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Analysis of Gujrat for Optimization Wind Energy using Genetic Algorithm

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ABSTRACT

The establishment of a new wind energy project necessitates the examination of numerous variables in order to maximize advantages while minimizing harm to the atmosphere. Article represent, an methodical structure based on GIS and fuzzy is applied for to discover the ideal position for wind turbines to produce the most electricity. Atmosphere, physical, and societal factors all contribute to assessing if a region is suitable for energy efficiency. Gujarat's wind farm locations can now be better determined thanks to the findings of this study. The study's findings show that wind farms along Gujarat's western coast are a viable option. An energy planner or a decision maker could use the proposed model to help them decide the location of a wind turbine in the future. For a variable-speed wind energy conversion system, this research aims to find the best parameters for the frequency converter employs PI controllers. . In order to optimize the controller parameters, GAs might be employed.

KEYWORDS: Genetic Algorithm –GA, Frequency Controller PI controller, Gujrat Wind Farm

1. INTRODUCTION

Now Wind is applied for by the uneven circulation of temperature and pressure around the world. Many factors influence the wind's speed and direction, including topography. Many countries' principal focus is reducing by deploying new energy sources based on renewable power; they can lower their dependence on fossil fuels. The enormous capability of renewable energy to lower CO2 secretion and hence safeguard the atmosphere is another key contribution. In terms of renewable energy, wind power is main source major source. Wind energy important type for 68.9% of India's total grid-interactive or grid-tied renewable energy (excluding hydroelectric power plants), countries that photovoltaic (PV) solar energy represents a total value of 4.59% of India total renewable energy capacity. Table 1 illustrates the capability of India's renewable energy technologies. Even though wind power does not generate any harmful emissions into the atmosphere when producing electricity, there are still some detrimental effects on society and the atmosphere. Many learners have learned many aspects of wind energy to stretch many years. For additional economic benefits, site selection procedures, atmosphere real implications, and so on and so forth. An evaluation of the wind energy systems in a certain location. The purpose of this investigation was to examine all facets of the wind energy infrastructure in Gujarat, India. Gujarat has the country's longest coastline, stretching from the Arabian Sea to the Arabian Sea. Over 10,000 MW of power may be generated from inland wind installations. Since April of this year, India's wind power capacity has

topped 3.11 GW [3]. Table 2 lists the sites of 15 wind farms, the majority of which are in Gujarat's western region. Over a period of 25 years, more than 65 sites were studied for wind speed and wind power density, out of which more than 50 sites were identified to be suitable for capturing Wind Power by Gujarat Energy Development Agency (GEDA). Site suitability for wind farms is assessed using structure projections that take into account human, physical, and atmosphere aspects. There are a variety of elements that go into determining wind resource and proximity to a substation or other terrain-dependent infrastructure, including human factors like proximity to development, public enjoyment, and agricultural use of the land.

OBJECTIVES

Wind farm of Bhuj situated in Gujarat state consists of 34 1.5-MW wind turbines coupled to a 25-kV distribution system, which exports power to a grid via feeder. The same feeder is applied for both loads. In addition to monitoring machine speed, voltage, and current, the wind turbine and the load both include built-in protection systems. The PMSG's DC link voltage is likewise being tracked.

A genetic algorithm is applied for to manage a PMSG and an AC/DC/AC IGBT-based PWM converter in wind turbines. The rotor is fed at a variable frequency via the AC/DC/AC converter, while the stator winding is directly connected to the 50 Hz grid. To maximize energy extraction at low wind speeds, PMSG utilize optimal turbine speed technology to alleviate mechanical stress on wind turbine turbines. Another advantage of PMSG technology is that it increases the capacity of the electronic power supply or absorber power supply, as well as the speed of the wind turbine inductors generator.

