ISSN (ONLINE): 2395-695X
ISSN (PRINT): 2395-695X

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol.3, Special Issue.24, March 2017

Wind Drive Optimization Based Economic Dispatch for the Effective Micro Grid Utilization

U.Ashwini[1], Dr.A.Ravi, M.E., Ph.D[2] , J.Daniel Sathyara J [3]
1pg Scholar, Dept. of Power Systems, Francis Xavier Engineering College, Tamilnadu, India.
2 HOD, Dept of EEE, Francis Xavier Engineering College, Tamilnadu, India.
3 Assistant Professor, Dept of EEE, Francis Xavier Engineering College, Tamilnadu, India.

ABSTRACT: **Economic dispatch is the short-term determination of the optimal output of a number of electricity generation facilities, to meet the system load, at the lowest possible cost, subject to transmission and operational constraints. Establishing a new model of economic dispatch considering energy conservation and renewable energy resources is used to improve its effectiveness. This work is addressing a novel economic dispatch based on optimization approach. It is of great significance to study coordinated and optimizing dispatch of large-scale grid-connected system of hydro-power, thermal power, wind power, and photovoltaic for greatly improving the operating efficiency of smart grid. Robust optimization has become an effective decision tool for achieving solutions with reasonable practicability, economy, and reliability under uncertain circumstances. This project work is utilizing wind driven approach for the purpose of robust optimization in economic dispatch. The proposed optimization technique is producing promising results in the seven bus system topology. The proposed work is implemented on the MATLAB R2014a software with the real time datum of solar, Wind, hydro and thermal power plants.**

Keywords: Wind Driven Optimization Algorithm(WDOA), Economic Dispatch Problem (EDP).

I.INTRODUCTON

All over the world more and more serious shortage of energy resource, developing renewable energy, e.g., photovoltaic and wind energy, and constructing sustainable energy systems have become a tendency for power system nowadays. Meanwhile, both hydropower, featuring lower generating cost and short initiating time, and thermal power which is stable and reliable in operation and easy-to-dispatch will still be very important power sources in future smart grid. Modern power systems have grown larger and more geographically expansive with many interconnections between neighboring systems. The need for proper planning, operation and control of such large systems has stimulated research in power system operational studies. One of the problems that have been extensively studied is the economic load dispatch (ELD) problem. ELD is the method of Statistical methods used in the analysis of experimental data and in the construction of empirical models. determining the most efficient, reliable and low cost operation of a power system by dispatching the available electricity generation resources to supply the load on the system. Its main objective is to minimize the total cost of generation while satisfying the operational constraints of the available generation resources. The reduction of carbon dioxide emissions, the partial independency from fossil fuels and the increase of energy generation take advantage of every available renewable energy source and to convert it into hydrogen for the power plants fuel consumption, as well as to exploit solar or geothermal energy to support the steam generation for the heat recovery system or for an auxiliary boiler. Stochastic process techniques are used to analyze problems which are described by a set of random variables of known distribution. Hybrid renewable energy systems are becoming popular as standalone power systems for providing electricity in remote areas due to advances in energy technologies and subsequent rise in prices of petroleum products. A hybrid energy system, or hybrid power, usually consists of two or more renewable energy sources used together to provide increased system efficiency as well as greater balance in energy supply.

In this previous phase proposed used a new meta-heuristic algorithm called penguins Search Optimization Algorithm (PeSOA), based on collaborative hunting strategy of penguins. In recent years, various effective methods, inspired by nature and based on cooperative strategies, have been proposed to solve NP-hard problems in which, no solutions in polynomial time could be found. The global optimization process starts with individual search process of each penguin, who must communicate to his group its position and the number of fish found. This collaboration aims to synchronize dives in order to achieve a global solution (place with high amounts of food). The global solution is chosen by election of the best group of penguins who ate the maximum of fish. After describing the behaviour of penguins, we present the formulation of the algorithm before presenting the various tests with popular benchmarks. Compare the meta-heuristics have WDO performs better as far as PeSOA optimization strategy of collaborative and progressive research of the space solutions.

