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Comparative Analysis of Optimization Techniques in Wind Farm Layout Optimization

Gulshan Katre* | **Radharaman Shaha**

TulsiramjiGaikwad Patil College of Engineering & Technology Nagpur, Maharashtra
*Corresponding Author Mail Id: gulshankatre.44@gmail.com

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ABSTRACT

This paper introduces research results using a simulation method to compare the effectiveness and efficiency of the two algorithms redesign methods. Genetic Algorithm (GA) and Ant Colony Optimization (ACO). The data used is 2 regions, so the result shows that the ant colony algorithm is able to get a shorter distance than the genetic algorithm, but the genetic algorithm views a good end rate than the ant colony algorithm. Both algorithms are used within a global map that provides accessible nodes from the original location to the target.Performance between both algorithms was observed and evaluated in terms of mathematical efficiency by calculating speed and number of duplications, solution accuracy,variability and integration behavior.

KEYWORDS: wind farm, renewable energy, Genetic Algorithms (GAs), Ant Colony Optimization, objective work.

1. INTRODUCTION

Wind power has been growing worldwide for the past two decades. In 2015, the global power supply reached approximately 433,000 MW (Global Wind Energy Council, 2015). The study of the accumulated turbine accelerated by declining prices also continuous technological gliches, such as increased turbine length and rotor radius (International Renewable Energy Agency, 2012). Wind energy is the best Renewable Energy sources. Renewable energy is used primarily to provide clean and more energy efficient electricity. There are a few promising types of renewable energy sources, such as wind, solar, fuel cells, micro-hydro, etc. among others, wind power grows rapidly and is associated with positive energy. The demand for electricity is pleasing to wind turbines because of its many advantages such as low cost and really strong environment.

• In today's world an irresistible way to generate wind power. Conversion of wind turbine into electric phase involves major phases: main degree the conversion of kinetic electricity into mechanical power so that the shaft wind generator is pushed. The most important changing gadgets in this category are wind blades. The second degree is mechanical electricity held by wind blades and in addition is converted into electric power by windmills.

• Grid connection is specially pushed to the converter, miles are very important to maximize the overall performance of the main converter, which can be eliminated by using variable speed mills because the conversion efficiency can be very low. Large-scale post-wind farm production courses are conducted

locally, (a) wind farm improvements (b) Modeling wind generator procedures (c) Cost reduction (d) Planning and operation of grid (e) Energy and power management.

• These improvements have contributed to the growth of electricity for the operation of all wind generators. However, since wind generators are not available individually, however as part of a wind farm with multiple wind generators, it is important to keep in mind the negative effects of associated air awakening on the normal outflow of wind farm. When the wind hits the blades of the turbine rotor, electricity is released into the air, causing it to reduce the wind speed and affect the wind turbulence profile behind the turbine. This condition is called wake impact.

• Therefore, the special placement of generators on the wind farm, does an important job of designing and constructing green wind farms and may appear to be even more important in the future. The wind farm format problem is considered Nondeterministic Polynomial Time (NP) Completed, this means that the time required to get the actual response is more than polynomial in the case model, at least as long non-polynomial rules for NP. problems are found.

• Therefore, the use of heuristic search techniques, such as genetic algorithms, is often used in developmental problems, as right here the time of integration and the appropriateness of the response may be well measured (Chen, et al., 2013). A number of different heuristic techniques have been used in the wind farm format problem, including Simulated Annealing, Particle Swarm Optimization, Ant Colony Search Algorithm or Global Greedy Algorithm, Whale Optimization however "(...) The percentage of genetic algorithms is over 75 % development of wind farm format "(Shakoor, et al., 2015). While those heuristic strategies have shown affordable results, current drawings have been achieved in gradient-seeking techniques — primarily based entirely on location, surpassing genetic algorithms in quantitative and quantitative clauses.

• Genetic algorithms can be used extensively to overcome complex performance problems. This set of rules embraces the concept of the emergence of social issues and environmental choices within biological technology knowledge, in which people who are unable to keep up with them can be naturally removed. Simply put, genetic algorithms are used to create an exciting response from many pre-existing solutions.

