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ABC and TLBO Hybridized Algorithm Based Reactive Power Compensation for DFIG Based Wind Farms - A Survey

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Abstract: **Continuity in the development of the human race ultimately needs sources of renewable or virtually inexhaustible energy such as wind renewable energy resource. The history of wind energy describes a general evolution from the utilization of simple, light equipment's driven by aerodynamic drag forces; to heavy, material-intensive drag equipment's; to a rise in the utilization of light, material-efficient aerodynamic lift equipment's in the modern period. Wind energy is essentially looked at in the area of public policy, economics and managerial perspectives. Due to the increasing penetration of wind energy in the transmission system modern wind turbines are required to take over the control tasks, which were traditionally aligned to conventional power plants, and to contribute to power system stability. The most promising wind turbine concepts for the future market are investigated in the presented work, namely the doubly-fed induction generator wind turbine (DFIG) and the direct driven wind turbine using a permanent magnet excited synchronous generator (PMSG) connected via a full-scale converter.**

Keywords: **energy, light equipment's, utilization, full-scale converter.**

1. INTRODUCTION

As a result of industrial revolution worldwide energy consumption has steadily risen as well as economic growth. Non-renewable resources such as coal, natural gas, oil, and nuclear energy are the major sources of power for most parts of the globe. Burning fossil fuels, nevertheless, is hazardous to the environment, and fossil fuels are known to be limited and subject to price volatility. Also, issues of safe storage and discarding of radioactive waste, the possibilities of radioactive pollution from mishaps or vandalism, and the possibility of nuclear proliferation are serious obstacles to the success of nuclear power. Therefore, renewable resources such as wind possess great potential since they are indigenous, nonpolluting, and inexhaustible.

Nowadays, we are faced with environmental disasters that threaten our well-being and existence. Rising pollution levels and dramatic changes in climate demand a reduction in environmentally damaging emissions. One of the major sources of air pollution is fossil fuel combustion in power plants for producing electricity. Preferred solutions to prevent emissions are using renewable and cleaner energy sources. In fact, for every 1 kWh of electricity generated by wind, the emission of CO2 is reduced by 1kg, and operation of a wind turbine weighing 50 tons prevents burning of 500 tons of coal annually [21].

Electric-power production from renewable energy sources, such as wind, is growingly drawing attraction due to environmental issues, long-term economic advantages and scarcity of conventional energy sources in the near future. The main cost-efficient and practicable disadvantage of wind power is its intermittent characteristics. Wind power requires not only that wind is flowing, all the same it also rely on cut-in and cut-out wind speed that is the wind speeds at which production starts and is brought to a stop in order to keep away from harm.

Wind energy technology application has come of age, with numerous nations preparing and establishing extensive wind energy farms, with enormous amount of wind turbines. The strength of wind power technology is that it is clean and inexpensive. As a result of increasing fossil fuel price and state-of-the-art technology, more and more residential and commercial consumers of electricity have been installing wind turbines, the motivation being to cut energy bills and carbon dioxide emissions, and are even vending extra electricity back to the grid network.

2. LITERATURE SURVEY

M. Boutoubat(2013), has examined that depending on the rate power of the RSC, the power quality can be improved by compensating the reactive power and the grid harmonics current due to nonlinear loads. Hence, the RSC is controlled in order to manage the WECS function's priorities, between production of the maximum active power captured from the wind, and power quality improvement.

Huabin Wen(2014), has developed a robust adaptive control scheme for MSI. As confirmed by theoretical analysis the proposed method is able to maintain satisfactory performance under varying operation conditions without the need for manually redesigning or reprogramming the control gains and meanwhile complicated and painful trail-and error process for control gains determinations are no longer needed.

Gabriela Nicoleta Sava(2014), analyzes the capability of a wind power plant, based on doubly-fed induction generators (DFIGs) with an improved control system, to fulfill low voltage ride-through (LVRT) capability of the wind turbines providing the reactive power support and concluded that proposed method increases the capability of reactive power compensation for DFIG.

