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DAMPING OF POWER SYSTEM OSCILLATIONS USING SVC AND STACTOM

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Abstract

Today's Power system is a complex network; the integration of two neighboring power systems by an interconnecting lines may often offer attractive benefits to both parties. Inter-area oscillations are inherent in large interconnected power systems. System outage resulting from these oscillations is of growing concern. Over the last three decades, attention has been focused on power system damping control design to reduce the risks of system outage following undesirable oscillations. Flexible AC Transmission provides unprecedented way for controlling transmission grid and increasing transmission capacity. This paper is Highlighting the concept of the power system transient stability analysis and its improvement by FACTS controllers and this approach can be applied in complex power system network

Index Terms: Damping, FACTS controllers, inter area Oscillations, Power Oscillation, STATCOM, SVC

I. INTRODUCTION

A problem of interest in the power industry at which FACTS Controllers could play a significant role in it is increasing damping of low frequency power oscillations that often arise between areas in large interconnected power grid networks. These oscillations are named as inter-area oscillations, which are generally characterized by poor damping [1-4].The integrated power system therefore is prone to low-frequency "inter-area" power swings, when the equilibrium between generational load balance in each system and the power transfer along the interconnection line is being disturbed. Such disturbances may be caused by loss of a main transmission line. These transient disturbances can be produced by switching operations, load changes, and particularly, loss of excitation and faults.

Ideally, the loads must be fed at constant voltage and frequency at all times. In recent times, the use of FACTS devices has become a common practice to make full utilization of existing transmission capacities instead of adding new lines which are often restricted for economic and environmental reasons [3].

The high- voltage transmission system connects the generating stations and the load centers [8-9]. Interruptions in this network may unstable power flow to the load. Since almost all power systems are interconnected with neighboring systems. So random changes in load are taking place at most of times, with subsequent changes in generation. Synchronism may be frequently lost in that transition period, or increasing oscillations may occur over a transmission line, eventually leading to its tripping.

Power system stability may be broadly defined as that property of a power system that enables it to remain in a state of operating equilibrium under normal operating conditions and to regain an acceptable state of equilibrium after being subjected to a disturbance phase shifter. Series capacitor and shunt capacitor are different approaches to strengthen the power system load

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"Synthesis, Characterization and DFT Studies of Nano Scaled Lithium Ion Battery Materials for Renewable Energy Storage"

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Energy storage and conversion have become a prime area of research to address both the societal concerns regarding the environment and pragmatic applications. The development of renewable energy resources together with more efficient technologies for energy conversion and storage is one of mankind's key challenges. The enhancement of energy conversion and storage technologies (fuel cells, solar cells, batteries, super capacitors, etc.) needs to be improved to enable better use of intermittent renewable electricity sources and to develop sustainable transport solutions associated with a modern society. The fact that output power of renewable energy sources such as solar and wind power plants depends on meteorological conditions. Lithium ion batteries are getting enormous attention as power source and energy storage devices in Renewable energy field[1-3].

The performance of the battery is improved by developing the high power density cathode materials at Nano level. Batteries with Nano scale materials develop more power quickly with less heat. This work explains the synthesis of most interesting cathode materials with Lithium Manganese Spinel **$LiMn_{1.5}Cu_{0.25}Ni_{0.25}O_4$** with 25% replacement of Mn by Cu and Ni to avoid capacity fading. **$LiMn_{1.5}Cu_{0.25}Ni_{0.25}O_4$** is synthesized using eco-friendly co-precipitation methods.Synthesized powders were characterized by XRD, FESEM,EDAX,HRTEM,UV,electro chemical characterization(CV,) and thermal (TGA/DTA) characterizations then compared the experimental results with computational results s from DFT calculations using Material Studio and Quantum wise wise Atomistix Tool Kit (ATK),Virtual Nano Lab software's. Both experimental and computational results shows that LiMn2NiCuO4 belongs to Fd3m space group with lattice parameter approximately equal to 8.32A and volume of 563A ^{3}. These capabilities establish first principle computation as fast-track tool in the design of $LiMn_2O_4$ electrode material at nano scale for Lithium ion battery. In purity and stability point of view nano $LiMn_{1.5}Ni_{0.25}Cu_{0.25}O_4$ synthesized by Co-precipitation method provided best structural and thermal properties as compared to microwave assisted solgel method and solution combustion *method. $LiMn_{1.5}Ni_{0.25}Cu_{0.25}O_4$ shows very clear lattice image and electron diffraction pattern indicated that* these samples maintained crystalline nature at high current density. $LiMn_{1.5}Ni_{0.25}Cu_{0.25}O_4$ *sample has relatively* smaller morphology including small particle size of 40nm and homogeneous particle distribution with similar particle shape This kind of morphology is very important to both the high specific capacity and good cyclability of the material[4-6]. Therefore nano $LiMn_{1.5}Ni_{0.25}Cu_{0.25}O_4$ should be most suited cathode material for LIB s used for renewable energy storage.

