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Modelling and Improvement of Function of Solar Resources using PSO Comparative Multipurpose Algorithm

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Abstract

In this article using comparative multi-purpose algorithm of PSO, optimum capacity of new resources and their spinning storage is defined. Spinning reserve requirements and optimized to maximize profit per unit is determined according to uncertainty. In fact by increasing the level of cost reservation, power supply increases but penalty of blackout decreases. In this paper in has been tried to accomplish the optimal amount of reservation by creating a conciliation between penalty of blackout and power supply cost of photovoltaic cells. In this research each part of the algorithm has been produced in a way that they do not have maximum potency. Time of problem solving is considered to minutes for every hour which causes planning every hour to improve before reaching the intended time so that there is accurate anticipation of function of the intended call would be in disposal.

Keywords: Photovoltaic cells, Spinning reserve, Cost reservation, Penalty of blackout.
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1. Introduction

Today energy is treated as a separable part of people's lives thus mankind has always been looking for the most optimized and the best of types of energy to supply their needs. Solar energy is one of the purest/ cleanest and most affordable type of energy supply resources which has no destructive effects on the ecosystem. While using solar power as an energy source, we should consider some mediums to transform solar energy to the required energy. Those cells that transform solar power to electrical energy, photovoltaic cells, are entirely recognized. A photovoltaic plate is a collection of solar cells that are placed next to each other. To increase voltage level current flow rate and ultimately increasing production power in each plate, according to special instruction, many of these cell connect to each other like parallel series like battery connections that causes the increase of voltage level or current flow through their system [1].

Electrical energy is created by radiation of sunlight on solar cells in multiple stages that these stages are mentioned in continuation: 1) Addition of sunlight on cells causes creation of pairs of cavity electrons in p and n layers. 2) According to structural nature of the cells, electrons and rescued cavities rush to p-n band and pass it. 3) According to the arrangement of p, positive loads and in n layer, negative loads are gathered. 4) By connecting the cell to an exterior electrical circuit, a path would be created for the transmittance of the flow. Design, test and analysing solar cells taking place according to characteristics of voltage flow and voltage power [2], [3].

What has been done in this paper is optimizing and performance improvement of solar cells with a view to limitation of power and spinning storage using algorithm of PSO. In part 2 the method and the reason for choosing the mentioned algorithm is being analysed. Part 3 is about the results of using the algorithm on the existing dates and the result.

2. Method

Optimizing issues contain a wide range of engineering of power system issues in the area of planning and utilization studies. Solving optimizing issues is one of the pillars of electrical systems engineering that takes place according to type of issue (linear, nonlinear, continuous and discrete) and the needed time to solve that takes place in different ways [4]. In this chapter aim of creation of optimizing and providing the AMOPSO with a focus on photovoltaic cells function will be analysed. Utilization of a micro grader cell consists of reproducible sources in need of estimation of spinning storage. The spinning storage is the difference between producible power and produced power of the units in peak time [5]. On the other hand estimation of the required spinning storage and optimization in micro graders is not that easy.

Capability of providing spinning storage depends on type of composition. Furthermore accidental output power of reproducible units such as photovoltaic systems, creates significant uncertainty in micro graders. Since the cell output generally depends on radiation of sunlight and amount of ration is conversional during the day, they normally follow bimodal distribution for hourly distribution in a certain place which can be a linear compound of two unimodal distribution dependent. Unimodal distribution can be modelled by beta distribution, Weiball and log-normal PDFs. In this paper double Weiball distribution is used according to equation 1 [6].

$$f(g) = \omega\left(\frac{k_1}{c_1}\right)\left(\frac{g}{c_1}\right)^{(k1-1)} e^{-\left(\frac{g}{c_1}\right)^{k1}} + (1 - \omega)\left(\frac{k_2}{c_2}\right)\left(\frac{g}{c_2}\right)^{(k2-1)} e^{-\left(\frac{g}{c_2}\right)^{k2}} \quad (1)$$

g is the radiation in terms of kw/m^2, w is the weight factor, k_1 and k_2 are the form factor, w and c_1 and c_2 are the scale factor. The distribution function curve can be considered discrete too. An interval distribution function is shown is fig.1 which the needed amounts for analysis are determined using this dependent.

