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A REVIEW ON: ARTIFICIAL INTELLIGENCE TECHNIQUES IN ELECTRICAL AND COMPUTER ENGINEERING

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ABSTRACT

Due to recent development of artificial intelligence (AI) applications in active power filter (APF) growth of electricity market has distinguish in the intelligence users recognize electricity. These changes may require consumers have become more challenging. The amount and feature of the data being confined in existing electrical power monitors through artificial intelligence (AI) has been increasing significantly in recent years.

INTRODUCTION

During the last decade, new findings of research in emotions from the areas of psychology and neuroscience have attracted the attention of scientists from the circles of computer science and artificial intelligence (Gadanho *et al*., 2001; Petta *et al*., 2001). Due to such an important requirement of electrical power being all the areas and requires to be enlarged, from its production part to the distribution end that it should be increased in a more executive fashion then at present by using Artificial intelligence. A lot of work has already been done in the field of generation and the distribution sector, but the transmission sector still lags behind than the later. The Figure – 1 illustrates the unusual phases necessitated for transmission system planning. This flow chart is a basic one and all the phases engage in this are uniformly appropriate in the ancient times even at this moment in time and also accomplishes the essential constraints for future transmission system planning (Rajat *et al*., 2005). The group supporting the belief that emotions play a key role in human cognitive processes is being extended, emphasizing its importance in problem

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solving and decision makes processes. In particular, artificial intelligence, an area dedicated to modeling and simulation of cognitive processes, denote a growing attention in feelings. The intelligence mechanism occurred within human brain in performing many complex tasks such recognition, calculate, administrative, categorization and creating understanding that makes human smarter, has been attracting many scientists and researchers a long time ago. They come from diverse fields such as mathematics, psychology, informatics, computer science, social sciences, and engineering, especially electrical engineering.

They race to create ways and methods to emulate the intelligence shown by the human brain. These fields altogether at the end become a new field called Artificial Intelligence (AI), a field that is dedicated to "give birth" methods and techniques that are feasible to be implemented to machines in order that they can emulate or mimic humans' intelligence in making decisions or performing actions. These machines can be in form of computer systems or intelligent robots. Because human intelligence is definitely close to cognition, the psychological procedure by which information is obtained; therefore cognitive modeling is also considered. There are numerous difficulties and methods for power quality development as being conversed by different investigators.
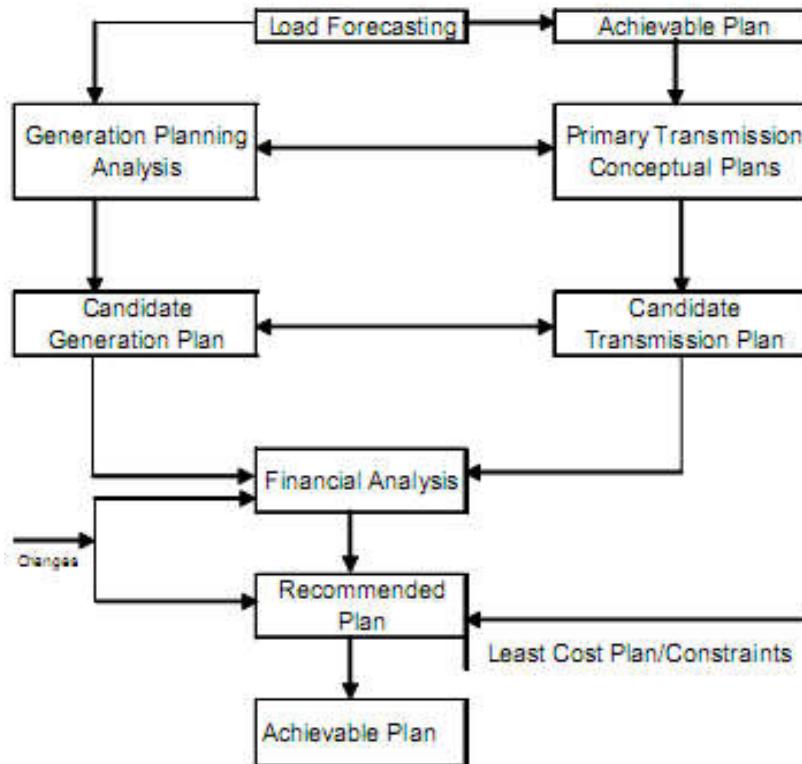
Fig: 1. Standard Practice of Transmission System Planning (www.energyonline.com)

Author (Andreotti *et al*., 2009), has argued the adaptive Prony technique which has utilized to determine PQ indices based on a time–frequency analysis of waveforms. Another author (Carlos *et al*., 2005) gives a novel real-time digital signal processing technique for power quality disturbance detection. Artificial agents can be any artificial entity that is characterized by a certain level of intelligence, working and acting autonomy, and learning capability. Recently artificial agents and agents' paradigm are popular in computer science community, where artificial agent is considered as a piece of code and is called software agent.