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DESIGN OF FUZZY LOGIC CONTROLLER OF RESIDENTIAL ELECTRIC WATER HEATERS

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ABSTRACT:

With the impending deregulation of electric utility industry, customer satisfaction with utility services will be crucial. Utilities will need to place a greater emphasis on their customer's preferences and desires. This paper describes a fuzzy logic-based control strategy for shifting the average power demand of residential electric water heaters from period of high demand for electricity to off-peak periods. A minimum temperature for hot water, defined as customer comfort level, is used as a control variable. Water temperature is not allowed to fall below the minimum temperature set by the customer. Simulation result show that the proposed strategy can shift the average power demand of residential water heater to improve the load factor of residential load profile.

Key words: Fuzzy Logic control, mat lab tool box, Electric water Heater.

I. Introduction:

An Englishman Benjamin Maugham, in 1868 invented the first instant water heater called "The Geyser", a device where the water was heated as it flowed into the bath. They were known to be quite dangerous.Maughn's invention influenced the designs of a Norwegian mechanical engineer by the name of Edwin Ruud, who immigrated to Pittsburg. Ruud who invented the electric water heater (automatic storage) in 1889, founded the Ruud Manufacturing Company, which is still in operation today, and pioneered the advancement of water heaters, in both the residential and commercial market.

Population growth along with technological growth force the utility companies to continue struggling to meet the ever-increasing need for electricity. With the majority of residents conforming to the 8 AM-5PM work schedule, the utility companies experience overwhelming demand peak associated with large amount of power being consumed at the same time. Complementing this effect are periods of low demand. Although over a period of time, the average amount of power consumed by community may be easily generated by a utility, that utility still has to provide enough generation to meet its highest power demand peak. It is in the best interest of the utility companies as well as the consumer to try to reduce these high peak demand periods and out their power demand profiles as much as possible.

One way this can be accomplished is by controlling residential electric water heaters. The Electric water heater accounts for the single largest contributor to the total power consumption of a residence. Existing electric water heater DSM (Demand-side management) strategies focus on on/off control of the water heater, where a group of heater are disabled during certain periods of time using a direct load control strategy [5].When water heater are energized, they are either on consuming a fixed amount of power, i.e.4.5kW,or they are off. the paper presents a fuzzy logic based variable power control strategy, where the power consumed by the water heater can be controlled based on the information available from the water heater such as water temperature, maximum and minimum water temperature allowed (or desired),and distribution level power demand. Based on the status of the above variables, the fuzzy controller will determine

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Adaptive Neuro-Fuzzy Based UPQC in A Distributed Power System for Enhancement of Power Quality

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Abstract
The power quality problems during distribution of power are mainly occurs due to transient distortions in the line voltage like harmonics, flicker, sags and swells. These power quality issues can cause damage of equipment, losses in power transfer or even can lead system towards instability. To alleviate these complications, ANFIS based UPQC is to be proposed. The object of this work is to develop the power quality all over and done with a new unified grid-connected inverter-based distributed power system by using ANFIS-UPQC. In this paper ANFIS based UPQC (ANFIS-UPQC) is being used as a Facts controller to mitigate together current & voltage distortions at the consumer end of Distribution system. The concert of ANFIS-UPQC has very precise dynamic response by means of a very simple design of control circuit. This paper shows validation of ANFIS based UPQC and Results are compared with UPQC by means of hysteresis control Band by means of PI controller and improvements are observed. The ANFIS-UPQC reduces the harmonics at highly accepted level compared to PI Controller based UPQC. The simulation results, carried away by MATLAB/Simulink, shows that ANFIS-UPQC has a less THD and the output voltage/Current profiles are improved compared to PID Controller based UPQC.

Key words: Power Quality (PQ), UPQC, PI Controller, ANFIS, MATLAB/SIMULINK

Introduction

It`s always a challenge to distribute the electric power without loss and it is necessary to retain the power quality within the limits. For achieving this, one of the newly developed Facts controllers is UPQC. It`s a Facts device that consists of end-to-end connected two 3-ϕ ACTIVE POWER FILTERS (APFs) i.e. series and shunt inverters with a common DC-link. The shunt inverter of UPQC acts as a CSI for injecting current from end to end of a transformer in parallel, while the series inverter acts as a VSI for feeding voltage across a transformer in series. PCC can be extremely distorted; also the changes in highly rated load linked to PCC may result into voltage distortions on the PCC has been discussed [2]-[3]. Here, using of UPQC at PCC is an effective approach to care for the distribution system from sensitive loads. UPQC is a flexible device that can compensate nearly all power quality issues such as voltage sags/swell, voltage distortions, current distortions etc. The effect of sags can be less destructive than swells. For example, the high voltage during swell condition may cause insulation damage or breakdown in components or equipments. Due to unexpected changes of line current in the source impedance, voltage sag/swells takes place in the distributed system. The main aim is to keep the load bus voltage to be sinusoidal and the chief concern is the flow of active & reactive power in this situation. It shows a vital role to choose the KVA ratings of both APFs. Among latest technical options available to enhance power quality, UPQC has set up more promising for compensate of current/voltage harmonics at the same time. As per literature review, application of UPQC for alleviation of voltage/current harmonics has been presented. It is normally constituted with two voltage source converters connected back to back through a DC-interface capacitor.

