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A New Efficient Method for the Performance Evaluation of a Concentrating Solar Power system using Fuzzy and PSO

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Abstract:

The recent onset on the scenario snatching the zooming enthusiasm of the selfless scientists is the shining concentrated solar power plants (CSPs) which have found themselves emerging as one of the most significant subjects of all times appearing in twin forms like the parabolic trough collectors (PTC) and/or the solar tower collectors (STC). CSP invariably employs renewable solar resources to produce electricity while giving rise to incredibly low levels of greenhouse-gas emissions. Thus, it is equipped with ample potential to qualify itself as a key technology for mitigating climate vagaries. Further, the elasticity of CSP plants effectively enhances energy security. As against photovoltaic (PV) technologies, CSP is endowed with an innate prowess to store heat energy for short periods of time for subsequent adaptation to electricity. When they are blended with thermal storage capacity, CSP plants are competent to sustain the generation of electricity even in circumstances when the clouds put stumbling blocks in the path of the sun or after sundown.CSP plants are also invariably endowed with backup power from combustible fuels. In this document, our earnest endeavor has been to effectively launch a proficient technique with the objective of ascertaining the concentrating solar power excellence and functioning. Firstly, the neural network weighting model is employed with an eye on reproducing the input data. In the second stage, fuzzy classifier based predictionis utilized for training and testing the dataset to perform the forecast productivity. During the third stage PSO is employed so as to optimize the best results gathered so far. Thereafter, to corroborate the accuracy and efficiency of the system, parameters such as regression coefficient, RMSE value and error variation are estimated. With the result, the

forecast is performed efficiently by means of our brilliant method which has shown its mettle as an effective approach when compared to the existing Photovoltaic system.

Keywords: Solar Power system, Photovoltaic system, Particle Swarm Optimization (PSO), concentrated solar power (CSP)

1. Introduction

The curse which stares starkly at our face, nowadays, is the inevitable era of energy crisis through which we have been traversing for a long time. It is generally caused by the protracted employment of electricity which is usually generated by fuels like coal, gas, diesel etc. And, in fact, it is the offshoot of these fuels that triggers untold damage to the ecology paving the way for the initiation of adverse features like global warming, ozone layer exhaustion and acid rain, which do not augur well for the smooth existence of the most wonderful species on this blue marble called planet earth [16]. It is everybody's knowledge that energy is a crucial factor in all walks of life. And it is unfortunate that the zooming quest for energy together with its ineffective utilization have triggered a dismal pollution of the ecosystem both directly and indirectly [15].No wonder, the human community has reached a crucial phase in which the investigations for other alternate sources of energy which may displace the already-scarce electricity have gone sky-high. This work invariably takes its initial breath from the substitute techniques which find their tracks in the direction of substantial cutback in the utilization of electricity. In this regard, we find solace in the oasis of the solar air heating which sparkles with the glowing features of zero pollution and trivial maintenance charges, with the added plusses of being eco-friendly [20] These days, solar energy has appeared as one of god-send gifts to the human race and established itself as the most coveted source of renewable energy sought after all through the cosmos. [18].

Solar energy is, in essence, a form of energy, which is emitted by the Sun-God every second in the shape of solar radiations in incredibly substantial quantities to bless the needy humans. Once the solar radiations touch the absorbing surface, they metamorphose in to heat energy which is effectively employed for several heating functions [19].The solar energy is equipped with a thermal transformation mode requiring an easy method, which is implemented in the site and the specific domain for several applications [20]. The striking benefit of employing the solar energy lies in its sterling quality which makes itself subsist and persist as a never-ending and pollution free source of energy [6].Normally, solar energy conversion systems are categorized into two unique type such as the thermal systems, entrusted with the task of transforming solar energy into heat and the photovoltaic systems, which performs the honorable function of effectively shaping the solar energy into electricity [5].

Even though CSP is equipped with beneficial qualities, the daily and monthly changes of the solar irradiation flux continue to be the major challenges. Solar collectors are the fundamental modules of active solar-heating systems [7].It is home to a dark surface termed absorber, fluid flow passage, and appropriate arrangements for effecting significant cutback in heat loss [14]. One of the outstanding solar thermal

collectors are the flat plate collectors, which enjoy the merits of simplicity in design and entail lesser maintenance and cost even though they generate only inferior temperatures [8]. Flat-plate collectors have become the most sought-after solar collectors, extensively engaged in solar water-heating systems in homes and solar space heating [9].The efficiency and functioning of the solar thermal flat plate collectors are invariably related to the quantity of solar isolation gathered by the plate [10].Flat plate solar collectors exhibit a vibrant character as a feedback in the form of the ever-occurring daily modulations in the solar radiation attained right from sunset till sunrise[13]. Nowadays, several brands of the flat solar collectors have received extensive application in the solar energy field [11].The accurate prediction of the thermal functioning of solar collector system is invariably dependent on the manner in which the glass cover material is assessed [12].