• A set of rules for doing good an ant set is a set of rules that adopt ants' behavior. Naturally, ants can easily find a pleasant path from the nest to the good food source or vice versa. Ants within the colony, are able to find a place to visit primarily based on footpaths as a unique way of linking a route that has been given before. The more people in the colony walk the trail, the clearer it is that the colonists understand the previous route.As a set of development rules, ant colony algorithms are highly designed to solve route search problems.

Previous research has focused on a wind farm that is a square shape and usually excludes the height or effects of a country. The purpose of this is to increase the expected power of the wind farm by improving the configuration of its wind turbine facilities. A new version of the local impact is the use of real geo data in the process of remembering the effects of topography and land cowl on the electric field.

2. LITERATURE REVIEW

Feng Liu; Zhifang Wang "Algorithm with a flexible genetic novel algorithm for the improvement of the wine farm structure" IEEE, 2017 North American Power Symposium (NAPS) Morgantown, WV, USA.

In this paper we propose a flexible genetic algorithm (AGA) to improve the similar formation of a wind farm in according to the order to achieve the highest and greatest efficiency of combined energy conversion and also the presence of arousal effects. Instead of using random “crossover” in each duplicate as in standard GA, our proposed algorithm introduces the novel transport of “bad” turbines so that wind turbines facing the negative impact of arousal on the building will be moved to new and more efficient locations. Each AGA duplicate can therefore significantly improve the conversion of combined wind energy and greatly accelerate algorithm integration. We examine the proposed AGA also compare its effectiveness with the conventional GA based on a particular number of factors such as multilateral air distribution, coastal air distribution also inland air distribution, with minimal farm settings. The numerical outputs confirms the effectiveness of the proposed AGA algorithm which is assume to be able to obtain the correct structure at a fast

mixing speed and obtain more integrated compact air from the farms.

Daughter Sariff N. and Buniyamin N. (2010). "Genetic Algorithm and Ant Colony Optimization Algorithm - Comparison of Functions in Robot System Planning" CINCO, 7th International Conference on Information Management, Automation and Robots.

This paper introduces research outputs using the simulation method for comparing the effectiveness and efficiency of double-way editing algorithms. Both algorithms are used within a global map that provides potential locations from the first location to the intended destination. Performance between the two algorithms was compared and also evaluated for statistical efficiency by measuring speed and number of repetitions, solution accuracy, solutions variability and integration behavior.

Ignatius Rendroyoko, Ngapuli I Sinisuka, Deddy P Koesrindartoto .In 2019 the paper was presented at the IEEE conference. This paper discusses other ways to improve UC in energy systems with descriptive solutions in small grid energy systems with inter-crop RES. In this paper, a comparison of the strengths and weaknesses of each performance model is discussed, with the aim and objective of finding the most suitable development method to use. The problem in the UC system has been studied by experts using method numbers. The combination of mathematical strategies and stochastic / meta-heuristic techniques is proven to provide the best solutions. This study aims to develop UC in energy systems with RES power plants in RES. In particular, the energy system under study is a renewable energy system, either in islands or in remote areas. The proposed approach is to enrich existing development strategies, with additional innovations in analytical methods to improve the performance of UC schemes used in a small grid system.

Mohammad Amin Javadi; Hossein Ghomashi; Maryam Taherinezhad; MahtabNazarahari; RaminGhasemiasl "Comparison of Monte Carlo Simulation and Genetic Algorithm in Optimal Wind Farm Layout Design in Manjil Site Based on Jensen Model" IEEE, 2021, Shahrood, Iran Published: 7th Iran Wind Energy Conference (IWEC2021).

Proper arrangement of turbines in wind farms is very important to grab high power at very minimum cost. In the study, the use of the Vestas V-47 wind turbine and also single engine air to obtain and gain a full set of horizontal axis turbines in Manji l genetic and also Monte Carlo algorithms istruly investigated. The Jensen model is operate to mimic the effect of arousal on lower turbines. Purpose work is considered a measure of the cost and power of an electrical facility Under the similar conditions, the Monte Carlo algorithm will give 29% and 40% more better results in the terms of number of the turbines and also output power. In terms of efficiency, in the Monte Carlo algorithm, its eligibility value is less than 16% than the genetic algorithm, which indicates its improved development.