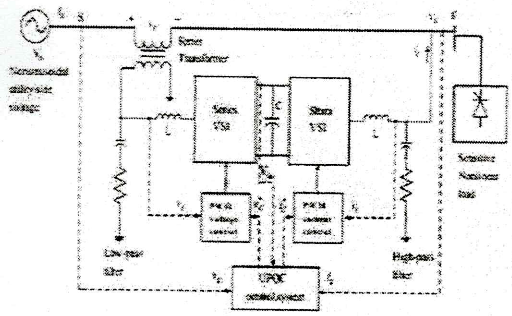

Fig.1. Basic Arrangement of UPQC

Control Methods

UPQC basically incorporates three sections: The series APF, shunt APF and energy storage capacitors. Both are couples together through the DC-interface capacitors. Series APF associated with grid and load by coupling transformer is predominantly used to modify the load voltage magnitude and mitigate the power supply voltage sag/swell in the controlled VSI mode. Shunt APF associated to the load end is used to steadiness load currents.

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Comparative Study of Maximum Torque Control by PI ANN of Induction Motor

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Abstract

A novel maximum torque per Ampere (MTPA) controller for the induction motor (IM) drives is presented. It is shown to be highly suited to applications that do not demand an extremely fast dynamic response, for example, electric vehicle drives. The proposed MTPA field oriented controller guarantees asymptotic torque (speed) tracking of smooth reference trajectories and maximizes the torque per Ampere ratio when the developed torque is constant or slow varying. An output ANN based feedback linearizing concept is employed for the design of torque and flux subsystems to compensate for the torque-dependent flux variations required to satisfy the MTPA condition. As a first step, a linear approximation of the IM magnetic system is considered. Then, based on a standard saturated IM model, the nonlinear MTPA relationship for the rotor flux are derived as a function of the desired torque, and a modified torque-flux controller for the saturated machine is developed. The static and dynamic flux reference calculation methods to achieve simultaneously an asymptotic field orientation, a torque-flux decoupling, and an MTPA optimization in a steady state, is proposed. The proposed ANN based MTPA control algorithm also demonstrates a decoupling of the torque (speed) and flux dynamics to ensure asymptotic torque tracking. In addition, a higher torque per Ampere ratio is achieved together with an improved efficiency of electromechanical energy conversion.

INTRODUCTION

During recent decades there has been a growing trend within many applications to replace the induction machine (IM) with a permanent magnet synchronous machine (PMSM) due to its higher efficiency, torque, and power density. However, the cost of a PMSM is significantly higher than that of the IM due to the use of rare-earth magnetic materials which have a very limited origin and their cost is continuously increasing. The tendency to reduce the use of expensive rare-earth magnets in industrial and electrical traction drives has driven a renewed interest for research into advanced design and control concepts for IM. Field-oriented vector control (FOC), advanced FOC, and direct torque control (DTC) of IMs have been established as a defacto industrial standard for high and medium dynamic performance applications. Vector controlled and DTC IM drives typically operate with constant flux magnitude even at low values of produced torque which results in a good dynamic performance. However, conversely, the machine efficiency and power factor can be low, especially for small torque values.

The IM torque is a product of the flux amplitude and the torque component of the stator current, providing a degree of freedom for reduction of the power conversion losses or for attaining other performance criteria. The optimization techniques typically reported in publications adjust the flux level as a function of the electromagnetic torque using various optimization procedures. The flux regulation restricts the drive's dynamic performance; hence, this approach can be employed in applications not requiring an extremely fast response, for example, in electric vehicle drives where the drive only operates at a rated torque for a limited proportion of time. A number of control strategies to optimize different performance objectives are known including minimization of active and total losses, power factor maximization, maximum torque per Ampere (MTPA) control, maximum torque per voltage control, and maximum power transfer. The established optimization methods are designed for a steady-state operation (i.e., the drive is operating in constant torque). Dynamic behavior optimization during torque transient is only considered in very few papers.