The awareness of temporal and spatial modulations of global solar-radiation at the Earth's surface and its spread and direct segments are crucial to climate and agricultural surveys and investigation, to evaluate the effectiveness of solar energy collectors and many other applications [20]. Solar radiation data offers sufficient data on the quantity of solar energy entering a surface at a locality on earth in the course a specific time frame. The related data are highly indispensable for effectual investigation into solar-energy utilization [17]. It is pertinent to note that solar radiation is the major driving force behind all atmospheric functions. In the domain of airconditioning, the heating or cooling loads and operation control of technologies are intimately linked to solar irradiance. It is common knowledge that the major component of cooling load of an air conditioning system arises generally out of heat transmission, triggered by the temperature divergence between indoor and outdoor and because of solar radiation, the former being dependent on the latter [13]. Still, there crop up certain hassles in evaluating these amounts or in assessing them with numerical modeling methods.Needless to add, it is highly essential to conduct a probe into the prediction of solar irradiance while undertaking an earnest analysis of the challenges as regards the loads of air conditioning systems and the system control [15]. The corresponding values of solar radiation are found to be incredibly elated and hence suitable for solar energy applications and inert building plan. Thus, it goes without saying that an absolute assessment of the solar energy input with the help of solar climatological measurements related to the site is well-set to receive a red carpet welcome [17].

In the current section1we have been introduced to the various potentials and accessibility of technologies with diverse application merits and defects. The roadmap of the residual section of the document is clearly drawnbelow. Section 2 effectively puts in a nutshell the relevant literary works related to the solar system. The neural network weighting pattern-fuzzy classifier-PSO vividly carves out an elegant diagram of the ground-breaking technique in Section 3. And Section 4 rests content with the awful outcomes and attendant analysis on the amazing approach. The captivating conclusions add relevance to the contents of the concluding Section 5.

2. Related Review:

Ramteen Sioshansi and Paul Denholm[1] have proficiently propounded the value of concentrating solar power (CSP) and thermal energy storage (TES) in a multitude of domains in the southwestern United States. Our appraisal add credibility to the fact that TES is competent to amplify the value of CSP by paving the way for further thermal energy from the solar field of a CSP plant to be extensively engaged, permitting a CSP plant to put up with a greater solar field, and by entailing CSP generation to be elevated to hours with superior energy prices. We tend to appraise the sensitivity of the corresponding value to a multitude of parameters such as the optimization duration, price and solar prediction, supplementary service/sales, and dry cooling of the CSP plant, and also evaluate the capability value of a CSP plant with TES.We further proceed to delve deep into the value of CSP plants and TES net of capital costs.

Zhang and *et al*. [2] have proficiently propounded that the concentrated solar power plants (CSPs) are fast gaining zooming enthusiasm, mainly as parabolic trough collectors (PTC) or solar tower collectors (STC). In spite of CSP vantage points, the daily and monthly fluctuations in the solar irradiation flux have surfaced as a major challenge. Even though the fairly accurate match between hours of the day where solar radiation and energy demand reach the summit levels, CSPs are exposed to temporary deviations during the rainy season and find themselves incapable of supplying energy all through the night without deploying thermal energy storage (TES) and/or backup systems (BS) to function evenly without a break. To ascertain the optimum design and function of the CSP during the whole year, at the time of specifying theneeded TES and/or BS, a precise appraisal of the solar irradiation on a daily basis ishighly essential. Local solar irradiation data are generally obtainable only as monthly averages, and hence a predictive transformation into hourly data and direct irradiation area must-have to furnish a further precise input into the CSP blue print.

Yousef and Adam [3] have amazingly advocated the impact of mass flow rate flow channel depth and collector length on the system thermal accomplishment and pressure decline through the collector with and without porous medium. The solution process is carried out for flat plate collector in single and double flow mode. The appraisal of the outcomes at the identical structure and constraints vouch safes the instantaneous surge in the thermal capacity of the system, simultaneously perking up the pressure plunge. All collectors emerge as well-documented credentials to chart out the enhanced effectiveness achieved when the collector functions at comparatively elevated flow rates and at moderately low collector temperature swell as the collector losses exhibit a tendency to be lesser in trivial temperature divergences.