We propose introduce a new type of global optimization algorithm that is inspired by the motion of wind in the Earth's atmosphere. We call this new nature-inspired technique Wind-Driven Optimization (WDO). WDO is a population based iterative heuristic global optimization technique for multi-dimensional problems. A population of infinitesimally small air parcels are distributed throughout an N-dimensional problem space and assigned random velocities such that the positions of air parcels are updated at each iteration based on the physical equations that govern large-scale atmospheric motion.

II.WDO PRINCIPLE

WDO technique is a recently developed nature inspired evolutionary algorithm, which is getting much acclaim due to its good exploration and diversity properties. It belongs to a class of swarm intelligence technique where the air parcel in the earth's atmosphere have deliberate and pointed movement towards an optimum air pressure location in an attempt to balance the horizontal pressure of the air parcel. The population of air parcels travel within the search space randomly bounded in . The velocity and position of each air parcel is updated similar to the particles of PSO technique every iteration. This iterative process continues till the air parcels achieve optimum pressure location to provide the optimum solution. Gravitation and Coriolis forces present in the velocity update equation makes the algorithm robust and also adds extra flexibility to fine tune. This algorithm is found to be superior to some well-known soft computing techniques such as PSO,GA,PeSOA and comprehensive .The output of the plant is distorted due to the presence of noise n(k), mostly additive white Gaussian noise (AWGN).

A.THEORETICAL BACKGROUND AND MOTIVATION

In the atmosphere, wind blows in an attempt to equalize imbalances in air pressure. More specifically, it blows in the direction from a region of high pressure to low pressure at a velocity which is proportional to the pressure gradient. Assuming the air is in hydrostatic balance and considering that the horizontal motion is stronger than the vertical motion, the pressure variation, and hence the wind can be treated as a horizontal movement. Albeit, we live in a three dimensional world, our abstraction of wind motion addresses multi-dimensional problems. Moreover, certain assumptions and simplifications will be made in the derivation of the operators used in the WDO algorithm. The starting point in the development of WDO is with Newton's second law of motion, which is known to provide very accurate results when applied to the analysis of atmospheric motion.

B.WDO ALGORITHM

The Wind driven optimization (WDO) algorithm is a new type of nature inspired globel optimization methodology based on atomospheric motion. The Wind Driven optimization (WDO) technique is a population based iterative heuristic global optimization algorithm for multidimensional and multimodal problems with the ability to implements constraints on the search domain. At it core, a population of infinitesimally small air parcels navigates over an N-dimensional search space following Newton's second law of motion, which is also used to describe the motion of air parcels within the earth's atmosphere. compared to particle based algorithms, WDO employs additional term in the velocity update the equation(e.g. gravitational and corolis forces),providing robustness and extra degrees of freedom to fine tune the optimization. In some cases, out.Perform other well known technique such as Particle Swarm Optimization (PSO) and the WDO is well suited for problems with bth discrete and continuous valued parameters.

If we consider an infinitesimal air parcel that is moving with the wind, we can derive a velocity update equation . we can write ρ in terms of the pressure and we can assume a unity time step, $\Delta t = 1$, for simplicity. we can derive the following velocity update equation:

$$\vec{u}_{new} = \left((1-\alpha)\vec{u}_{old}\right) + g\left(-\vec{x}_{old}\right) + \left[\left|\frac{P_{max}}{P_{old}} - 1\right| RT\left(x_{max} - x_{old}\right)\right] + \left[\frac{-c\, u_{old}^{other\, dim}}{P_{old}}\right]$$

In the above equation, the updated velocity for the next iteration, unew, depends on the current iteration velocity (uold), the current location of the air parcel in thesearch space (xold), the distance from the highest pressure point that has been found (xmax), the maximum pressure (Pmax), the pressure at the current location (Pold), the temperature (T), the gravitational acceleration (g), and the constants R, α, and c. The pressure term in the WDO is analogous to the fitness of a chromosome in GA terminology

The training rule for the weight update of WDO based model is enumerated in the following steps.

Step 1:

A group of R (= 40) number of air parcels each represented by M unknown parameters which are to be optimized are initialized. Each air parcel represents potential candidate solution.

Step 2:

Uniformly distributed random signal in the interval [-1, 1] and having unity variance is generated and fed to the plant and WDO based identification model simultaneously.