According to radiation distribution and power conservation function distribution of photovoltaic power can be figured out. The function used in this paper is shown in equation 2 in which p is the output power of the cell in terms of kw, $\eta^{\rho v}$ % efficiency and S^{pv} is the whole area in terms of m^2.

$$p = \eta^{PV} S^{PV} g \quad (2)$$

What has been considered in this research consists of investment cost, operating cost and improvement of reliability cost which has been modelled as expected but not supplied energy. Purpose function is shown in equation 3 according to the mentioned factors.

$$\min\left\{\sum_{j=1}^{Nmax} U_{Pv,j} Inv_{j_j} + \sum_{t=1}^{T}\sum_{i=1}^{I}\left[C_{i,t}\left(P_{i,t}, U_{i,t}\right) + \right.\right. \quad (3)$$

SCi.Ki,t +t=1Ti=1Iqi,tRi,t+EENS.VOLL+ LOLP

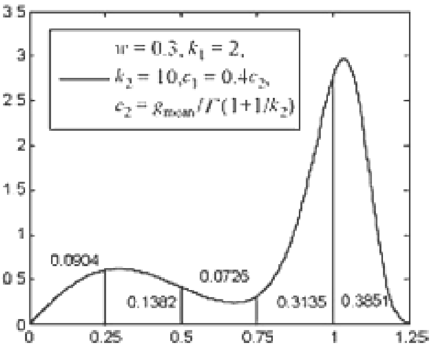


Fig. 1. Distribution of radiation probability curve[7]

First term of the equation is whole investment; second term is exploitation cost which includes production costs and setting the units in motion. Production cost function *ci,t(.)* could be shown by a linear function or a linear part, third term is the saved cost and final term is the expected blackout which equals to value of lost load (VOLL) multiplied by EENS. VOLL is estimated using questionnaires from the users. Final component of purpose function, is considered as the reliability because EENS or LOLP indicator cannot alone assure the reliability of the network. On the other hand EENS indicator is transformable to cost and is naturally retractable with cost components but LOLP indicator is not transformable to cost form therefore the need to use multipurpose algorithms arises. EENS is the amount of expected energy has not been obtained and LOLP is the amount of loss of load possibility. For photovoltaic cells, rang of equilibrium power and range of spinning storage is considered which is presented according to equations 4 and 5.

$$\sum_{i=1}^{I} P_{i,t} = P_t^D \ \forall t = 1, \dots, T \quad (4)$$

$$\begin{cases} R_{i,t} \le P_i^{max} U_{i,t} - P_{i,t} \\ R_{i,t} \le U_{i,t}(R_i^{up} \tau) \end{cases} \quad (5)$$

Furthermore each production unit has its own operational limitation including maximum and minimum limitation of production, limitation of minimum time of lighting and blackout, limitation of preliminary conditions and limitation of slope of increase and decrease of production.

To use the mentioned algorithm for purpose of this paper, has been chosen n=200 at first. Repetition of algorithm should be determined for assuring about the obtained answers which is considered 50 time in this paper which is the condition for the end of algorithm. Each parameter of the optimizing algorithms is used in the way shown in table 1. In the next chapter results of setting down the intended algorithm in solar cell function will be presented.