MTPA control minimizes the stator current for a given machine torque. Maximizing the machine torque by having limited source voltage and inverter current capability improves the electromechanical system performance. This is particularly beneficial for traction systems. Under the MTPA control strategy, the torque controller adjusts the flux reference to increase the efficiency at low loads. As a result of this optimization, the torque per Ampere ratio is maximized and, in addition, the achievable values of motor efficiency are close to those obtained using the minimum active losses optimization criterion. The basic MTPA control objective is achieved by controlling stator current torque and flux components, expressed in terms of rotor flux reference frame, to be equal. This leads to an IM operation with a constant slip frequency which is equal to the reciprocal of the rotor time constant. The MTPA relations are derived from the condition of the IM when producing constant electromagnetic torque. A few theoretical results based on vector and scalar control concepts are: modified field-orientated control nonholonomy approach, and voltage frequency control. However, simultaneous control of machine torque and flux results in poor torque dynamics; moreover, these dynamics cannot be specified due to the complexity and nonlinearity of the controlled plant (IM).

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"THREE PHASE PARALLEL MULTILEVEL INVERTER FED ASYNCHRONOUS MACHINE USING PHASE DISPOSITION SCHEME"

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Abstract

This Paper presents the Phase Disposition Scheme, which is topology independent. This scheme is used in Multilevel Inverters, interleaved parallel combination. Analysis on the other scheme which is Phase Opposition Disposition has also been performed. The best strategies related to the paralleling of inverters are evaluated, particularly those associated to current balancing between commutation cells of the same phase. Pulse width modulation (PWM) strategies and methods for multilevel converters are usually developed for series converters. In this paper it is shown that they may be applied to parallel converters using interleaving techniques, given that these converters also have multilevel characteristics. PWM methods based on carriers' disposition and on zero sequence injection are studied for parallel multilevel inverters. Analysis shows that the best method in terms of load current ripple is the phase disposition method. The current balancing between commutation cells of the same phase is comparatively superior with this method. Another objective on which work was done was to analyze these problems and to propose a solution to cancel current imbalance when using PD strategy. In addition to the above scheme POD (Phase Opposition Disposition) strategy has also been simulated which has shown comparatively same results as that of the PD strategy. The load was chosen to be a three phase induction motor drive and its parameters such as Stator Current, Speed and Electromagnetic Torque have been analysed as such.

INTRODUCTION

Power electronic converters, especially dc/ac PWM inverters have been extending their range of use in industry because they provide reduced energy consumption, better system efficiency, improved quality of product, good maintenance, and so on.For a medium voltage grid, it is troublesome to connect only one power semiconductor switches directly [1,2,3]. As a result, a multilevel power converter structure has been introduced as an alternative in high power and medium voltage situations such as laminators, mills, conveyors, pumps, fans, blowers, compressors, and so on. As a cost effective solution, multilevel converter not only achieves high power ratings, but also enables the use of low power application in renewable energy sources such as photovoltaic, wind, and fuel cells which can be easily interfaced to a multilevel converter system for a high power application.

The most common initial application of multilevel converters has been in traction, both in locomotives and track-side static converters [4]. More recent applications have been for power system converters for VAR compensation and stability enhancement[5], active filtering [6], high-voltage motor drive [3], high-voltage dc transmission [7], and most recently for medium voltage induction

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Modeling and Harmonic Analysis of Domestic Loads and Harmonic Mitigation Techniques

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Abstract— *Distribution system is the part of power system consisting of different combinations of linear and non-linear loads. The widespread application of power electronics is introducing non-linear loads in the distribution system resulting in the distortion of current voltage waveforms. The objective of this project is to study the harmonic distribution in a typical distribution system and suggest suitable harmonic compensation technique. Various domestic loads such as TV/CPU, computer, fluorescent lamp, CFL lamp, fan, light dimmer, washing machine, water pump, refrigerator, air conditioner dish washer and small scale industry loads such as adjustable speed drive, arc welder and lift water pump are modelled in PSCAD/EMTDC. These models are then used for harmonic analysis of domestic and small scale industrial system. Voltage and current harmonics injected at point of common coupling (PCC) due to these nonlinear loads is tested for an individual house, village and a typical industry. THD of voltage and current are used as harmonic indices and harmonic components are found.*

Current and voltage harmonic analysis is performed for standard IEEE 13-Bus medium voltage industrial distribution system by performing simulation using PSCAD/EMTDC. Adjustable speed drive is modelled and used as nonlinear loads and RL loads as static loads. The harmonic distribution in found and THD of voltage and current is found at all buses. Harmonic mitigation is performed by using single tuned, double tuned and reactance one-port filters. Also, use of shunt and series active filters is made for mitigating harmonics at PCC. Sensitivity analysis is then performed to analyse the effect on harmonic distribution and filter performance various load conditions, variation in system or transformer or feeder X/R ratio, change in filter positions and effect of power factor correction capacitor.