Ipaki, Jeong Woo; An, Bo Sung; Lee, Yoon Seung; Jung, Hynsuk; Lee, Ikjin (2019). The improvement of the wind farm structure using the genetic algorithm and its performance on the Daegwallyeong wind farm. Development of JMST, -. doi: 10.1007 / s42791-019-00026-z. This paper proposes a new approach to developing a wind farm structure based on a genetic algorithm using a simulation model that considers the effect of awakening. This approach consists of (1) the preparation of the bulk for the optimal formation of a wind farm to generate more energy on a large scale, and (2) the development after obtaining a refined structure to improve power generation on a smaller scale. The proposed two-step implementation facilitates the construction of a wind farm and can thus be applied to the construction of large wind farms. A case study of the real Daegwallyeong wind farm indicates that the wake loss is 2.3% good after a well-designed construction which is about 2.5% maximum energy production analyse to the old building.

Eroğlu, Y., &Seçkiner, S. U. (2012). The design of the wind farm structure uses the ant colony algorithm. Renewable Energy, 44, 53–62.

Air is a source of clean, abundant, and renewable energy. Big and large wind farms are being built around the world as a clean source of electricity, but operators are still looking for maximum efficient wind farm buildings to increase wind power capture. This given paper introduces an ant colony algorithm to maximize expected power outages. The algorithm estimates the enhanced wake loss, which can be calculated based on the location and area of the wind turbine, and the location of the wind. The proposed model is illustrated with three different wind speed

conditions and the distribution and execution of wind direction and, in comparison with the evolutionary algorithm strategy found in the literature. The results indicates that the ant colony algorithm works great and good than the actual current strategy, relaying on the maximumlevels of the expected energy given results and wake loss.

Alexander1, Haris Sriwindono2 "Comparison of Genetic Algorithm and Development of Ant Colony in Ending the Problem of Traveling Traders" Department of Information, University of Sanata's, Indonesia.
Abbreviated Travel Salesman Problem as TSP, an NP-hard problem commonly used in various programs. TSP is a polynomial problem, so the solution is visible. Next way to improve NP-hard obstacle solving is to use possible algorithms such as genetic algorithms, ant colony optimization algorithms, and more. In this study the genetic algorithm (GA) was utilised in the crossover order method and the same conversion act. Also use the ant colony algorithm (ACO). This study will analyse the execution of both the algorithms. The data utilised is 10, 20, ..., 100 cities, so the output shows that the ant colony algorithm can get a minimum distance with the genetic algorithm.
YunusEroglu, SerapUlusamSeçkiner "Wind farm design using ant colony algorithm Faculty of Engineering", Department of Industrial Engineering, Gaziantep University, 27310 Gaziantep, Turkey
Air is a source of clean, abundant, and renewable energy. Large wind farms are being built on around the world as a clean source of electricity, but operators are still looking for more efficient wind farms buildings to increase wind power capture. This paper introduces an ant colony algorithm to maximize the expected power outages. The algorithm estimates the wake loss, which can be calculated based on the location and area of the wind turbine, and the location of the wind. The proposed model is illustrated with three and more different wind speed conditions and the distribution of wind direction direction and, in comparison with the evolutionary algorithm strategy found in the literature survey.

Ying Chen, Hua Li, Kai Jin, Qing Song 2012) MSC 191, 700 University Blvd., Kingsville, TX 78363, USA
The efficiency of the building is one of the ways to increase the efficiency of the wind farm and power outage. Previous research has shown that different wind-length wind turbines can increase wind power output. However, a few studies have focused on increasing the formation of a wind farm in a two-dimensional area and location using different wind-length wind turbines. In this paper, the authors initially investigate the effect of utilizing various wind turbines on a small wind farm in power outages. Three various wind conditions are analyzed using a nested algorithm with various operations, where the results show that the wind farm using different wind turbine will be multiplying even when the total number of wind turbines are the similar. Different cost models are considered in the analysis, and results indicates that different hub-length wind turbines can also increase or enhance the cost per unit of wind farm. Finally, a big wind farm with commercial wind turbines is being analyzed to another consideration of the benefits of using different wind turbine wind turbines in actual life fundamentals.