Step 3:

Desired signal is the resultant signal obtained by feeding the input samples to the plant and contaminating its output with measured additive noise i.e. k numbers of desired samples are produced.

Step 4:

Desired output sample is compared with the corresponding output of the identification model. Therefore, k number of errors is produced for R number of air parcels, in all.

Step 5:

The fitness of air parcel is evaluated at each epoch according to (4).

Step 6:

Each air parcel is ranked in ascending order of their fitness function value and the most fit air parcel (minimum MSE) is progressively stored which manifests the learning characteristics of the adaptive model.

Step 7: The velocity of each air parcel is updated according to (5) and (7). The position is updated using (6).

Step 8:

When minimum MSE reaches the prespecified level or maximum number of iterations, the recursive process stops.

C.FLOWCHART OF WDO ALGORITHM

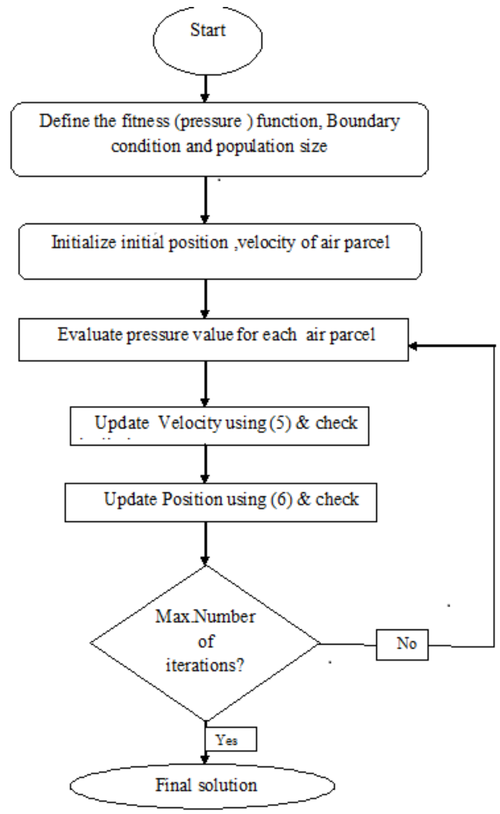


Fig1Flowchart of WDO Algorithm

The above figure shows the flowchart of the Wind driven optimization algorithm which has the main advantage of the low time consumption. The main and the first step of this process were initializing all the necessary values. Then check the limitation of the power flow constraints. If it was satisfied then update all the initialized values. This process repeated again and again until the optimized values were obtained.

III.DESCRIPTION OF PROPOSED SYSTEM

Based on above robust optimization theories, this project establishes a Robust Optimization with Adjustable Uncertainty Budget (RO-AUB) dispatch model for based On Wind Driven Optimization Algorithm (WDOA) that is coordinating reliability and economy. The concept of uncertainty budget is introduced for making up for the deficiency of conventional robust optimization of conservation. The uncertain domain can be enlarged or condensed by adjusting uncertainty budget so as to control robust optimization solution flexibly. Moreover, this work derives an uncertainty budget decision making method based on the built optimization dispatch model to avoid blindness of uncertainty budget decision. Because the established ROAUB optimization dispatch model includes variables with high dimensions and is nonlinear while has the characteristic of uncertainty, it is difficult to solve and demands more in optimization algorithm. Classical optimization algorithms, e.g., Newton algorithm, Lagrange multiplier method, Sequential quadratic programming, and soon, with simple procedures and explicit results, are not suited for the above mentioned highly complex robust optimization dispatch problem anymore because their derivations are based on local information and their results would inevitably converge to local extreme value.

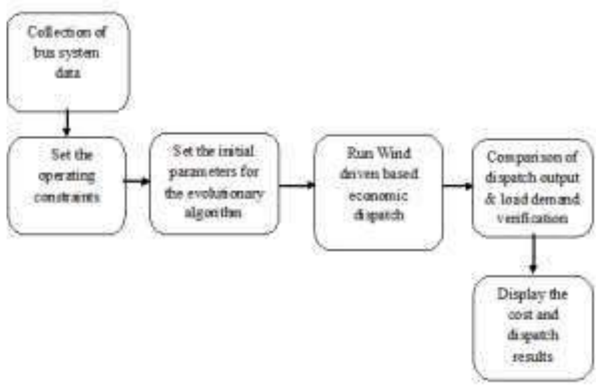


Fig2:Block diagram

A.COST EQUATION

COST OF CONVENTIONAL POWER:

The energy consumption characteristic curve of conventional thermal power generation units usually can be fitted by quadric function. Moreover, the sudden open of intake valve of steam turbine would cause valve-point effect and the effect can be reflected by adding a pulsation effect on the unit consumption characteristic curve. The total consumption cost of Nt conventional generation unit sat time interval T is

$$C_T = \sum_{t=1}^{T} \sum_{i \in N_t} \left(a_i P_{Gi,t}^2 + b_i P_{Gi,t} + c_i + \left| g_i \sin\left(h_i \left(P_{Gi,t} - P_{Gi}^{min} \right) \right) \right| \right)$$

Where a_i, b_i, c_i - Fuel cost coefficients

g_i, h_i - Valve-point effect parameters of the unit

P_{Gi}^{min} -Output lower limit of the i_{th} thermal power unit.

P_{Gi} - Generator output power

B.DESCRIPTION OF SEVEN BUS MODEL

In fig 3 the 7 bus multi machine system is taken here for the analysis purpose as shown in the figure.

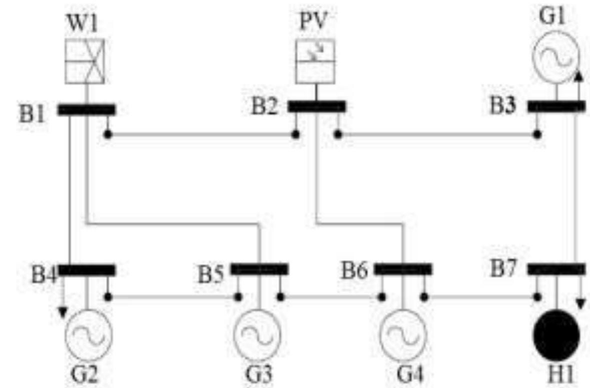
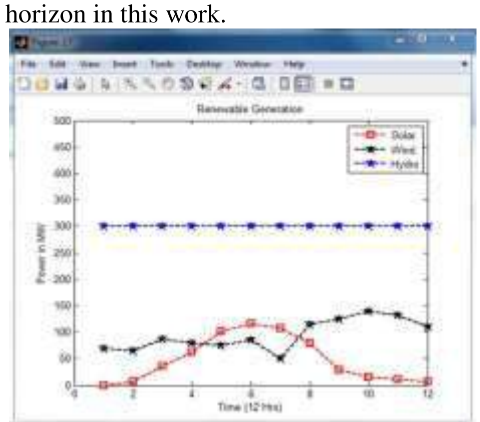


Fig3 : Single Line Diagram Of Seven Bus System

It consists of 7 buses, 4 thermal generators, 1 wind generator, 1 PV generator and 1 hydro power plant generator with 7 loads. The hydro plant in this bus topology is in the operating rate as 300MW is taken as an for the optimization dispatch analysis.

IV.SIMULATION RESULTS

The following fig 4 represents the generated power from wind and solar power generation. And the power generation is scaled for 12 hour time horizon in this work.



The load curve for the corresponding day is shown in the following fig 5

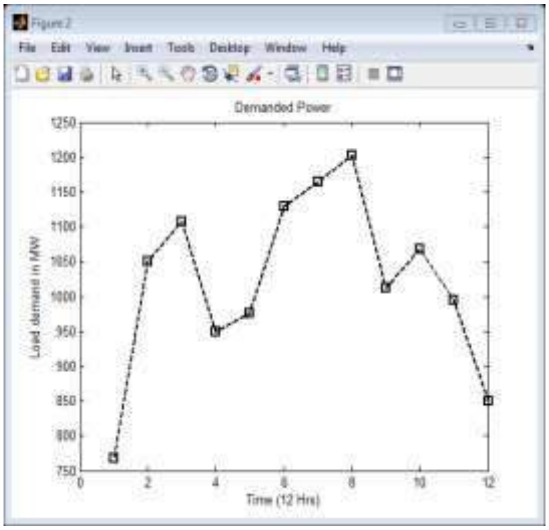


Fig5 : Load Demand For 12 Hrs.