Bhatt *et al*. [4] have brilliantly brought to limelight attest replication of a horizontal single glazed flat plate collector. The diverse damages cropping up in the collector have been gauged as well as evaluated in accordance with the temperature registered by forty-eight-plus thermocouples situated at various modules of the collector. Input energy to the collector is furnished by means of electrical heater of 1000 W capacity, maintained below the absorber with reflectors for uniform flux. The damages have been calculated and estimated under stable state condition and at changeable plate temperature, and the percentage distribution of damages has been offered.

Prasad *et al*. [5] have pragmatically postulated a replication of flat plate collector for solar water heater by means of a C-language program designed with the intention of forecasting the feat of a solar collector system for a specified set of data such as locality and time of the day. The program evaluates instant beam and diffuse radiations for the specified locality of the collector, number of days for the specific date, angle of incidence of beam radiation on the collector, overall solar flux incident on the collector, transitivity – absorptive product for beam and diffuse radiations, incident flux captivated by the absorber plate, collector heat removal factor, overall loss coefficient, water outlet temperature and the instant effectiveness. The envisaged replication program not only forecasts the functioning of a specified solar collector system, but also is highly useful in sizing the solar hot water systems for various applications.

Krishnaiah and *et al.* [6] have competently conceived an artificial neural network (ANN) algorithm for evaluating, on an hour-to hour basis, global solar radiation (HGSR) in India. The ANN models are offered and performed on authentic meteorological data. The solar radiation data from seven stations have been employed for guiding the ANN and data from two stations are deployed for ascertaining the forecast values. Multi-layer feed forward neural network with back propagation learning is invariably employed for the modeling. Forecasting performance parameters such as root mean square error (RMSE), mean bias error (MBE) and absolute fraction of variance (r) are offered for the model.

Solar photovoltaic and thermal systems have established their mettle as the probable solutions for modern energy requirement. Hosseini and *et al.* [7] have been hassled by several severe setbacks in the effective utilization of photovoltaic systems such as the inferior energy transformation efficacy of PV cells with the added disadvantage of the inferior effectiveness further dwindled during the functional duration by an enhancement in the cells temperature beyond a threshold limit. Moreover, reflection of the sun's irradiance from the panel characteristically cuts down the electrical output of PV modules by 8-15%. With the intention of stepping up the efficacy of PV systems an alternate method employed is the process of cooling the systems in the course of the functional duration. In this investigational work, a deft blend of a PV system cooled by a thin film of water with a supplementary mechanism to utilize the heat transferred to the water has been effectively envisaged.

3. Proposed Methodology for the evaluation of Concentrating Solar Power system using Fuzzy classifier and Particle Swarm Optimization:

Concentrated solar power (CSP) is an electricity generation technology which effectively employs the heat furnished by solar irradiation concentrated on a minute area. In line with theaccessible technology, CSP is competent to be an aggressive resource of bulk power in summit and intermediate loads in the hottest domains. In a nutshell, this milestone method is launched with a view to forecast the output and it is subjected to contrastwith the Photovoltaic system. Figure 1 fascinates us by a beautiful picture on the modus operandi of the method for concentrating solar power. Thus the mechanism boasts of housing the following modules:

- *Concentrating solar collector field*
- *Thermal Energy Storage*
- *Power block*