Index Terms—Harmonic analysis, Mitigation Techniques, Power quality

I.INTRODUCTION

In an ideal ac power system, energy is supplied at a single constant frequency and specified voltage levels of constant magnitudes. However, this situation is difficult to achieve in practice. The undesirable deviation from a perfect sinusoidal waveform (variations in the magnitude and or the frequency) is generally expressed in terms of power quality. The power quality is an umbrella concept for many individual types of power system disturbances such as harmonic distortion, transients, voltage variations, voltage flicker, etc. Of all power line disturbances, harmonics are probably the most degenerative condition to power quality because of being a steady state condition. The Power quality problems resulting from harmonics have been getting more and more attention by researchers.

1.2: Power Quality Problems

- The characteristics of the utility power supply can have a detrimental effect on the performance of industrial equipment.
- Harmonics produced by industrial equipment, such as rectifiers or ASDs, can have a detrimental effect on the reliability of the plant's electrical distribution system, the equipment it feeds, and on the utility system.
- The characteristics of the current and voltage produced by ASDs can cause motor problems. While power quality is basically voltage quality, it is not strictly a voltage issue. Since the supply system has a finite, rather than an infinite, strength, currents outside the direct control of the utility can adversely affect power

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Design of Fuzzy Logic Controller of State Estimation Uncertainty Reduction for IEEE14-Bus System

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ABSTRACT

State estimation is widely used for bad data detection and identification. To further insure the validity of measurements from the power system, additional information is incorporated into sensor fault detection and isolation schemes. In particular, we develop a fuzzy logic-based state estimation method that includes data such as historical usage trends and component reliability. Results from applying this hybrid fuzzy classifier system to the IEEE 14-bus test system are presented.

KEY WORDS — Fuzzy logic, State estimation.

I. INTRODUCTION

POWER networks are critically dependent on information and sensing equipment for system reliability, operation, protection and maintenance. In the competitive electric market, this reliance has increased with the development of information and control infrastructures. In energy management systems, state estimation is responsible for processing a set of noisy and redundant measurement data in order to provide an accurate real-time database to be used by application programs, such as economic dispatch and security analysis. The correct estimation of the system operating states in the presence of uncertain measurement data is a crucial challenge for real-time power system monitoring. Contamination of sensor data is customarily viewed as being caused by instrument inaccuracies and failures. Lately, intrusion into computer systems has become a threat to power system monitoring and sensory applications due to this potential source of corrupted data. Hence, measurement uncertainty can be introduced by a variety of causes.

Human operators have an advantage over control and protection systems in terms of their experience and ability to assimilate a wide spectrum of information and new data. In contrast, computers have the advantage of being able to process such information much faster than their human counterparts. This research is aimed at augmenting state estimation methods using an approach that can incorporate additional information that is not traditionally included as a part of the state variables. Considering the additional information such as historical usage trends, weather, and system/component reliability data engineering interpretations become highly subjective and Context dependent. Fuzzy logic is an artificial intelligence tool that can take advantage of the operators' experience and the fast data processing capability of computers. Consequently, fuzzy logic is selected in this research to create a Hybrid Fuzzy Classifier System (HFCS). Presented herein are the HFCS and its application to the IEEE 14-bus test system.

II. BACK GROUND

A. STATE ESTIMATION

The sensory network and control systems are a strategic component of power and communication infrastructures. State estimation has long been used as a method for bad data detection and identification and suppression [i-ii]. The inputs to an estimator are imperfect power system measurements of voltage magnitudes and power, VAR, or ampere-flow quantities. The estimator is designed to create best estimates of

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Automatic generation control of multi-source interconnected power system including DFIG wind turbine and FACTS devices

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***Abstract*—This paper presents the solution of automatic generation control (AGC) problem of four-area interconnected power system including DFIG (doubly fed induction generator) wind turbine using optimized sliding mode control (SMC) and combination of FACTS devices namely thyristor controlled series capacitor (TCSC) and superconducting magnetic energy storage (SMES). The hybrid disrupted oppositional based gravitational search algorithm (DOGSA) is used to tune the parameter values of SMC; TCSC-SMES along with gains of the speed and pitch angle controller of the DFIG wind turbine. The simulation results show the effectiveness of the proposed control scheme in comparison to GSA and OGSA tuned proportional integral derivative controller already reported in the literature in terms of faster convergence, settling time, overshoot and undershoot of the deviations in frequency and tie-line power. Further, the efficiency of the scheme is shown by varying the wind power from 10% to 40% in the considered power system followed by effect of large load perturbation from 0.1 p.u MW to 0.4 p.u MW in all the control areas of the power system.**

***Keywords—** automatic generation control; disruption operator; DFIG wind turbine; inertia control; pitch control; FACTS devices*

I. Introduction

Due to random load variations in a power system, there is deviation in frequency and tie-line power of the control areas. The automatic generation control is required to control these deviations. In the most recent times, the integration of the wind power sources in the power system has gained a wider importance due to the consideration of the environmental impacts of the conventional generation sources [1]. The wind turbines do not provide frequency control when integrated in the power system due to their incapability to provide inertial support which is the issue of concern for the power engineers.

