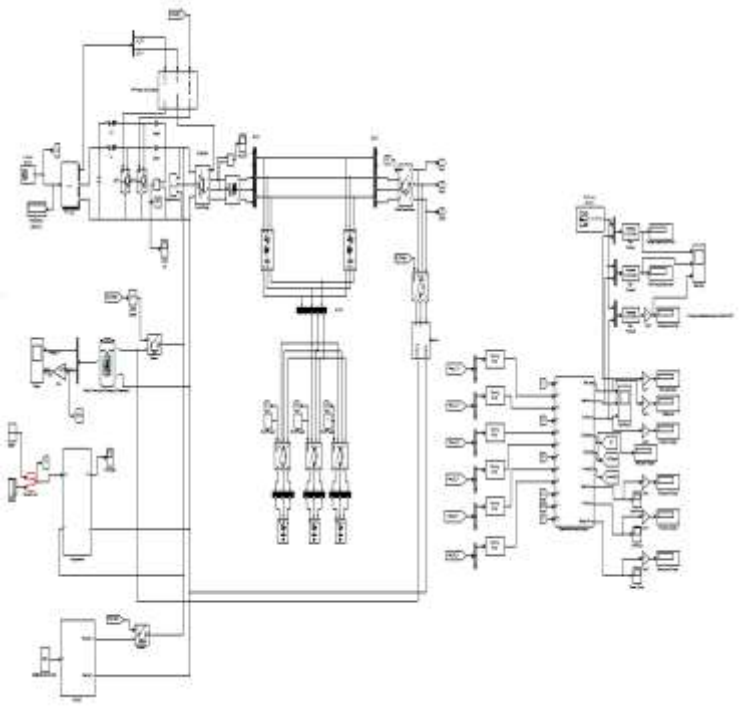

Fig 4: Simulink model of hybrid energy system

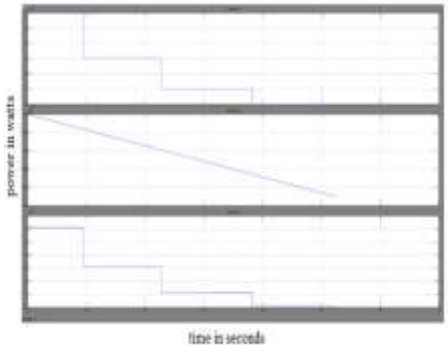

Fig 5: power flow graph

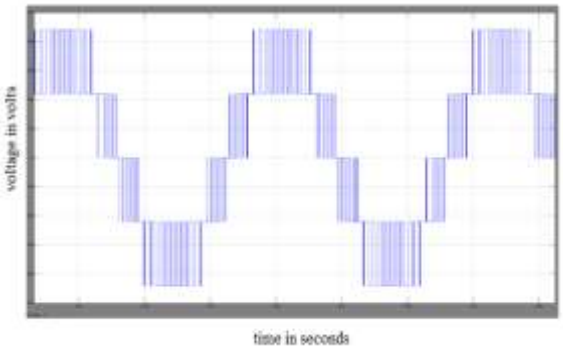

Fig 6: inverter AC voltage

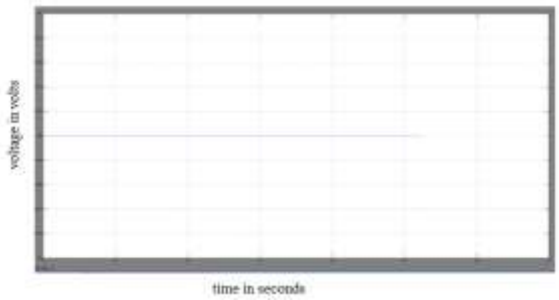

Fig 7: inverter DC voltage

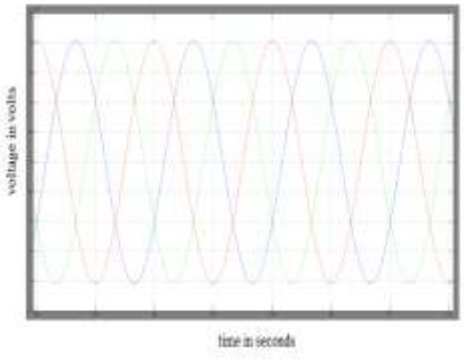

Fig 8: grid voltage

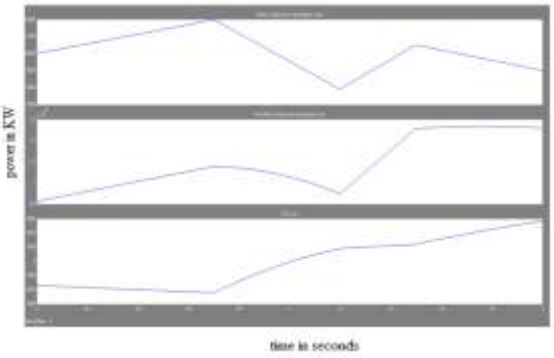

Fig 9: cost graph

Table 1 Data analysis

S.no	sources	rating
1	Solar	60KW
2	Battery	400V/650Ah
3	Wind	15KW
4	Fuel cell	50 KW
5	RL load	30 KW
6	Inverter	440V/250KW
7	Main grid	120KV/2500MVA

Table 1 power & cost comparison

Load	Main Power In Kw	Micro Power In Kw	Main Cost	Micro Cost
60 KW	10	54.56	9000	9330
30 KW	19.64	54.64	5088	9268
10 KW	39.65	54.66	1680	9155

Conclusion

In this hybrid energy system, robust optimization algorithms have been proposed. It is the combination of two or more energy sources which is used to supply the targeted load. The result shows that for each variable system consisting of solar, wind, fuel cell with battery and inverter bring out the most economical and reliable power for the proposed site.