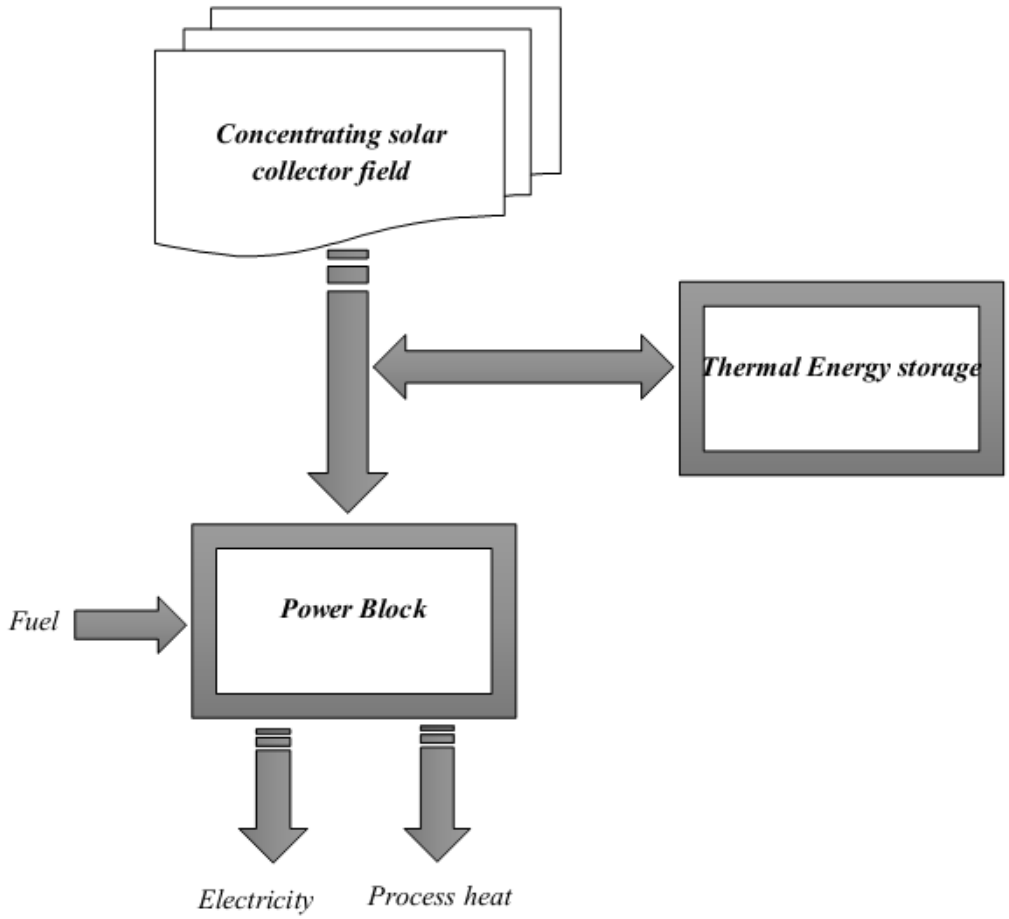

Figure 1: Operationalmethod of concentrating solar power

- ***PSO Algorithm:***

Particle swarm optimization (PSO) made its debut in 1995 with the consistent efforts towards its design and launch by Eberhart and Kennedy. The PSO is a population based probe approach taking a cue from the replication of the social character of birds, bees or a school of fishes. Each and every individual forming part of the swarm is characterized by a vector in multidimensional search space, already having a single assigned vector which influences the subsequent movement of the particle and is known as the velocity vector. The core traits of PSO technique include the position and velocity of the particles, which are chosen for the optimization function. The activation and revision of the velocity and position to specific iteration is carried out with the target of attaining the issue to be optimized. The number of iteration is fixed as per the directions of the client himself, as he is the only person having inkling on the input data. The PSO embraces various stages of functioning,

which are well-elucidated in the ensuing section.All the solutions in PSO are capable of being characterized as particles in a swarm. Each and every particle enjoys a position and velocity vector and each position coordinate characterizes a parameter value. Akin to the large majority of the optimization approaches, PSO also is badly in need of a fitness evaluation function germane to the locality of the particle.

3.1 Modelling using Neural Network Weighting Pattern:

Neural Networks have surfaced as an amazing device to evaluate, model and forecast. The added advantage of neural networks is reflected in the succeeding hypothetical data. At the outset, neural networks are data-triggered self-adaptive techniques wherein they are competent to adapt themselves to the data without any obvious requirement of functional or distributional form for the unique model. In addition, they represent universal functional approximations wherein neural networks are capable of approximating the needed function with arbitrary precision. Neural networks, in essence, are nonlinear models, which makes them flexible in modeling real world complicated associations. Neural networks have the acumen to better approximate the ensuing likelihoods, which form the corner stones for establishing categorization rules and carrying out statistical evaluations.The artificial neural network invariably contains input data as an individual neuron furnishes one output. As it is not possible to achieve the solution with a single neuron we proceed to hunt for the succeeding possibility. The data is trained with the help of constraints such as sun radiation, temperature, to name a few.The yield is produced and then estimated by means of the storage effectiveness and yieldstrength. The neural network effectively cuts back the total error by the input data to generate an output data, modifying the weights all through its gradient. The neural network guidance is meant for scaling down an error function that is offered by the weighing function.

$$\bar{w} = -\phi_i \left[\left(\frac{\exp\left(1 - \sum_{j=0}^{N-1} \delta_{jk}\right)}{1 - \exp^2\left(1 - \sum_{j=0}^{N-1} \delta_{jk}\right)} \right) - \left(\frac{1}{1 - \exp^2\left(1 - \sum_{j=0}^{N-1} \delta_{jk}\right)} \right) \right] \quad (1)$$

Where, $\bar{w}$ - Weighting factor, ϕ_i δ_{jk} - Initial weight to be optimized

$$\bar{w} = -\phi \left(\frac{\exp\left(1 - \sum_{j=0}^{N-1} \delta_{jk}\right)}{1 - \exp^2\left(1 - \sum_{j=0}^{N-1} \delta_{jk}\right)} \right) + \phi \left(\frac{1}{1 - \exp^2\left(1 - \sum_{j=0}^{N-1} \delta_{jk}\right)} \right) \quad (2)$$

3.2 Prediction using Fuzzy Classification:

The fuzzy classifier comprises comprehensible if then rules together with fuzzy antecedents and class labels in the resulting segment. Then if-components of the rules which segregate the input space in to an assortment of fuzzy regions by fuzzy sets, whereas the resultants recount the yield of the classifier in the relative domains.