KarthikBalasubramaniana, SudhakarBabuThanikantib, UmashankarSubramaniamc, N.Sudhakar d and Sam Sichilalue Institute of Power Engineering, Department of Electrical Power Engineering, Tenaga National University, IKRAM-UNITEN, 43000, Selangor, Malaysia (2020) "Review a novel in the development techniques used to model a wind farm "Significant interest and efforts have been made by industry and research institutes for the production of renewable and clean electricity from the maturity of existing technologies. With the reduction in oil prices, renewable energy is a key to generating more efficient and environmentally friendly electricity. Of all the available renewable energy sources, Wind Energy is at the forefront of its ability to generate electricity efficiently and generate energy on a large scale. Due to the indirect nature of wind power, development strategies are very important as they are responsible for building an efficient wind farm. The layout of the structure is done using soft computer techniques and is widely read in the literature available. Therefore, this review paper highlights important research activities for wind farm modeling using development techniques. This work also deals with new methods used in modeling a wind farm. In addition, it also presents an important evaluation of existing research methods used for the improvement of wind farm

structure. Therefore, the purpose of this work is to benefit scientists and newcomers to the field of modeling and efficiency of wind farm design.

3. MODELING METHODS USED IN WIND FARM TECHNOLOGY

Wind turbines use strong winds to produce electricity. A wind turbine is a rotor-mounted machine with propeller blades. To produce power, the blades are arranged horizontally in a horizontal direction. Wind farms are situated in regions with maximum wind speeds. This generated gas is supplied to certain stations through an electrical grid. The wind farm includes many wind turbines usually about 50 m long and wide. Air movement will increase with increasing altitude. Therefore, wind turbines are usually built at higher altitudes. It is noteworthy that mechanical power during high wind speeds should be controlled and maintained. The diagram shows the structure of the air engine system. The figure shows many features of a Wind turbine system that includes a gearbox and a grid-connected machine. The figure further highlights the conversion stages that include the first conversion and the second conversion.

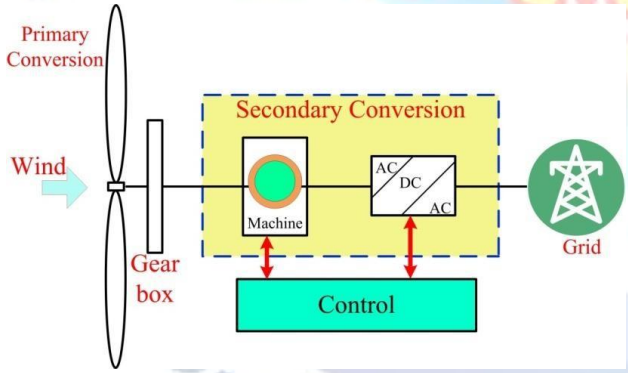


Figure- 1.1. Wind turbine system structure (Novel Review on Development Strategies Used in Wind Farm Model)

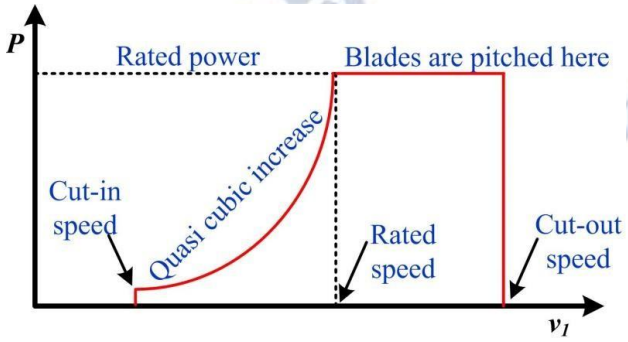


Figure 2. 2. Wind Turbine Power Outflow (Novel Review of Development Strategies Used in Wind Farm Model)

Key options in wind turbine construction and construction include:

Number of blades (usually two or three);

Rotor orientation: descending or ascending wind of a tower;

Blade material, construction method, and profile;

Hub design: solid, moving, or frozen;

Power control using aerodynamic control (table control) or variable-pitch blades (voice control);

Adjusted or variable rotor speed;

Direct control by direct action (free yaw), or direct control (active yaw);

Synchronous or input generator (squirrel cage or double feed);

Gearbox or direct drive generator.