Simulation results show the reliable power to gets, the breaker off and to connect the main grid and to supply the load. Robust optimization algorithm is used to optimize the reliable power and to minimize cost.

References

1. M. S. Ismail, M. Moghavvemi, T.M.I. Mahlia,"Genetic algorithm based optimization on modeling and design of hybrid renewable energy systems, Energy conversion and management" 85, pp. 120 – 130, 2014.
2. Corsiuc Georgiana, Marza Carmen, C. Emilian, "Hybrid solar-wind stand alone energy system: a case study, applied mechanics and materals", vol 772, pp. 536-540, 2015
3. N. Razak, M. Othman, "Optimal sizing and operational strategy of hybrid renewable energy system using HOMER", IEEE transaction, pp. 495 – 501, June 2010.
4. G. Vuc, I. Borlea, C. Barbulescu, "Optimal energy mix for a grid connected hybrid wind – photovoltaic generation system", IEEE transaction, pp. 129 – 132, March 2011.
5. M. ShakawatHossan, M. MarufHossain, A. ReazulHaque, "Optimization and Modeling of a Hybrid energy system for off-grid electrification", IEEE transaction, 2011.
6. Rui Huang, S. Low, U. Topcu, K. Chandy, "Optimal design of hybrid energy system with PV/Wind Turbine/ Storage : A Case study", IEEE transaction, pp. 511 – 516, 2011.
7. M. S. Ismail, M. Moghavvemi, T.M.I. Mahlia, "Design of an optimized photovoltaic and microturbine hybrid power system for a remote small community: Case study of Palestine, Energy conversion and management" 75, pp. 271 – 281, 2013.
8. Satishkumarramoji, BibhutibBhusanrath, D.Vijaykumar,"optimization of hybrid pv/wind energy system using genetic algorithm", vol 4, pp. 29-37, january 2014.
9. A.Rohani, K.Mazlumi and H.Kord. "modeling of a hybrid power system for economic analysis and environmental impact in homer", may 11-13.
10. Ajai Gupta, Saini R. P. and Sharma M. P. (2008), "Hybrid Energy System for Remote Area - An Action Plan for Cost Effective Power Generation, Industrial and Information Systems", IEEE Region 10 and the Third international Conference.
11. Anitagudelj, Majaktcum, (2013) "Simulation and optimization of independent renewable energy system", vol.02, no.01, pp.28-35.
12. Bernal-Agustin, J. L., Dufo-Lopez, R, Contreras J, (2007), "Optimization of Control Strategies for Stand-Alone Renewable Energy Systems with Hydrogen Storage, Renewable Energy", 32 (7), pp. 1102-1126.
13. Bernal-Agustin, J. L., Dufo-Lopez, R., Rivas-Ascaso, D. M, (2006), "Design of Isolated Hybrid Systems Minimizing Costs and Pollutant Emissions, Renewable Energy", 31(14), pp. 2227-2244.
14. ChengzhiL and Hongxing, Y., Z. Wei, (2009), "Optimal design and techno-economic analysis of a hybrid solar–wind power generation system", Applied Energy 86: 163–169.
15. Corsiuc, Emilian.C Georgiana, Marzacarmen, (2015) "Hybrid solar-wind stand alone energy system: a case study, applied mechanics and materials", vol 772, pp. 536-540.
16. Daud, A-K. and Ismail M.S, (2012), "Design of isolated hybrid systems minimizing costs and pollutant emissions", Renewable Energy Vol. 44, No. ,pp. 215-224.
17. M. Anwari, Idris M.H., and Khairuddin A., Twaha, S. (2012), "Applying grid-connected photovoltaic system as alternative source of electricity to supplement hydro power instead of using diesel in Uganda Energy", Vol. 37, No. 1,pp. 185-194.
18. Ashish S. Ingole, Prof. Bhushan S. Rakhonde, (2015), "Hybrid Power Generation System Using Wind Energy and Solar Energy", Vol. 5, No. 2, pp 2250-3153.
19. Thenmalar K, Ramesh S and ThiruvenkadamS(2015),"Opposition Based Differential Evolution Algorithm for Dynamic Economic Emission Load Dispatch (EELD) with Emission Constraints and Valve Point Effects" Vol.4,pp 1508-1517.
20. Thenmalar K, Ramesh(2017),Self Adaptive Hybrid Differential Evolution Algorithm (SAHDEA) for Dynamic Economic Emission Power Dispatch (EEPD) with Valve Point Effects Vol.5.No.1

*****