The ultimate aim of a fuzzy classifier lies in the forecast of the class

$$x_i = (n_1, n_2, ...n_n) \quad (3)$$

The fuzzy if-then rule is effectively evolved as under:

r_i: If y_1 represents $B_{i,1}(y_1), y_2$ is $B_{i,2}(y_2),.....$, and y_n denote $B_{i,n}(y_n)$

Then $\overline{x_i} = n_1$ with $P(n_1 \mid r_i).....,\overline{x_i} = n_n$ with $P(n_n \mid r_i)$

Where,

r_i is the i 'th rule (i=1…R)employed in the fuzzy classifier

$B_{i,1},.....B_{i,n}$ Stand for the membership functions for the related features

The certaintyelement $\overline{w}$ is employed to characterize the preferred impact rule, r_i which may be deemed as the significance of the relative rule classifying the model.

$$\vec{y}_i = [y_1, y_2, ...y_n] \quad (4)$$

Gaussian function is deployed to build the membership function of each trait as detailed below:

$$B_{i,j}(y_j) = \exp\left(-\frac{1}{2} \frac{(y_j - c_{i,j})^2}{\sigma^2{}_{i,j}} \right) \quad (5)$$

Where, $c_{i,j}$-center and $\sigma^2{}_{i,j}$ stands for the variance of Gaussian function. The output of the classifier which is formed by if then fuzzy rules is estimated by the label of the class possessing the greatest activation

$$\overline{y} = n_{\rho^o} \quad (6)$$

$$\rho^o = \arg\max \frac{\sum_{i=1}^{R} \eta_i(\overline{y}) P(n_k / r_i)}{\sum_{i=1}^{R} \eta_i(\overline{y})} \quad (7)$$

3.3 Optimization of paramount expected output using PSO:

The innovative PSO technique exploits the quicker calculation duration of the PSO in tandem with its convergence power to execute the outcomes to the near global solution. The measures used to perform the forecast mechanism in PSO technique is detailed below:

- ***Step1:*** *Initialize position p_i and Velocity v_i discretely*
- ***Step2****: In respect of the entire particle calculate fitness by means of the relative equation*
- ***Step 3****: If the fitness is better in relation to the earlier p best set the current values as the new p best*
- ***Step4****: Continue to perform step3 and step 4 for the whole particles and choose the best particle as the g best*
- ***Step5****: Perform for the entire particle compute the velocity and revise their position*
- ***Step6****: If the maximum iteration is not met, proceed to continue steps coming after the fitness function step*

Preliminarystage:

The PSO activates the population which is a throng of expressions offered by the client. The PSO technique commences with activation of the population, which embraces the input data. Hence, the locality of particle i characterized as:

$$X_i = (x_1, x_2, ...x_n) \quad (8)$$

Where, X_i - locality of the particle.

The particle encompasses memory of the prior best position, expressed by the relation below:

$$P_i = (p_1, p_2, ...p_n) \quad (9)$$

Where, p_i - prior best position

The velocity of the particle is furnished as per the expression:

$$V_i = (v_1, v_2, ...v_n) \quad (10)$$

Where, V_i -Velocity of the particle

❖ ***Fitness task:***

Each and every optimization program is constrained with certain fitness functions, and mainly based on the nature and behavior of the inputs and outputs; the fitness functions also undergo changes. We choose the population already defined, for evaluation of the fitness. Every expression in the population is chosen for estimating their fitness. The outcome is then processed by means of above offered values. The expression with highest fitness value is selected as the global best.