Dao Zhou(2015), has first compared the consumed lifetime of the GSC and the RSC in a DFIG system based on a typical annual wind profile and also examined that if there is no reactive power exchange between the DFIG and the grid, the GSC has more than 100-times lifetime compared with the RSC due to their various control objectives and the various fundamental frequencies of the output current.

Dao Zhou(2015), compares the current ripples and supportive reactive power ranges between the conventional *L* and optimized *LCL* filter, if the reactive power is injected from the grid-side converter. Then, the loss distribution is evaluated both for the generator and the wind power converter in terms of the reactive power done by the rotor-side converter or the grid-side converter with various grid filters and concluded that overexcited reactive power injected from the grid-side converter has lower energy loss per year compared to the overexcited reactive power covered by the rotor-side converter.

Hung-Cheng Chen (2014), presents dynamic modeling and simulation of a doubly fed induction generator based on grid-side and rotor-side converter control and also examined that The direct control of the active and reactive power of the DFIG by the stator current provides global asymptotic regulation in presence of the stator current reference variation D.V.N. Ananth(2013), examines the performance of DFIG under three cases viz., i) generator speed, ii) reactive power demand from grid and iii) wind speed. Based on the above disturbances, the system performance is analyzed by considering the parameters like rotor speed, generator torque, stator and rotor voltages and powers during voltage control and grid fault conditions and also illustrate the efficacy and robustness of torque, speed and stator reactive power control for DFIG system by the proposed methodology.

Sevki DEMİRBAS (2013), proposed direct power control technique for a doubly fed induction generator (DFIG) used in wind power conversion system with the help of Matlab&Simulink program and to test the proposed control technique, an experimental test bed has been established. The experimental test bed consists of a DFIG, induction motor with variable speed driver and a bi-directional back-to-back converter. TMS320F2812 microcontroller has also been used to control the system and from the experiment results concluded that the DFIGs stator active and reactive powers can successfully follow the reference active and reactive power values under different operating conditions, such as different rotor speed and active and reactive powers Gerardo Tapia (2005), PI-based control strategy to manage the net reactive power Interchanged between the grid and wind farms made up exclusively of DFIGs is suggested and examined that if faster responses were required, a more general algorithm, based on a PI, could be tuned and implemented and moreover, it has been experimentally concluded that, as the number of DFIGs entering saturation increases, static gain *K* of open-loop transfer function decreases and, accordingly, the closed-loop settling time of the wind farm net reactive power augments.

Aman Abdulla Tanvir (2015), achieved the control scheme for active and reactive power compensation in DFIG-based WECS under varying rotor speeds and also shows the design of the integrated GSC and RSC control, under the direct-current control configuration, to implement the active-reactive power, DC-link voltage, and grid voltage support control functions.

Mohammad Pichan, Hassan Rastegar (2012), a new direct power control method based on afuzzy logic controller is proposed and suggested that better results are obtained if hysteresis comparator and switching look-up table are replaced by PWM modulator.

J. Wisniewski (2013), presents reactive power compensator and its control structure dedicated to wind power station while no reactive power is absorbed from the grid, no matter of the produced active power and it is concluded that follow-up control of reactive power compensator can be give the better results only when wind driven induction generator can operate with given power factor cosϕ=1.

Fahad S. Abu-Mouti (2012), presents an overview of the literature employing the Artificial Bee Colony (ABC) algorithm in their solution approach and discuss the Key features of the ABC algorithm, as well as its performance characteristics. The performance of the ABC algorithm shows its superiority and the potential for solving complex real-world problems.

Changming Zhu (2015), proved that the parameter setting is one main factor significantly influence the optimization performance of DE algorithm. In this paper , a TLDE algorithm based on a new crossover operation strategy "Cloud Model-Based self-adaptive crossover operation" is proposed to overcome the premature convergence and improve the reliability and also conclude that TLDE shows better convergence performance in terms of the rate and the reliability on both un-modal and multi-modal benchmark functions Compared to three self-adaptive DE algorithms.