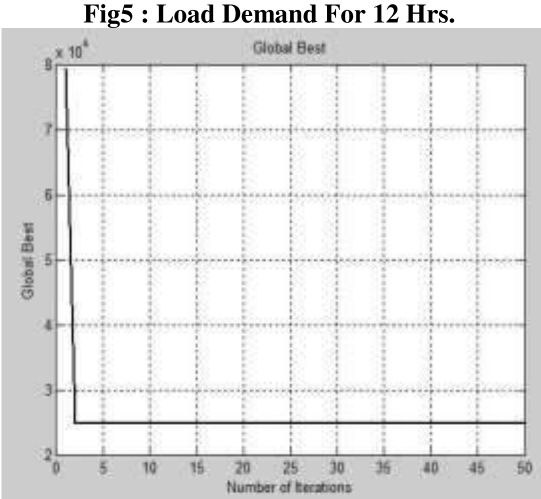


Fig6 : Global Best Plot On Every Epoch

The subsequence section broadly showing the performance of proposed penguin search based economic dispatch. The optimized four thermal generator power is showing in the following table and also the fig showing the optimum power generation curve of each generator.

Table 1: Optimized Thermal Power Generation

Time	P_{G1} (MW)	P_{G2} (MW)	P_{G3} (MW)	P_{G4} (MW)
1:00	30	165.8368	283.5633	301.9196
2:00	30	184.2994	206.1186	216.7304
3:00	30	250.0392	397.3503	148.345
4:00	30	336.1646	513.736	555.1096
5:00	30	165.282	251.7772	266.9549
6:00	30	97.48098	191.1905	-102.496
7:00	30	66.79249	149.7196	154.6915
8:00	30	192.3585	169.4033	176.3437
9:00	30	324.9336	498.5589	538.4148
10:00	30	32.77112	103.7448	104.1192
11:00	30	363.7406	551.0008	596.1009
12:00	30	22.20305	89.46358	88.40994

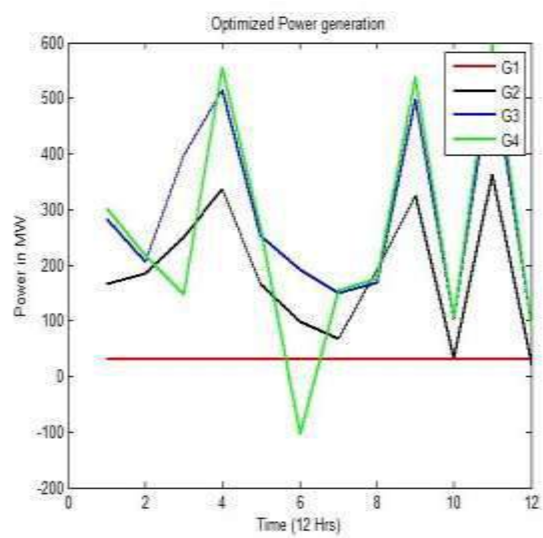


Fig7: Optimized Power Generation Curves For Four Generators

The reduced cost for the whole 12 processing hours is show in the following table 1 and the maximum, minimum cost values are shown in the next table.

Table2 : Reduced Cost and Emission values

Time	Fuel Cost ($)	Emission (gal/Hr)
1:00	11793.0771	19256.23119
2:00	30646.28822	44232.60284
3:00	28510.53984	38192.16832
4:00	27610.7852	33144.99823
5:00	22216.11166	29513.86675
6:00	27774.48016	36051.31944
7:00	35009.83577	37932.06109
8:00	37357.73106	39186.00444
9:00	75841.49512	35127.479
10:00	23564.0515	32363.9194
11:00	20147.93728	28750.0712
12:00	16785.52663	18550.7596

Yu

Table3 : Minimum Maximum Distribution Of Cost And Emission

	Fuel Cost ($)	**Emission (gal/Hr)**
Maximum value	75841.49512	44232.60284
Minimum Value	11793.0771	18550.7596
Average Value	29771.48829	32691.79012

The above table 3 gives the maximum value, minimum value and the average value of the cost function of the emission.