❖ ***Generating new population***

After selecting best fitness function fresh population is produced and therefore the fresh populations are produced for the ascertaining the best fit expressions among the other expressions in the population. The fresh populations are estimated as per the two specifications stipulated by the PSO algorithm.

$$v_i^{(n+1)} > v_m^{(n+1)}, then\ v_i^{(n+1)} = v_m^{(n+1)} \quad (11)$$

❖ ***Update the position and global best solutions:***

The specifications are position and velocity of the elements in the population, and in the existing circumstances, the expressions are deemed as the elements of the population. Thus, for attaining new populations, the velocity and the position of each value are kept up-to-date. Each particle is skilled enough to be aware of its best value till now (p best) and its position. In addition, each particle has apt data about the best value till now in the group (g best) among p bests. This data is akin to the comprehension of the manner in which the other particles in the vicinity have accomplished themselves. Each particle shows the tendency to vary its location by means of the ensuing data such as the distance between the current position and p best, the distance between the current position and g best. The updation of the function is made plausible by means of the equations shown below:

$$velocity = velocity^C + \alpha(pbest - pos^C) + \beta(gbest - pos^C) \quad (12)$$

$$V_i^{(i+1)} = V_i^{(i)} + l_1 * r_1 * (pb_i - \rho_i^{(i)}) + l_2 * r_2 * (gb_i - \rho_i^{(i)}) \quad (13)$$

$$x_i^{(i+1)} = x_i^{(i)} + V_i^{(i+1)} \quad (14)$$

❖ ***Norms for termination stage:***

Every particle is gifted with a best position in its swarm called *pbest*, if the refreshed position is greater than the *pbest*, then it is deemed as the *pbest*. The best value among the pbest is taken as the *gbest* value of the entire population. If the revised position exceeds the *gbest*, it is then represented as the *gbest*. The procedure gets replicated till a stage arrives, in which the termination benchmarks are satisfied, iterations being habitually deemed as the termination standards.

4. Results and Discussion

This section puts in a nutshell the upshots realized together with the consequential debate thereon. The experimental association along with reproduction results is colorfully carved out below. The database has been extensively employed for acquiring the productivity from times immemorial. In this case, 80% of data gets itself apportioned for the purpose of guidance and the residual 20% finds itself allocated for experimentation. Little wonder, the rejuvenating results reflect realistic relationship of the innovative technique relegating the modern method like the photovoltaic technology to the backyard.

4.1 Experimental Set Up and Simulation Results:

The proposed technique for speech enhancement is implemented in a system having 8 GB RAM with 32 bit operating system having i5 Processor using MATLAB Version 2014a. Here for finding the efficiency and to minimize the error we used certain parameter such as

❖ *Root Mean Square Error*
❖ *Regression Coefficient*
❖ *Error Variation*

The formula used to compute these parameters are as follows,

$$RMSE = \sqrt{\sum_{i=1}^{n} \frac{(x_i - y_i)^2}{n}} \quad (15)$$

Where,

x_i - Observed Data

y_i - Calculated Data

n- Number of Observations

$$ErrorVariation = \left(\frac{(y_i - \hat{y}_i)}{y_i} * 100\right) \quad (16)$$

Where,

y_i - Calculated data

$$\text{Re}\,gression\ Coefficient = 1 - \frac{\sum (y_i - \overline{y_i})^2}{\sum y_i^2 - \frac{\sum \overline{y_i^2}}{n}} \qquad (17)$$

Table 1: Actual and predicted values for the round 1 using Fuzzy-PSO

Actual Value	***Predicted output using fuzzy-PSO for CSP***
43	*42.54517*
55	*55.03957*
56	*55.57097*
37	*36.86727*
63	*62.72037*
65	*65.11076*
65	*64.71016*
59	*58.99341*
48	*47.92635*
26	*26.13258*
21	*20.98925*
20	*19.71612*
19	*19.3482*
16	*16.43955*
18	*18.00972*

Actual value	***Predicted output using fuzzy-PSO for CSP***
16	*15.85333*
17	*16.81552*

15	*14.5323*
15	*14.90349*
14	*14.12014*
13	*12.73683*
12	*11.82682*
12	*11.84656*
11	*11.26426*
12	*11.67985*
14	*13.72292*
48	*47.8611*
71	*71.36539*
81	*80.59329*
91	*91.20383*

A deft appraisal of tables (1-5) enlightens us to assert the following:

- *Table 1 depicts the Actual and predicted values for the round 1,2 and 3 by means of Fuzzy-PSO*
- *The Regression Coefficient, RMSE and Error Variation make their august appearance in Table 4, in respect of the epoch-making method like Fuzzy-PSO*
- *In a nutshell, the overall evaluation better projects the efficiency of the mechanism, with CSP better-placed than the Photovoltaic technology.*
- *A captivating contrast of the efficiency of both Concentrating solar power and photovoltaic technology is colorfully presented in Table 5.*