Windmill General Specifications:

General Information of Windmill	**Power** of Windmill	**Tower (Under Pivot)** of Windmill	**Rotor** of Windmill
Nominal Output 3.50 kilowatt	5.0 MPH (2.20 meter/sec) Cut in speed	Tubular-Steel Monopole	Diameter 8 feet (2.40 meter)
High End Output 5.0 kilowatt	1,500 watt at 22.4 mph (10 meter/sec)	18 feet (5.4 meter)	DAWT Swept Area 50.20 feet2 (2.40 meter2)
Horizontal Rotor Shaft	3.50 Kilowatt Generator	8 Bifacial Solar Panels	8 Bifacial Solar Panels
Grid Connected Operation	Direct Drive – Gearless		
Hub Height 25.5 feet (7.63 meter)			

Reducing energy costs

The cost of wind farm (WF) is divided into total energy production, is widely used in literature and is a widely used activity for:

Power Cost = CostPtot

Where 'Cost' represents the cost of a wind farm, Ptot is the total production power model for light work based solely on the number of wind turbines:

Cost = Nwt = (23 + 13e − 0.00174N2wt)

Energy costs are very important. Energy efficiency, which improves energy efficiency in wind farm technology ultimately results in lower costs

Increased energy production by year

The maximum annual power supply provided is investigated within the following references. The combination of turbine power combined with the distribution of wind speed over the wind speed spectrum can be explained due to the power of the year.

AEP = ∫VminVmax P (V) f (V) dV

where P (V) is the wind turbine power source, f (V) is the wind speed distribution.

Wind farm planning uses many efficiency techniques

4. ENHANCED GENETIC ALGORITHM

1. Hybrid Genetic Algorithm (HGA)

GA and traditional performance algorithms have respectively flaws. Many of the common development methods used in engineer construction require a better set of initial dynamic design values, and then combine quickly to produce the best results. However, many of those development algorithms face similar difficulties, such as the long trial-anderror process in finding a better set of original design variations or slower combinations. The original design flexibility set is determined and different sets of original design flexibility will provide a wide range of high quality results. Therefore, the method of selecting the best starting values for design variables is an important step for those traditional methods. When it comes to using GA, it has the advantage of working in a random environment. Although GA can find a solution for the whole domain, it does not easily solve the problems that it has, especially the specific issues. To overcome this difficulty, a new hybridization process, which combines GA with common improvement methods, was introduced in this study. In the first step of the process, GA is used to provide a set of initial design flexibility, thus avoiding the experimental process; after that, traditional algorithms are used to determine the best results.

2. Interval Genetic Algorithm

Development algorithms are well developed in long-term engineering; however, many upgrade algorithms detect methods in order to obtain high-level editing design variables. However, it is not always easy to make flexibility in engineering, due to job inefficiencies or errors within the production process itself. In addition, production often costs more. Periodic preparation is one of the algorithms that can overcome this difficulty. In the standard interval setting, the interval analysis is provided within the interval development process. the purpose of the periodic analysis is to generate upper and lower limits on the effect of all such errors on the calculated value. A good interval would be a parallelogram or circle inside a complex plane; or intervals in size and half may be used. Because the statements are higher than the indicators, a periodic analysis is necessary and necessary to improve the frequency. By mistreating the interval analysis, it is precisely to capture the final relationship between system performance, system parameters. however the formation of interval differences is often not easy to determine, especially with complex systems. during this chapter, an intermittent development technique, proposed known as Interval Genetic (IGA) law, is proposed. With IGA, the important thing is to get the right time parameters. Additionally, not only a temporary analysis can be included in the development method, but an increase in the width of the interval style can be achieved.

It is often not easy to make an accurate style variation in engineering, due to work errors or errors within the production process itself. In addition, production often costs more. Periodic adjustment is one of the rules that will overcome this difficulty. The genetic interim algorithm seems to be faster and more reliable than the well-known simulated anealing, as the search for the earth's minimalism is completed using a number of points. due to its quality the proposed method is compatible to develop multiple modal functions; in less complex cases the process of minimizing space. The genetic interval algorithm was created based on the speed closest to human size. The slides of the genetic rule are given as follows: No. 1: Set up the values of the give control parameters within the algorithm. Let t = 0, and start the number of people named x (t),.No.2: The validity of the associated interval is assigned to one person. No. 3: Open people by choice. No.4: Perform crossovers and conversion operators according to formulas, and produce from spring. Enable t = t + 1. No.5: select if the termination condition is occurred, if yes No. 6: then go to No..7; if not visit no. 2. No. 7: Uninstall the optima and set up the algorithm.