2. RELATED WORK

Numan Etin; Mustafa Mosbah; and Karim Sebaa are Raimon Bawazir's coworkers. Voltage stability can be improved through optimal integration of the wind source with the help of a genetic algorithm. Electrical engineering will be the focus of the IEEE 2020 International Conference (ICEE)

Wind energy-based Distributed Generation (DG) must be integrated into the electrical grid in order to modernise it. Due to the fixed supply of fossil fuels and the growing preference for clean energy, a source like this has already become important. Wind turbines (WT-DG) are the focus of this research, which examines the best way to integrate WTs all of the system. Using a Genetic Algorithm, this is accomplished by finding the best locations and sizes for WT-DGs to maximize voltage stability (GA). The conventional 30-bus modified power network is studied using MATLAB code in this study. The simulated findings show that as the number of WT-DGs in the network increases, voltage stability improves and power loss decreases.

Modified Genetic Algorithm for Wind Energy Based Grid Connected System Optimization by Veeresh S Gonal and GS Sheshadri.

International Conference on Technology Convergence (ICTC) 2018 (I2CT)

Energy is viewed as a critical resource for both economic and social development it's one of the quickest ways to put it to use in business. And it may be applied for efficiently for home purposes. As a result, there is an even greater rise in demand. An increase in energy output will be achieved. These sources of energy rely on climatic conditions that create a gap in output attributes like atmosphere al parameters. As a result of this, wind power approaches and strategies could be improved. Main considerations for wind farms are the wind turbine process, stability, control techniques, and Power Quality (PQ) issues. The earlier study on wind energy systems recommended using PSO, Genetic Algorithm (GA), and other optimization approaches and controllers. This category of GA has various difficulties including very low convergence and huge computational time. The Modified Genetic Algorithm (MGA) is applied for to optimize in this work for grid linked wind energy system. Total Harmonic Distortion (THD) and computation time are lowered with MGA and compared to GA, fuzzy logic control using MATLAB. Simulink

Amir Kazari; Hashem Oraee; and Bikash C. Pal,

Energy Storage Requirement for Power Fluctuation Mitigation Using Wind Farm Layouts, IEEE Transactions on Sustainable Energy (Volume: 10, Issue: 2, April 2019)

Page(s): 558 – 568 Studies in the literature have been done to maximize wind energy capture by optimising wind farm (WF) layouts Power spectrum density theory reveals that the layout of a wind farm (WF) has an impact on the total captured energy and the level of

power fluctuation, which in turn impacts the capacity of a battery energy storage system (BESS) needed to counteract this intrinsic power fluctuation. The outcome of the WF project on the energy level and the capacity of the BESS is present simultaneously, so that the problem of optimizing the WF project is reduced. However, the objective function is optimized using a genetic algorithm.Wind data from an actual offshore WF is applied for in the proposed technique and optimization process. Energy curtailment is analysed using a novel index that measures power variations. It is shown that power fluctuations are lowered and energy curtailment is improved by comparing real design with best design in different price lists Different BESS technologies have also been examined to see what effect their parameters have on the optimization results.

Renewable Energy Power System Frequency Control using PID Controller and Genetic Algorithm, 2020 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC)

Wind Generation (WG), Photovoltaic Generation (PV), Diesel Generation (DG), and a storage battery were all included in the hybrid power system presented in this study. In order to enhance the wind turbine blade pitch system's dynamic performance, a proportional integral derivative (PID) controller was developed. To lower the system's oscillation, (Super-conducting Magnetic Energy Storage (SMES) with a first order lead-lag controller was installed, which would supply and absorb active power quickly to achieve equilibrium among supply and demand and so manage system frequency. “Wind turbine PID controllers are designed with two goals in mind: minimizing frequency and wind output power variations. SMES's lead-lag controller also monitors variances in frequency and diesel output power. Employed an NSGA-II modified version to tweak parameters of the controller's parameters. Matlab ® simulations confirmed the proposed /Simulink ® method's robustness and effectiveness. We assessed the controllers' ability to dampen all frequency and output power fluctuations and improve system stability and dependability based on simulation results.