Table 3: Actual and predicted values for the round 3 using Fuzzy-PSO

Actual	***Predicted output using fuzzy-PSO for CSP***
51	*51.38437*
56	*56.35253*
44	*43.5802*
38	*37.95033*
83	*83.1628*
82	*81.63538*
56	*56.07913*
53	*52.84092*
56	*55.72503*
45	*45.47029*
29	*29.35083*
31	*30.69741*
34	*33.93764*
42	*41.61919*
33	*32.60873*
20	*20.20996*

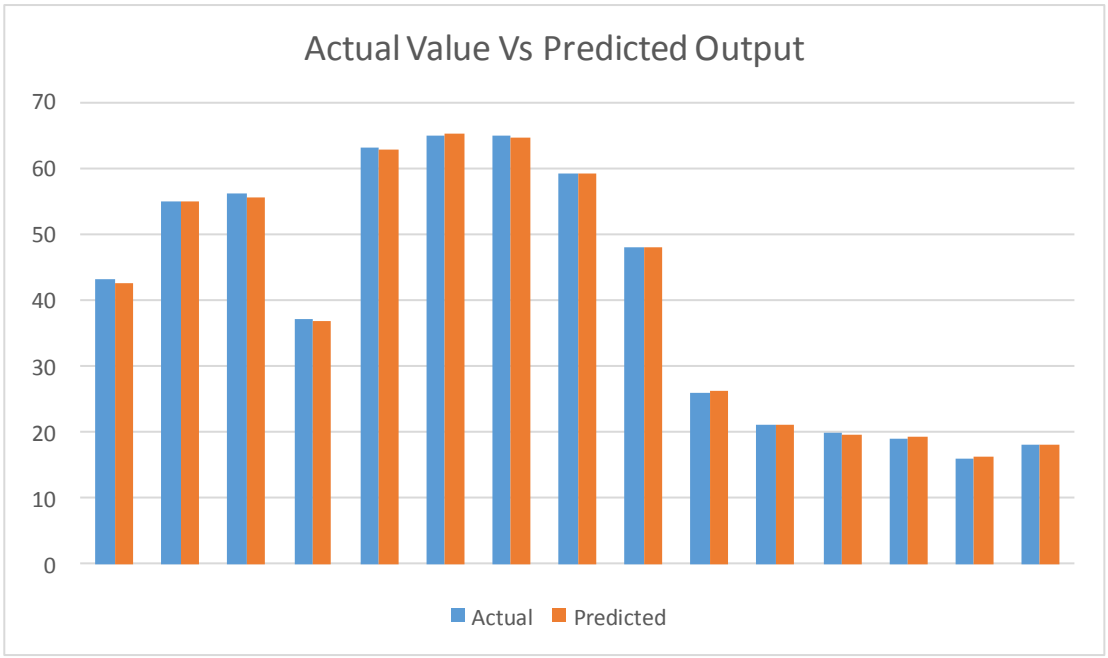

Figure 2: Actual and predicted values for the round 1, 2 and 3 using Fuzzy-PSO

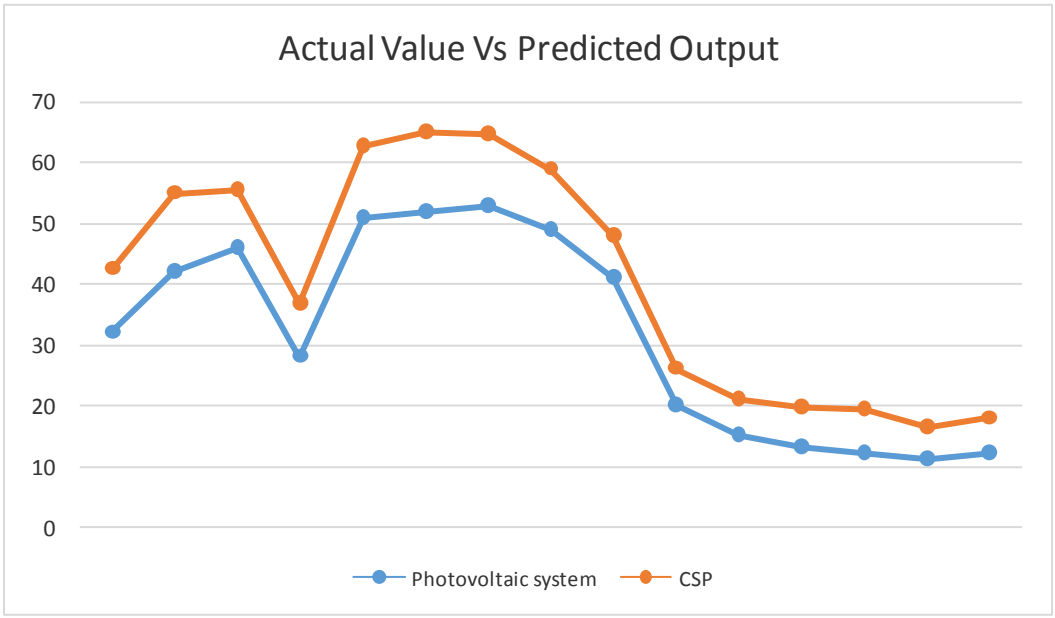

Figure 3: Comparison Output values of Concentrating solar power and Photovoltaic system