3. Hybrid Interval Genetic algorithmic (HIGA) system

With the advancement of computer skills, periodic analysis and periodic preparation are respected and used in every way in recent years. The hybrid interval

GA genetic algorithms is a combination of every genetic hybrid algorithm and the genetic interval algorithms. In engineering, the spatial planning of this method is widely used in building construction. In the actual immune gamma globulin within the upper class than the phase, the target E-error is calculated from the improved statistics. In fact, it is straightforward to define and perform system statistics into a simple system, yet complex systems are often difficult to achieve. In addition, a simplified system equation is sometimes difficult to find suitable solutions. to overcome that difficulty, the technology combines immune gamma globulin with the Finite part technique (FEM) code for the temporary preparation provided during this phase.

Ant Colony Algorithm (ACO)

Ant colony optimization (ACO) has changed every other set of rules to deal with various efficiency issues, the set of rules also produces the behavior of real ants and a colony within a food search strategy.

Related Activities:

The authors familiarize themselves with the ant colonies' rules of magnification of preferred power, taking into account the loss of power determined in the form of a wind turbine circuit and air space. The results show that this process produces higher results than a set of evolutionary laws. The ant colony algorithm is given in Fig. 6. Information of the flow chart stairs provided within the algorithm.

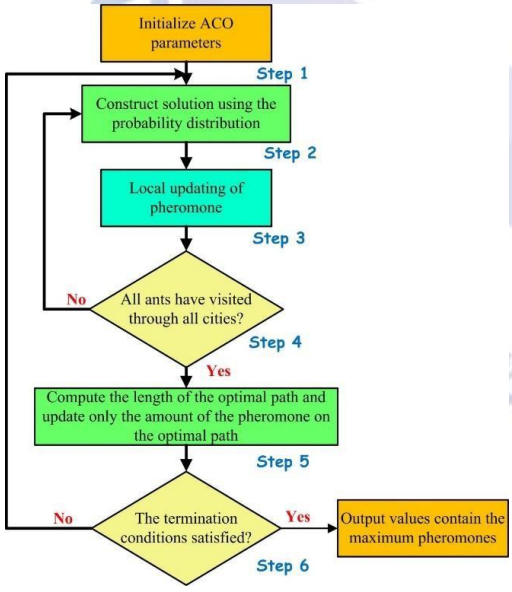


Figure- 3. Ant colony algorithm (Novel review of Development Strategy Applied to wind Farm Model)

Features of Ant colony algorithm

The ant colony algorithm mimics the behavior of important ants while they emerge from food.

- Ants indiscriminately explore areas in search of food.
- When the ant finds the source, it returns to its nest.
- Throughout the journey, ants leave the path of the pheromones.
- The secret value will increase in line with the price of food
- Ants following the first ant follow the pheromones attached to the first ant.
- As a result of this transaction, the pheromone placement in the channel is strengthened.
- The amount of bleeding in all winds can evaporate.
- If there are 2 ways to promote the same food supply, the hymenopter finds a shorter route between its nest and food.

The first step involves the activation of the pheromone pathway. each ant builds complete appreciation for the difficulty of complying with the law of the land reform that relies heavily on the pheromone world. Finally, the final amount of pheromones reaches this actual point in stages; the vapor component are given where part of the pheromone evaporates, and the solvent part where each ant sets a secret value is equal to the life of its solution, this process is repeated until the condition is going off to the block. Hence, Proven locally in the form of pseudocode.

Rajasthan wind project - Jaisalmer (WPPJ) :-

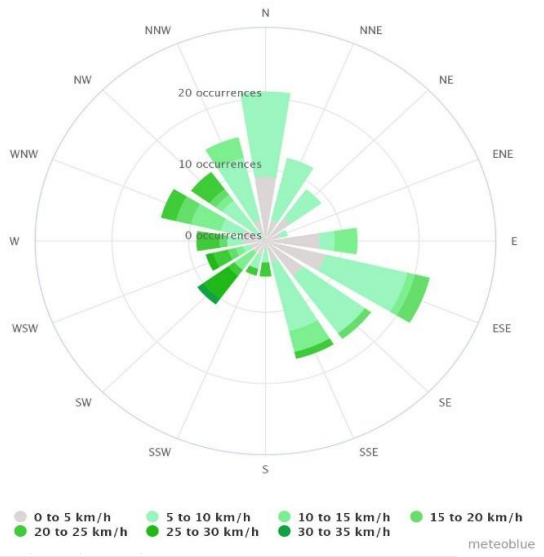
The Jaisalmer wind project is installed in the 50 MW operation which is located in the Village-Lakhmana, Tehsil-Fatehgarh, Dist.-Jaisalmer (Rajasthan) India.