The different researchers have reported some methods such as inertia control, droop control and pitch control using which the frequency regulation can be provided by the DFIG wind turbines to the power system [2, 3]. The decoupling of the wind turbine inertia from the system by the power electronic converter results in more frequency deviations when load perturbation occurs in the power system. The authors in [4] proposed a method to enhance the inertia of the system using a secondary inertia loop in the system. The droop control is based on the difference of measured and nominal frequency which is proportional to the power supplied by the wind turbine. The inertia and droop control of the wind turbine are addressed in [5, 6]. The blade pitch angle control is required in case of very low and high wind speed to maintain the optimal aerodynamic power. When wind speed is less than the cut-in speed, the pitch angle control maximizes the wind turbine output. On the contrary, when wind speed is more than the cut-out speed, the pitch controller limits the wind turbine output to its rated capacity [7, 8]. The proportional integral (PI) based pitch angle control is presented in [9] to assess the capability of the DFIG wind turbine, but the concern with these controllers is the optimal tuning of their parameter gains. The inertia and droop control using the optimal control methodology for two area system is reported in [10, 11]. The researchers in [12] proposed the gravitational search algorithm optimized speed and pitch angle controller for two-area thermal system including DFIG turbine. However, the diverse sources are not considered in the system. This paper presents the solution to frequency regulation problem of four-area interconnected power system with diverse power sources including DFIG wind turbine.

Many researchers have used different control techniques namely classical controllers such as integral, proportional integral, proportional integral derivative controller [14]; optimal and sub-optimal control [11]; artificial neural network [17] and fuzzy controllers [18] etc. The concerns with classical controllers are the tuning of their parameter gains and incapability to handle large size systems. The modern and adaptive control techniques pose the limitation of unsatisfactory performance in the presence of non-linearities such as generation rate constraint, governor deadband and time delay during signal processing in the power system [14]. A more robust sliding mode controller used in [19-23] possesses the features of order reduction and decoupled design process and hence, reduces the complexity of control logic in large dimension systems. The controller parameters of SMC have been tuned using genetic algorithm [19-21], particle swarm optimization [22] and teaching learning based optimization algorithm [23]. However, these algorithms sometimes get trapped in the local minima and have more computational time.

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Biogeography based Optimization Technique for Noncascaded Short Term Hydrothermal Scheduling with Reservoir Constraint

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Abstract—Short term hydrothermal scheduling aims at determining the optimal hydro and thermal generations to achieve minimum production cost of thermal plants for a 1 day or a 1 week while satisfying various hydraulic and electric system constraints. This paper presents, a biogeography based optimization approach for solving short term hydrothermal scheduling problem. The practical hydrothermal system is highly complex and possesses linear, nonlinear relationship of the problem variables that makes the short term hydrothermal scheduling problem difficult to solve using conventional optimization methods. To overcome these shortcomings, the proposed biogeography based optimization is employed for solving this complex optimization problem. To show its efficiency and robustness, the proposed approach applied on standard hydrothermal test system consists of one hydro and one thermal plant. Numerical result of the proposed approach is compared with those obtained with gradient search method, genetic algorithm, simulated annealing, evolutionary programming, differential evolution, particle swarm optimization and clonal selection algorithm approaches. The simulation results reveal that the biogeography based approach appears to be better in terms of convergence speed, solution time and minimum cost when compared with other reported approaches. Finally, this approach is considered to be a promising alternative approach for solving the hydrothermal scheduling problems.

Keywords—biogeography based optimization; short term hydrothermal scheduling; fixed head hydro plants;

I. INTRODUCTION

Optimal scheduling of hydrothermal power system is a complex programming problem involving nonlinear objective function and combination of linear and nonlinear constraints. In a short term hydro thermal scheduling (STHTS) problem, the objective is to determine the minimum cost of thermal generation simultaneously satisfying the constraints are load balance, operating capacity of hydro and thermal units, water discharge limits, upper and lower bounds on reservoir volumes and hydraulic continuity restrictions etc. The whole scheduling horizon in short term hydrothermal system is normally one day to one week.

Several approaches have been proposed for solving optimal scheduling of hydrothermal system. Some of these approaches such as gradient search (GS) method [1], mixed integer programming method [2], dynamic programming method [3] etc., have been applied to STHTS problems and concluded that may perform well but inefficient due to nonconvexity problems, large scale systems, computational burden and dimensionality of problem. In this context, the algorithms such as heuristics methods such as artificial neural network [4], simulated annealing (SA) [5], genetic algorithm (GA) [6], evolutionary programming [7-8], particle swarm optimization (PSO) [9], clonal selection algorithm (CSA) [10], cuckoo search algorithm [11] etc., have been developed and applied successfully

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Colliding Bodies OptimizationAlgorithm for Optimal Power Flow Problem of Power System