Grid-Connected Wind Storage Capacity Optimization Using an Adaptive Genetic Algorithm, IEEE,2018 China International Conference on Electricity Distribution, Mei Hongkun, Fu Jun, and Jia Chunjuan (CICED)

The electrical grid will be disrupted by the addition of grid-connected wind generation. The design of a grid-connected wind-storage power generating system relies heavily on the allocation of wind-storage capacity in order to minimize power fluctuation. The wind and stored electricity are simulated together. We use an adaptive approach.

Improved energy storage device discharging and recharging approach by genetic algorithm. It is possible to quickly determine the optimal number of fans and batteries based on a year's worth of real-time wind power data, with the probability of fluctuation exceeding a predetermined limit serving as the objective function and the charge and discharge of batteries serving as the constraint function.

Mohammed Ouassaid, Mohamed Maaroufi, and Meryeme Azaroual

Smart Grid Tied PV-Wind-Battery Hybrid Power System Optimal Control for Energy Dispatching, IEEE, 2019 Third International Conference on Intelligent Computing in Data Sciences (ICDS)

Energy scheduling in a grid-connected PV-wind turbine-battery storage system is the goal here. As a result, the model's goal is to lower electricity costs and maximize grid sales. The optimal control computation takes into account the time-of-use (TOU) power tariff. This problem is solved using a combination of 'Linear Programming (LP)' and 'Genetic algorithm (GA)' techniques. An industrial load case study and the simulation results show that the created control minimizes the operational costs of the examined system and the customers can receive a significant income from the sale of renewable energy. Using LP-based OC instead of GA saves money and resources, as shown by the simulation findings, the researchers said.

Hazem There is Fathy Mohamed, Naggar Hassan Saad, and Khaled Abdel Aty. In Grid Connected Wind Energy Based PMSG by DSTATCOM, Salah Eldin, "Moderation of Voltage Sag and Swell," Voltage and frequency management and stability must be considered when integrating wind power into the existing power system. IEEE, 2018 Twentieth International Middle East Power Systems Conference. Using a genetic algorithm to find the ideal settings for the tuning gains of the PI controller, a control approach for grid voltage regulation has been described in this study. Wind

energy based on Permanent Magnet Synchronous Generator (PMSG) grid-connected systems can benefit from the control of DSTATCOM. In addition, the flow of power has been restricted. DSTATCOM has improved the power quality of the grid-connected wind energy system. Using Matlab/Simulink, the system is tested and the findings show that the different dynamic changes of the system respond very well and that their dynamic responsiveness is improved.

Power Generation on a Microgrid: A Memory-Based Genetic Algorithm, by Alireza Askarzadeh Renewable and Sustainable Energy (IEEE) (Volume: 9, Issue: 3, July 2018)

Improved grid situational awareness and the ability to react quickly to changes in power generation are two of the most significant goals of smart grids. All of the necessary data is collected and an optimization problem is solved, and the correct distribution of energy is returned to each DER by the energy management system (EMS). Several distributed energy resources (DERs) are optimally distributed in this research using a memory-based genetic algorithm (MGA). The MGA is applied for in the smart grid architecture to lower energy production costs. Microgrid that include wind, solar and combined-heat-and-power (CHP) plants are able to optimally distribute their electricity generation. Particle swarm optimization, genetic algorithms, and the MGA's results are all compared to see how well the proposed technique performs in the real world. The proposed MGA method's superiority is reinforced by simulation results.