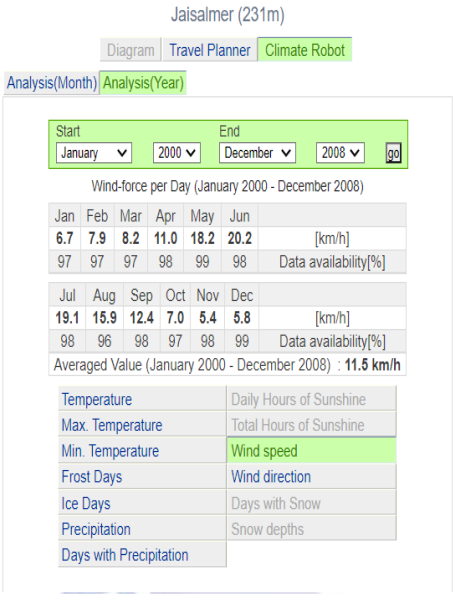
Contract instead the best price for the whole range of services under the EPC agreement is Rs- 302.50 steel contract with O&M for 10 years Rs- 47.fifty 5 cr.

Power agreement signed with Rajasthan State Discom. In addition, the Project registered under Generation is largely based entirely on the Incentive (GBI) @ Rs-50 unit funding component of IREDA, Renewable Energy Certificate (REC) at NRLDC respectively. The power station currently operates with Inox Wind Limited, Noida for a period of 10 years.

Location - Village Lakhmana, Jaisalmer District - (Rajasthan)

Nearby airport - Jaisalmer (Indian Air Force) 46 km, Jodhpur AirPort (Domestic) 245 km





Wind Rose Diagram for Jaisalmer
Wind speed of Jaisalmer

Technical Features-

WTG details: -

Manufacture of WTG	Inox-Wind
Limited	
Type	TC III B
Rated Release	2000 Kwh
Voltage	690 V AC, 3
Phase	
Cut the wind speed	3 m / s
Cutting wind speed	20 m / s
Hub height	80 m
Blade details	
Blade	3
Material	Glass Fiber
Company rating	Inox Wind
Limited	
Rotor Diameter	93.3 m
Height	45.3 m
Details of the Tower	
Height	77.4 m
Type	Tubular
Metal Items	Steel
Categories	4
Transformer details	
Type	Outdoor
Average	2300 kVA
Measured with Voltage	HV:

33kVLV: 0.69 kV

Limited Generation
Air density 1.130 Kg / m3
Installed Capacity 25 x 2 MW = 50 MW
Capacity Factor 21.54%
The average annual unit for a generation of 37.7 Lakhs per WTG
(P90 level) 94.25 MU per year

5. CONCLUSION

Three types of advanced genetic algorithmic rules are provided to overcome various technical problems. In HGA, a genetic algorithm is used to provide a set of original style mutations, to avoid the testing process; and another development algorithm is used to determine the best results. This new interval method is called the Genetic algorithmic rule and the Interval Genetic algorithmic rule (IGA). they are usually not included in this interval setting. This hybrid algorithm will extract mathematical formulation and interval analysis and determine the best interval parameters. It is concluded that the hiring of the ACO algorithmic system will make it easier to search for high-energy facility facilities than in previous studies while it is uncomfortable for many parents in the selected problem during the purchase response period. The performance of the planned algorithm was generally smarter than that of the existing algorithm proposed for ongoing problems, so it is clear that the algorithm for victimization ACO helps to gain an international quantity compared to our ongoing work. For example, although this issue improves wind farm power production, it still requires an integrated value model

compared to investment costs, maintenance costs, and more. Right in the middle of the farm. We can determine the list, of the remaining questions.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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