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Abstract—*A new evolutionary algorithm called colliding bodies optimization (CBO) considered in this paper to solve optimal power flow (OPF) problem in a power system network. CBO is based on natural phenomenon of one dimensional collision between two objectives. It does not have any control parameters and is simple in structure. IEEE 30-bus system with various objective functions like, minimization of total fuel cost with valve point loading effect, minimization of emission profile are considered to test the feasibility and effectiveness of the CBO algorithm. In comparison with the other existed methods presented in the literature, the proposed CBO algorithm gives better optimal solutions for single objective OPF problems.*

Keywords—colliding bodies optimization; evolutionary algorithm; optimal power flow; emission profile

I. INTRODUCTION

Optimal power flow (OPF) has asignificant importancein power system planning and operation control. OPF was first defined by Dommel and Tinneyin 1960. The main goal of OPF is to find a most favorable settings of any givenobjective functionby adjusting some of the control variables to satisfythe set of equality and inequality constraints imposed by the power system. The control variables include real power outputs except slack bus and voltage magnitudes of generated buses, shunt var compensators connected at various buses, and transformer taps.The equality constraints are the nonlinear power flow equations, and inequality constraints are the load buses voltage magnitudes, transmission line flows, slack bus real power output and reactive power limits of the generators [1].

Various analytical and conventionalmethods are used to solve the OPF problemslike, linear programing (LP) [2], Interior point [3], Newton method [4]. Nevertheless, these methods are difficult to solve when the objective functions and constraints are nonlinear. In order to defeat the drawbacks in conventionalmethods and to getapproximate optimal solution evolutionary algorithms such as, genetic algorithm (GA) [5], tabu search (TS) [6], differential evolution (DE) [7], evolutionary programming (EP) [8], artificial bee colony (ABC) [9], particle swarm optimization PSO [10].teaching learning based optimization (TLBO) [11], shuffle frog leaping algorithm (SFLA) [12]and Stud Krill Herd (SKH) [13] are developed to solve the several OPF problems.

Recently, Kaveh and Mahdavideveloped a new evolutionary called colliding bodies optimization (CBO) [14] to solve the continues optimization problems. CBO is a multi-agent algorithm and it is inspired from natural phenomenon of one-dimensional collision between two objective bodies. In CBO each agent is considered, as a colliding body (CB) with specified mass and velocity. A collision occurs between any two pair of objects and its new positions are updated with new velocities based on the collision laws. The main advantage of CBO is that, it does not have any tunable parameters and simple is in its structure. The CBO algorithm has been successfully applied to many real world problems [15-17] and obtained results have proven that the CBO is effective and superior to solve the optimization problems. In this paper, CBO is applied to solve the OPF problems of IEEE 30-bus system with different objective functions.

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Novel Method for Loss Reduction and Voltage Profile Improvement with Multiple DGs

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Abstract— Distributed generation (DG) can be integrated into distribution systems to meet the increasing load demand. This paper discusses the sizing and sitting issue of DG placement in radial distribution systems using novel method. The main objective of the work is to minimize the active and reactive power loss and enhance voltage profile of overall system. This paper presents a methodology for optimal distributed generation (DG) location and sizing in distribution systems. The main objective of the added DG units is minimizing the total electrical network losses with acceptable voltage profile. The effectiveness of the novel method has been successfully tested on IEEE 33 bus radial distribution system in ETAP software and the results are found to be in very good agreement.

Index Terms— Voltage profile, real power losses, reactive power losses, radial distribution system, distributed generation,

1 Introduction

The electric utility system is usually divided into three subsystems which are generation, transmission, and distribution. The distribution system is commonly broken down into three components: distribution substation, distribution primary and secondary. At the substation level, the voltage is decreased and the power is distributed in smaller amounts to the customers. Consequently, one substation will supply many customers with power. Thus, the number of transmission lines in the distribution systems is many times that of the transmission systems. Furthermore, most customers are connected to only one of the three phases in the distribution system.

When you on the traditional power grid energy generation and distribution was relatively simple. The generator produced electricity at plant and the transmission system carried electricity from the plant to substations. At the substation, voltage was reduced and electricity continued to travel along the distribution system where transformers converted into voltage used by customer. At the customer site electricity passed through the meter which recorded usage as electricity was consumed. Energy flow was essentially one way. On a smart grid with distributed generation, energy can be generated close to the point of use and those who produce this power have the option to resell it to the utility [1],[2].