Wind farm optimization utilizing Nelder-Mead and Particle Swarm optimization, IEEE, 2021 7th International Conference on Electrical Energy Systems, Bhavya Bhardwaj, J Jaiharie, R Sorabh Dadhich, Syed Ishtiyaq Ahmed, and M Ganesan (ICEES)

Atmosphere lists all over the world are becoming increasingly interested in wind energy as a clean and renewable energy source. In order to maximize the layout of wind farms, firms and governments are increasingly investing in and expanding wind farms. As a result of the wake effect, a wind farm's output is diminished and the company's earnings can be affected. Because wind farms might contain dozens or even hundreds of turbines, maximizing their output while using the least amount of space is a challenge. This work advocates combining the use of genetic algorithms, Particle Swarm Optimization (PSO), and the Nelder-Mead Simplex Method for optimization in order to solve this challenge. A method for greedy search is applied for in conjunction with Nelder Mead and PSO. It is possible to increase annual production by 4-7 percent by using the strategy that will be discussed in the next sections. The Jensen's model is applied for to calculate the wake effect in the optimization problem. For a wind farm with 50 turbines and a size of 4000x4000 m2 and an AEP of 526GWh, the final result was achieved. Otchere, Otchere, and Kyeremeh have developed an adaptive PI-GA-based technique for automatic generation control with the integration of renewable energy.

A strong autonomous generation control system is required for the traditional power grid to maintain the balance between generation and demand in order to improve system reliability. To guarantee the stability of the electrical system, it is necessary to have a flexible control strategy to improve the penetration of energy through our solar and electrical energy installations. It is necessary to use a genetic algorithm (AG) based on proportional adaptation (PI) and a proposal for a thermal plant for the recovery of associated areas with renewable energy (FER). In the MATLAB / Simulink environment, the test system is simulated. The proposed method has been demonstrated and demonstrated that a certain frequency and time of establishment for the established establishments. The application is a point of reference for checking the number of parts.

'Energy Europe in India' by R. Bakshl, IEEE 2002 IEEE Energy Community Energy Association. Atos of a meeting only the following summary form is provided. Compared to other renewable technologies available in India, grid-connected wind power generation has acquired a high level of attention and acceptance. More than 6.75 billion kilowatt-hours of electricity have been generated by wind turbines in the United States since March 31, 2001. In one of the world's greatest programmers for wind resource assessment, India has covered 25 states and 900 stations with its Wind Resource Assessment Program (WRA). The total wind potential is predicted to be approximately 45,000 MW, while the technical potential is anticipated to be around 13,000. The fact that private industry has shown such an interest in India's wind energy initiative has been

particularly noteworthy. Those involved in the construction of wind farms for industrial use

Akshay K. Ahirwar, Zakir H. Rather, and Santanu Paul ‖ India's Gujarat Coast is the ideal location for a 1 GW Offshore Wind Farm Project, with an optimum and cost-effective cable connection. IEEE expects to have a new standard in place by 2020 this is the IEEE International Conference on Electrical Power Systems (IEEEES) (PEDES)

In recent years, wind power in India has grown significantly, accounting for almost 10% of the country's total installed generation capacity. Offshore wind energy is also being researched in India's coastal state of Gujarat. Wind turbines (WTs) for a 1 GW offshore wind farm (OWF) off the Gujarat coast will be connected using this paper's optimal and cost-effective technology. The OWF has 500 WTs, each with a 2 MW output. This research will focus on a portion of the OWF's proposed configuration (about 25% of the total capacity). The sweep method is applied for to identify the best number of WT clusters, and then the Clarke and Wright saving technique is applied for to minimize the length of undersea cables for each WT cluster. WT clusters each have an offshore substation attached to them (OS). Submarine cable costs have been taken into account in this study, and the best location for OS has been found.

3. METHODOLOGY

The study area is a state of Gujarat located in the west of Table 2. The table shows the European generation capacity in 2011 and the annual capacity of a single turbine in India between 20˚N and 24˚, and 68˚E - 74˚ E and Figure 1 obtained by GEDA. The area cubes casi 196024 sq. km with 26 districts. Nest a area, humidly cube 2113.86 sq. km, agriculture 93967.60 sq. km, urban land 1981.85 sq. km etc The western part of Gujarat has a cost of 1,915.29 km to the longest in Mar Arabia. The altitude is between 0 and 1050 m. The potential agricultural population of the State of Gujarat is measured in Figure 2, the map of the national areas of the United Nations Development Program (PNUD) in 2006. As can be seen in Figure 2, the eastern part of my potential energy in comparison with the western part..