Table.1.
Parameters of AMOPSO algorithm

Parameter of algorithm	Amount
Primary population	200
Capacity of the archive	50
Maximum inertia factor	0.9
Minimum inertia factor	0.4
Primary recognizing factor	2.5
Final recognizing factor	0.5
Primary social factor	0.5

3. Results

The presented algorithm has been considered in accordance with tables 2 and 3 on template micro grader assembly characteristics of the local and price of energy [8]. Three units of DG are existent on this micro grader [9]: a wind turbine, a fuel cell, a micro turbine. Micro grader includes an ESS and it is connected to the upper network. It can be considered as a 5-unit system. Purpose of adding solar units with focus is reliable.

Table 4 shows summary of the intended parameters. Here nominative photovoltaic system for investment is presented too. For simulation of system using algorithm, two conditions has been considered. In the first simulation condition it has taken place without considering blackout fine meaning EENS and the presence of LOLP alone which is presented in chapter 1-3. In the second condition, considering EEMS factor, simulations has been repeated again and the result has been analysed in chapter 2-3.

A) Simulation results without considering blackout fine

Result in this chapter consists of investment cost, load supply cost, maximum reservation in disposal, optimized reservation and amount of LOLP throughout the programming period. Fig 2 shows the amount of optimized reservation and Fig 3 shows the maximum amount of reservation in disposal. Also, Fig 4 shows the amount of hourly LOLP.

B) Result of simulation considering blackout fine

Results of this chapter is similar to the previous chapter including load supply cost, maximum reservation in disposal , optimized reservation and amount of LOLP throughout the programming period as well as amount of EENS. In this chapter, because of adding the blackout fine to the purpose function, we expect the amount of optimized reservation to increase and therefore the amount of LOLP to decrease. Fig 5 shows the amount of optimized reservation and Fig 8 shows maximum amount of reservation in disposal**.**

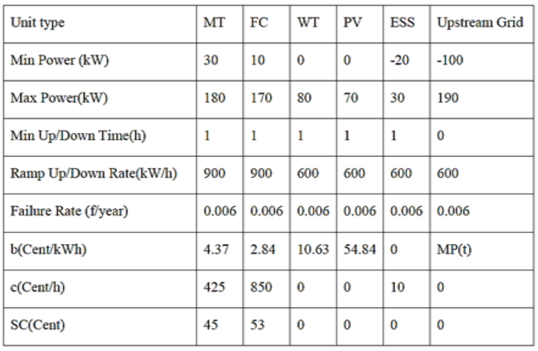
Table.2.
Level of system load in samples 24 hours

Time	Load	Time	Load	Time	Load
1	70	7	100	13	172
2	65	8	120	14	172
3	60	9	140	15	172
4	65	10	155	16	167
5	50	11	170	17	160
6	75	12	175	18	180

Table.3.
Electricity price in upper network in samples 24hours

Time	cost	Time	cost	Time	cost	Time	cost
1	3	7	2.9	13	15	19	3.5
2	2.9	8	3.2	14	40	20	4
3	2.8	9	15	15	20	21	12
4	2.7	10	40	16	15	22	5
5	2.6	11	40	17	6	23	4
6	2.7	12	40	18	4	24	3

Table.4.
Informations about micro grader unit production



Unit type	MT	FC	WT	PV	ESS	Upstream Grid
Min Power (kW)	30	10	0	0	-20	-100
Max Power(kW)	180	170	80	70	30	190
Min Up/Down Time(h)	1	1	1	1	1	0
Ramp Up/Down Rate(kW/h)	900	900	600	600	600	600
Failure Rate (f/year)	0.006	0.006	0.006	0.006	0.006	0.006
b(Cent/kWh)	4.37	2.84	10.63	54.84	0	MP(t)
c(Cent/h)	425	850	0	0	10	0
SC(Cent)	45	53	0	0	0	0

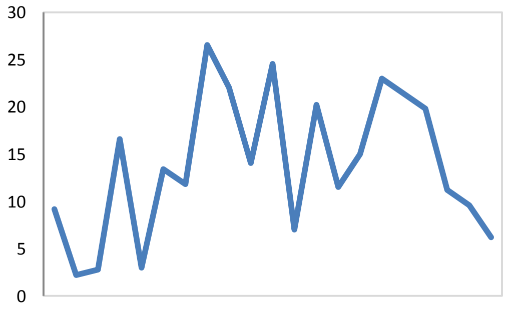


Fig. 2. Amount of optimized reservation(MW)