V.CONCLUSION

This project establishes a robust optimization of economic dispatch problem for the multi machine system. The uncertainties of renewable energy resources like solar and wind generations are heavily affecting the dispatch schedule of the thermal generator. The main objective of processing economic dispatch is to limit the emission effect from the thermal generators as well as the fuel cost of it. The renewable energy resources are actually affecting the economic schedule of the thermal generators. This can be solved by preparing the robust economic dispatch solution among the systems. This work is devoted for the later operation and also the proposed work is handled with the high efficient Wind drivenoptimization algorithm for solving the robust economic dispatch. The work is implemented on seven bus system where the solar wind and hydro power plants are taken into account and economic dispatch is prepared for four thermal generators individually. Simulation results shown in the previous section clearly describes about the effectiveness of the proposed work. The reduced fuel cost, reduced total emission and also the load demand satisfaction are the key points to understand the proposed work.

VI.REFERENCES

1. Chunhua Peng, Peng Xie, Lei Pan, and Rong

,"Flexible Robust Optimization Dispatch for Hybrid Wind/Photovoltaic/Hydro/Thermal Power System" *IEEE Trans. Smart Grid.,* March 2016.

2.Nagarjuna Duvvuru, and K. S. Swarup ,"A Hybrid Interior Point Assisted Differential Evolution Algorithm for Economic Dispatch ", *IEEE Trans.Power Systems, Vol. 26, No. 2, May 2011.*

3.C. Chen, Y. P. Li, G. H. Huang, and Y. F. Li, "A robust optimization method forplanning regional-scale electric power systems and managing carbon dioxide," *Int. J. Elect. Power Energy Syst.*, vol. 40, no. 1, pp. 70–84, 2012.

4.Zikri Bayraktar,Muge Komurcu and Douglas H. Werner,"Wind Driven Optimization (WDO): A Novel Nature-Inspired Optimization Algorithm and its Application to Electromagnetic",The Pennsylvania State University ,University Park, PA 16802 .

5.Rashmi Sinha, Arvind Choubey and Santosh Kumar Mahto," An Efficient Adaptive System Identification Technique Based on Wind Driven Optimization Method", *Indian Journal of Science and Technology, Vol 9(38), October 2016.*

6.U.Ashwini, S.Poongothai Nagyiar and A.Ravi," Optimizing and flexible dispatch of power in hybrid power system based on Penguin search optimization".*International journal of Advanced reserch Jan2017.*

7. M. Basu, "Improved differential evolution for

short-term hydrothermal scheduling" *Int. J. Elect. Power Energy Syst.*, vol. 58, pp. 91–100, Jun. 2014.

8. A. Bhattacharya and P.K.Chattopadhyay, "Hybrid differential evolution with biogeography based optimization for solution of economic load dispatch," *IEEE Trans. Power Syst.*, vol. 25, no. 4, pp. 1955–1964, Nov. 2010.

9. A. Ben-Tal, A. Goryashko, E. Guslitzer, and A. Nemirovski, "Adjustable robust solutions of uncertain linear programs," *Math. Program.*, vol. 99, no. 2, pp. 351–376, 2004.

10. A. Ben-Tal and A. Nemirovski, "Robust optimization Methodology and applications," *Math. Program.*, vol. 93, no. 3, pp. 453–480, 2002.

11.A. Ben-Tal and A. Nemirovski, "Robust solutions of LP problems contaminated with uncertain data," *Math. Program.*, vol. 88, no. 3, pp. 411–424, 2000.

12. D. Bertsimas and M. Sim, "The price of robustness," *Oper. Res.*, vol. 52, no. 1, pp. 35–53, 2004.

13. D. Bertsimas, E. Litvinov, X.A. Sun, J.Zhao, and T .Zheng, "Adaptive robust optimization for the security constrained unit commitment problem," *IEEE Trans. Power Syst.*, vol. 28, no. 1, pp. 52–63, Feb. 2013.

14. H. Beyer and B. Sendhoff, "Robust optimization comprehensive survey," *Comput. Methods Appl. Mech. Eng.*, vol. 196, nos. 33–34, pp. 3190–3218, 2007.

15. S. Boyd and L.Vandenberghe, *Convex Optimization.* Cambridge, U.K.: Cambridge Univ. Press, 2004.