Bharat Kumar Saxena et al (2015), suggested that Wind power density is an important parameter for the potential estimation of a wind farm and estimates wind power density of Soda site located at Western Rajasthan in India. It is also noted that the wind power density is more than 300 W/m2 during May, June, and July months. Thus it can be concluded that maximum energy production from wind turbines will occur during these three months. Weibull parameters of the site are estimated using Modified Maximum Likelihood, Empirical, and Graphical. The results obtained using Empirical method shows better agreement with the measured WPD; whereas the results obtained using Graphical method yields maximum percentage error methods.

Omid Alavi (2016), study the effectiveness of different distribution functions was evaluated to represent the wind speed distribution at five locations distributed in the east and south-east of Iran and he found that the MLE as an efficient method for parameters estimation was used to calculate the related parameters of all distribution functions. It was found that some parameters such as wind speed characteristics, quantity and quality of the recorded wind speed data can be considered influential on the performance of the distribution functions. Finally he suggested that Nak, Wei, Gam and GEV distributions are more flexible as they can provide favorable performance for all stations.

K.S.R. Murthy et al (2016), presents a preliminary Wind Power Potential (WPP) assessment for coastal site Bheemunipatnam located in the northern region of Andhra Pradesh, India. In this paper Power law has been used to estimate WPP at these heights. This paper will be a guiding document for policy makers, power and energy engineers as well as for researchers working in this area for providing solution to the problem of burgeoning gap between demand and supply of energy Rajeevan .A.K (2013), develop a mathematical relationship between reliability and wind power generation. He suggested to use cubic mean cube root of wind speed to obtain m onthly wind power per unit swept area.

K. S. R. Murthy (2014), estimated monthly and annual wind power density (WPD) based on the statistical approaches known as Weibull and Rayleigh distribution functions (WDF & RDF) for the hourly time series wind data measured during the year 2013.Survey has been conducted and it shows that though the particular site is not suitable for grid connected applications yet available wind potential is suitable for isolated standalone systems like rural electrification, house hold electric appliances like battery charging, mechanical applications like water pumping for irrigation etc.

L. Surugiu, considered that one of the major sources of air pollution is fossil fuel combustion in power plants for producing electricity. Preferred solutions to prevent emissions are using renewable and cleaner energy sources. In fact, for every 1 kWh of electricity generated by wind, the emission of CO2 is reduced by 1kg, and operation of a wind turbine weighing 50 tons prevents burning of 500 tons of coal annually.

3. CONCLUSION

From the literature its clear that combined algorithms like ABC and TLBO yields better optimal solutions compared to conventional algorithms.

REFERENCES

[1] M. Boutoubat , L. Mokrani , M. Machmoum " Control of a wind energy conversion system equipped by a DFIG for active power generation and power quality improvement" Renewable Energy 50 (2013) 378e386.

[2] Huabin Wen, Yu Zeng, LeiWang,Feng Yang,and Y. D. Song "Robust Adaptive Reactive Power Control for Doubly Fed Induction Generator" Volume 2014, Article ID 369349.

[3] Dao Zhou, Frede Blaabjerg, Mogens Lau, and Michael Tønnes "Optimized Reactive Power Flow of DFIG Power Converters for Better Reliability Performance Considering Grid Codes" IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 62, NO. 3, MARCH 2015.

[4] Dao Zhou, Frede Blaabjerg, Toke Franke, Michael Tonnes, and Mogens Lau "Reduced Cost of Reactive Power in Doubly Fed Induction Generator Wind Turbine System With Optimized Grid Filter" IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 30, NO. 10, OCTOBER 2015.

[5] Gabriela Nicoleta Sava, Minh Quan Duong, Sonia Leva, Marco Mussetta, Sorina Costinas, and Nicolae Golovanov "Coordination Control of Active Crowbar for Doubly Fed Induction Generators" DOI: 10.1109/ISFEE. 2014.7050541.