A generator is installed behind the metre to provide power. When this generator is not in operation power can be drawn from the grid. However, if there is an outage or when power prices peak, users can go off-grid and use a private generator to produce power. Solar, wind and thermal energy are renewable sources that can generate energy close to the point of use. Unlike major power stations, renewable energy resources can be installed in small increments and they have extremely low on-going costs. Though renewable energy resources are less predictable than the power generated by traditional means, hybrid systems can utilize both renewable and traditional power. With access to distributed generation resources within a smart grid, utilities can configure the existing systems to meet peak power needs and diversify the range of energy resources to increase the reliability of energy flow [3],[4]. For customers distributed generation supports

(i) Reduced energy costs

(ii)Reduced reliance on fossil fuels and

(iii) Increased use of renewable resources

Despite its relative unpredictability, renewable energy can fit with the load curve. For instance, in summer the sun produces high energy during the hardest part of the day when air conditioning is required, so solar energy is in affect converted into electric energy for cooling. Within the smart grid, integrated into the smart home and monitored by smart metering distributed generation is a new paradigm for energy distribution and use. For the first time energy flows to users as well as away from the users enabling utilities and their customers to work together to ensure that power is high quality, reliable, green and low cost.

Distribution systems hold a very significant position in the power system since it is the main point of link between bulk power and consumers. Effective planning of radial distribution network is required to meet the present growing domestic, industrial and commercial load day by day.

2 Load Flow Analysis

Consider a branch connected between buses 1 and 2 as shown in Fig. 1

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Wind Inter connection of Grid at the Distribution level to improve the Power Quality by Using Resonant Controller

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Abstract- Sustainable power source assets are as a rule progressively associated in dispersion frameworks using power electronic converters. This Paper manages an exceptional control technique To beautify the Power excellent at the dissemination framework by making use of a four-leg Inverter. The Inverter is appearing multifunction in that ability as 1) manage converter to infuse manage constituted of RES to the network, and a pair of) shunt APF to repay modern-day unbalance, stack cutting-edge sounds, stack receptive strength request and load nonpartisan present day. This new control idea is exhibited with broad MATLAB/Simulink reproduction thinks about. The Performance was tried for Proposed Resonant controller and Conventional PI controller and THD is likewise thought about.

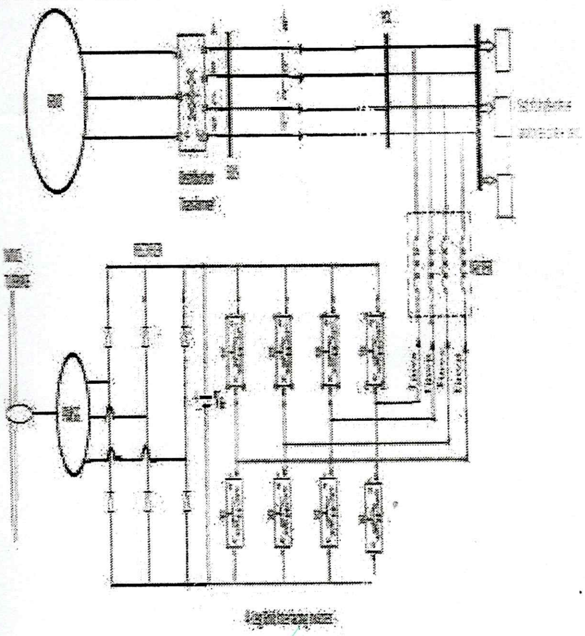
1. INTRODUCTION

Sustainable strength source is energy that is collected from inexhaustible belongings like daytime, wind, rain, tides, waves and geothermal power[1].Wind control is the usage of wind move thru breeze mills to mechanically manage turbines for electricity. Twist control,asan other to consuming petroleum products, is rich, inexhaustible, broadly appropriated, clean, creates no gas emanations all through task, expends no water, and uses next to no land[2]. The net impacts on the air are far less tricky than those of non-inexhaustible power sources. Wind control gives variable power, that is predictable from year to year however has vital variety over shorter time scales.

A breeze cultivate is a group of twist turbines inside a similar area utilized for generation of electrical power. A huge breeze homestead may incorporate numerous hundred individual breeze turbines appropriated over a broadened region. A breeze homestead may likewise be set seaward. Lion's share of all huge breeze turbines have comparative plan — a level pivot wind turbine having an upwind rotor with 3 sharp edges, snared to a nacelle over a tall tubular pinnacle..

2. SYSTEM DESCRIPTION

The proposed framework comprises of a breeze turbine framework which is associated with lattice through AC-DC-AC converter as appeared in Fig.1.Here AC to DC change is done through a Diode Bridge Rectifier(DRB) and DC to AC transformation is finished by 4-leg Voltage Source Inverter(VSI). A DC connect is utilized to interface AC-DC-AC converter and matrix. Also, network is associated with an arrangement of direct and non-straight loads through a conveyance transformer. The 4-leg voltage source inverter is a key segment of a DG framework as it interfaces the breeze turbine framework to the matrix and conveys the created control. The breeze turbine framework is an AC source with rectifier coupled to dc-interface. The variable pace wind mills create control at variable air conditioner voltage[6]-[8]. The dc-capacitor decouples the Wind turbine from matrix and conjointly permits independent management of converters on either aspect of dc-connect. Inductor is associated with 4-leg VSI which



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