Table 4: Comparison of Parameter evaluation using Fuzzy-PSO

Parameters	***Concentrating Solar Power***	***Photovoltaic system***
RMSE	*23.7925*	*26.825*
Error variation	*7.8445*	*11.026*
Regression Coefficient	*0.3456*	*0.289*

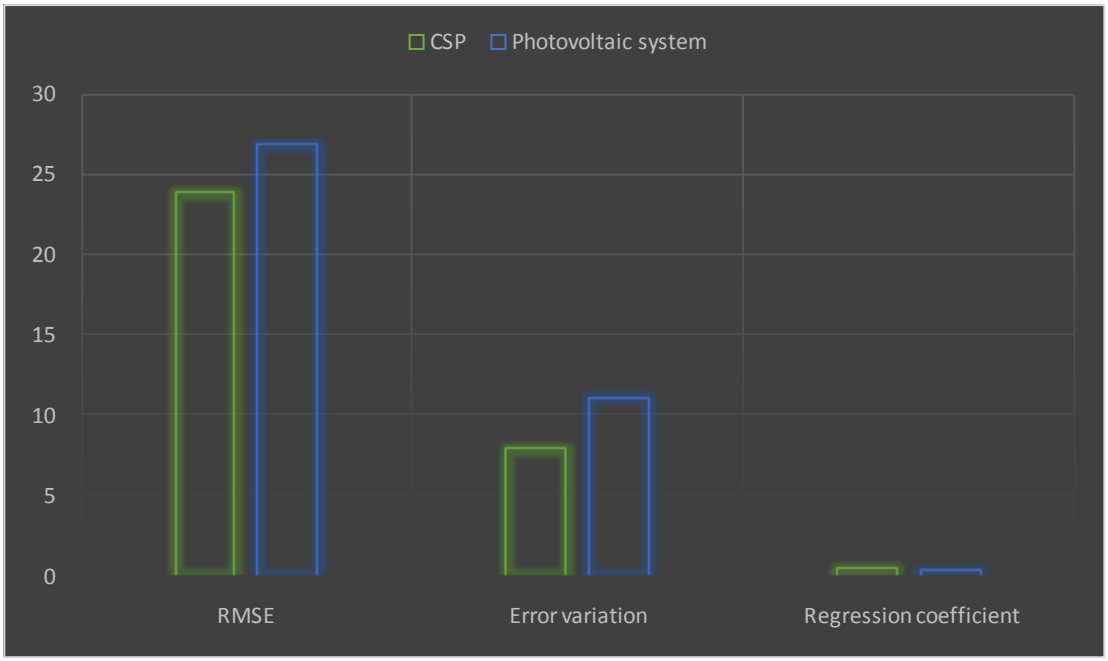

Figure 4: Comparison of Parameter evaluation using fuzzy-PSO

The assessment of figures (1-4) above takes us to the following conclusions:

- The predicted upshot is illustrated in figures for the analogous actual values.
- The concentrating solar power mechanism is analyzed and contrasted as against the photovoltaic system to demonstrate the unassailable edge of the former system over the latter.
- The Big bang technique establishes itself to be par-excellence in efficiency vis-à-vis modern peer approaches like the photovoltaic methodology.
- The appraisal metrics of constraints like RMSE, Error Variation and Regression coefficient have been effectively evaluated.
- The charismatic outcomes ushered in sings the success saga of the ground-breaking method in the realm of efficiency.

- The actual value and the predicted value tread the identical path projecting the efficiency of the much-coveted work.

5. Conclusion

In this document, we have taken pains to launch a proficient technique in with an eye on assessing the concentrating solar power efficiency and operation. In the initial phase, the neural network weighting pattern is employed with a view to replicate the input data. In the phase which follows, fuzzy classifier-dependent prediction is employed for training and testing the dataset to perform the forecast output. The third phase witnesses the deployment of PSO method to optimize the best results attained. Following, with the object of upholding the exactness and effectiveness of the mechanism, constraints like regression coefficient, RMSE value and error variation are estimated. Thus the forecast is performed fruitfully by means of our magnum opus method which corroborates the superlative efficiency of the system in relation to the rival Photovoltaic system.

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