[6] Hung-Cheng Chen1 and Po-Hung Chen"Active and Reactive Power Control of a Doubly Fed Induction Generator" Appl. Math. Inf. Sci. 8, No. 1L, 117-124 (2014).

[7] D.V.N. Ananth, G.V. Nagesh Kumar, T. Gayathri "Analysis and Design of Enhanced Real and Reactive Power Control Schemes for Grid Connected Doubly Fed Induction Generator" 2013 Annual IEEE India Conference (INDICON).

[8] Sevki DEMİRBAS, Sertac BAYHAN" Active and Reactive Power Control of Doubly Fed Induction Generator Using Direct Power Control Technique "DOI:10.1109/PowerEng.2013.6635578 .

[9] Gerardo Tapia, Arantxa Tapia, and J. Xabier Ostolaza "Proportional–Integral Regulator-Based Approach to Wind Farm Reactive Power Management for Secondary Voltage Control" IEEE Transactions on Energy Conversion · July 2007.

[10] Aman Abdulla Tanvir , Adel Merabet and Rachid Beguenane "Real-Time Control of Active and Reactive Power for Doubly Fed Induction Generator (DFIG)-Based Wind Energy Conversion System "Energies 2015, 8, 10389-10408; doi:10.3390/en80910389.

[11] Huabin Wen, Yu Zeng, LeiWang, Feng Yang, and Y. D. Song "Robust Adaptive Reactive Power Control for Doubly Fed Induction Generator" Volume 2014, Article ID 369349.

[12] Mohammad Pichan, Hassan Rastegar and Mohammad Monfared "Fuzzy-based Direct Power Control of Doubly Fed Induction Generator-based Wind Energy Conversion Systems" 2012 2nd International eConference on Computer and Knowledge Engineering (ICCKE), October 18-19, 2012.

[13] J. Wisniewski, w. Koczara "Follow-up control ofvariable reactive power of cage induction generator driven by wind turbine" 2013 Eighth International Conference and Exhibition on Ecological Vehicles and Renewable Energies (EVER).

[14] Fahad S. Abu-Mouti and Mohamed E. El-Hawary "Overview of Artificial Bee Colony (ABC) Algorithm and Its Applications "978-1-4673-0750-5/12/$31.00 ©2012 IEEE.

[15] Changming Zhu, Yan Yan, Haierhan, Jun Ni2 "Teaching-Learning-Based Differential Evolution Algorithm for Optimization Problems" 2015 Eighth International Conference on Internet Computing for Science and Engineering.

[16] Bharat Kumar Saxena, K.V.S. Rao "Estimation of wind power density at a wind farm site located in Western Rajasthan region of India" International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST - 2015).

[17] Omid Alavi , Kasra Mohammadi , Ali Mostafaeipour "Evaluating the suitability of wind speed probability distribution models: A case of study of east and southeast parts of Iran" Energy Conversion and Management 119 (2016) 101–108.

[18] K.S.R. Murthy, O.P. Rahi "Preliminary assessment of wind power potential over the coastal region of Bheemunipatnam in northern Andhra Pradesh, India" Renewable Energy 99 (2016) 1137e1145.

[19] Rajeevan .A.K, P.V.Shouri, Usha Nair "Identification of Reliability of Wind Power Generation and its Mathematical Modeling" International Conference on Microelectronics, Communication and Renewable Energy (ICMiCR-2013).

[20] K. S. R. Murthy, O. P. Rahi " Statistical Estimation of Wind Power Potential At Hamirpur Region in Himachal Pradesh, India" 978-1-4799-6042-2/14/$31.00 ©2014 IEEE.

[21] L. Surugiu, and I. Paraschivoiu, "Environmental, social, and economical aspects of windenergy," AIAA-2000-3008 Environmental, Social and Economical Aspects of Wind Energy, 35thIntersociety, vol.2, pp. 1167-1174.