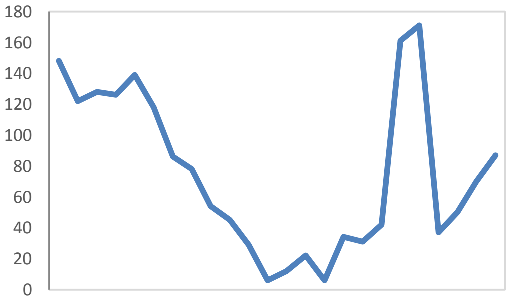


Fig. 3. Maximum amount of reservation

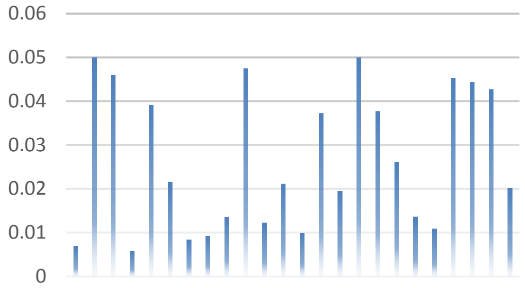


Fig. 4. Amount of hourly LOLP

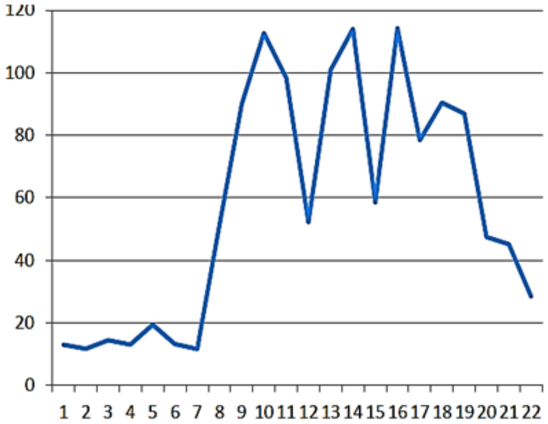


Fig. 5. Amount of optimized reservation considering blackout fine.

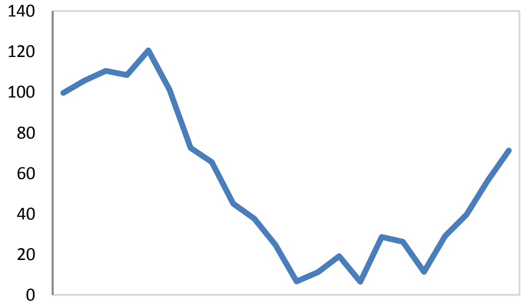


Fig. 6. Maximum reservation in disposal considering blackout fine.

4. Discussion and Conclusion

In this paper a method for determination of capacity of new solar sources and needed spinning storage due to uncertainty of micro graders has been presented. Needed optimized spinning storage is deter mind by maximizing the profit according to unreliability of units and uncertainty of loads and reproducible units. In fact by increasing reservation level, cost of load supply increase but blackout fine decreases. On the other hand by reducing reservation level, whole cost of load supply decreases but a lot of blackout fine would occur to the system. Therefore we tried to establish peace between these subjects according to these two important issues. Whole cost in a condition in which blackout fine is considered, is more than when the blackout fine is not in purpose function. This is while the reservation amount in the second condition is more than the first condition. Considering the blackout fine in purpose function leads to reduction of possible amount of load loss. Each member of population in algorithm was produced in a way that they do not have extra power, therefore base of the calculations is the minimum amount of wind and solar scenarios and maximum load scenario. Time to solve the problem has been considered 10 minutes in every hour.

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