Flow Chart:

Simple Genetic algorithm ()

{

Initialize population;

Evaluate population;

{

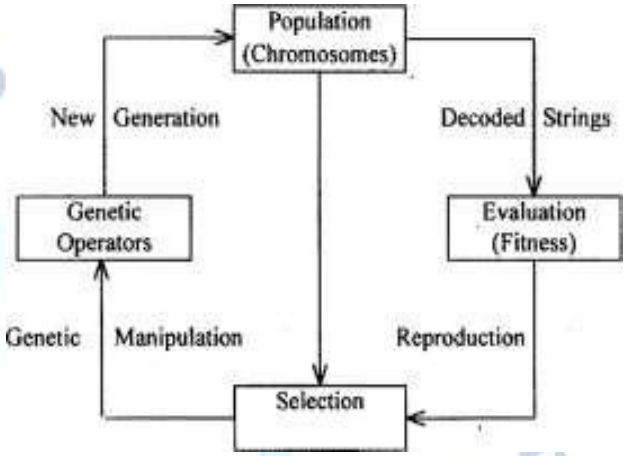
Select solutions for next population;

Perform crossover and mutation;

Evaluate population;

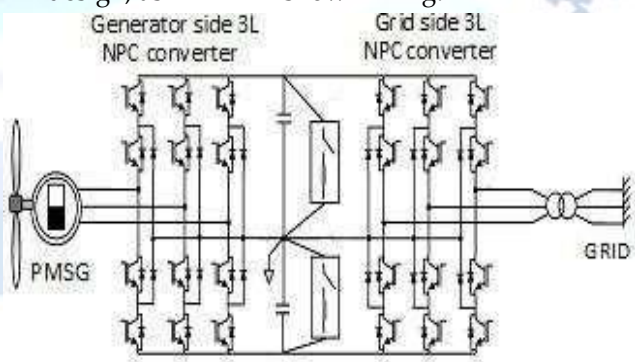
}

} while termination criteria not reached



Modeling of Control of Frequency Control

- Figure illustrate the schematic diagram of the VSWT-PMSG topology that was employed Article represent. A generator-side ac/dc converter, a dc-link capacitor, and a grid-side dc/ac inverter make up the frequency converter. The converter and inverter both use a three-level (3L) neutral-point clamped (NPC) design, as shown in Fig.



4. FUTURE SCOPE AND CONCLUSION

Analysis of the dynamic behavior of a wind farm consisting of multi- wind turbines. The topics of future scope would be to study the overall dynamics of the wind farm, the effect of unequal wind speed distribution on the mechanical and electrical power variation within the wind farm

• Analysis of the wind turbine system with more realistic power grid models, where other type of

generators like synchronous generators are also present. Similar study can be done in those power grids to evaluate the use of a STATCOM in such systems

• The steady state characteristics of the wind turbine system shows the better performance of the system at higher rated rotor speed. For example machine needs to develop less electromagnetic torque at higher rotor speed operating at rated power. As a result the stator as well as rotor side current decreases which results in smaller current rating required for AC/DC/AC converter and improved efficiency of the WECS. Reactive power capability of the also gets better at higher rotor speed generating rated active power. At the same time, higher rotor speed requires higher gear ratio and the higher voltage magnitude is developed at the rotor side. Considering these facts, further study can be done for the higher speed operation of the wind turbine By utilizing MATLAB Simulink, this project models the wind energy system and then determines the best controller parameters to utilize when transitioning from VSWT-driven PMSG to wind farm grid code, the frequency converter is switched on and off appropriately. Using GA approaches, accurate controller settings may be determined. Even in the case of an asymmetrical fault, the parameters were effective. The wind farm's GAs-capability should be acknowledged. An inverter/converter architecture that has been widely employed in variable-speed wind energy conversion systems can benefit from the optimum design technique adopted in this study.

Conflict of interest statement

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

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