Many research scientists and behavioral neuroscientists confirm that feeling manipulates thinking, decision-making, actions, social relationships, comfort, substantial and mental health in person. Inspired by the psychological models of emotions, researchers in artificial intelligence and cognitive robotics have begun to be familiar with the effectiveness of computational representations of feelings for improving complex, interactive programs. At this point we notify that the whole process of representing emotions as mechanisms and functions for implementation in machines is approximate. Interacting with agents that have a model of feelings can form a improved sympathetic of the customer's frame of minds, emotions and preferences and can thus adapt itself to the user's needs. The main objective of this research is to explore new possibilities to represent the reliability of computer-based loads, such as an electronically controlled equipment, with respect to transient phenomena in electric power systems, Power quality problem is an occur as a non-standard voltage, current and frequency.

The power quality has serious cost-effective suggestions for clients, utilities and electrical apparatus producers. Modernization and automation of manufacturing engages ever-increasing utilize of computers, microprocessors and power electronic systems for example adaptable speed drives. The power electronic systems also give to power quality difficulty.

Advanced Signal Processing Techniques

A power quality difficulty can be explained as any discrepancy in the power supplies, for example voltage sags, swells, disruptions, momentary, harmonics, notches, and fluctuations etc. This part of the paper deals with some of the AI methods which hold such types of difficulties with values. From the time-domain opinion, PQ troubles can be organized into "continuous" and "discrete" confusions. Continuous confusions can be at this time in every waveform cycle while discrete interruptions become visible as separated and self-determining occurrences (Gosbell *et al*., 2002). Regarding continuous interruptions, most PQ alphabetical listing have been expanded for periodic signals. Regrettably, the extensive utilize of power drivers and other nonlinear consignments cause waveforms distinguished by spectral parts that are considerably time show a discrepancy in amplitude and/or in frequency (Andreotti *et al*., 2009).

Adaptive Prony Process

Voltage waveforms with discrete PQ interruptions are distinguished by spectral parts with discrepancies confined to a small area in short time spaces. The signals differentiated by

the abovementioned continuous and discrete interruptions can be non-stationary and should be investigated using time frequency demonstrations. The demonstration of signals in the time-frequency domain has been of concentration in the signal dealing out field. A conventional time frequency illustration was the short-time Fourier transform (STFT), which was an uncomplicated expansion of the FFT, where the FFT constantly useful to a windowed description of the time domain signal (Santoso *et al.*, 2000).

Other techniques to examine non-stationary signals think about time-frequency distributions (TFDs). The essential purpose of TFDs was to make available instantaneous time and frequency information on the energy substance of the signal. All TFDs can be acquired from the "Cohen's class," a simplified formulation for the time frequency structure. Different categories of TFDs with exceptional properties have been recommended for the enhancement of the time-frequency resolution; some illustrations are the spectrogram, Wigner-Ville distribution, Choi Williams's distribution, and condensed intervention distribution RID. In paper (Ibrahim and Morcos, 2002) the authors develop a TFD analysis based on the diminished interference distribution to make available an incorporated explanation of novel PQ indices used for the categorization of non stationary waveforms in power systems. The original indices initially need the division of the examined waveform into two parts: the essential part and the disturbance waveform. The assessment of the primary part acquired using a curve fitting algorithm that takes for granted an essential frequency accurately equal to the power system frequency at the same time as the disturbance waveform, computed as a difference with the original waveform.

The Divide and Conquer Standard

Power quality concerns have become known, after the universal energy marketplace deregulation, as an exponentially challenging consideration investigate field for electric utilities and end consumers. Among the various achievable inspirations of the examiners, the authors of (Ribeiro, 2004) have emphasized the escalating exploit of electronic devices, nonlinear weights and microprocessor-based explanations in viable centers and manufacturing plants. As well, the electrical energy marketplace has examined an expansion in the number of independent power producers (IPP's) with inadequately restricted organization, an increase in contest a in some way associated lack of enthusiasm to replace information, alongside novel arrangement interconnections and consumers requirements. Numerous authoritative instruments have been in recent times expanded to explanation for the explosion of PQ disturbances consequences from above mentioned difficulties. In this circumstance, the most important scrutinized PQ disturbances comprise transients, long and short time voltage deviations, flickers, interruptions, waveform distortions, unbalances, faults, etc (Ribeiro, 2004).

Wavelet Transform (WT) Method

A power quality difficulty can be illustrated as any discrepancy in the power supplies. To evaluate these electric power system interruptions, data frequently offered as a form of an illustration time function that characterized by a time progression of amplitudes. When contracting with such information, the Discrete Fourier Transform (DFT) based move toward was most frequently used. The accomplishment of the DFT by different algorithms has been created as the origin of current spectral and harmonic examination. The DFT give ways frequency coefficients of a signal which characterizes the projection of orthogonal sine and cosine basic functions. The wavelet investigation process assumes a wavelet trial product function, the evaluating wavelet or the protect wavelet. Sequential analysis is completed by changing a constricted, high-frequency descriptions of the protect wavelet, while frequency examination is achieved with expanded, and low-frequency descriptions of the similar wavelet. Any signal can be symbolized in expressions of a wavelet development or progression (i.e. similar to Fourier series) using coefficients in a linear arrangement of the wavelet functions at unusual scales. The collection of the protect wavelet is not an insignificant concern. Different protect wavelets be present with different features. Success of a prearranged wavelet starting point in an exacting application does not represent that this set is well-organized for other applications (Mahmoud El-Gammal *et al.*, 2003).

Artificial Intelligence

A wide-ranging description of Artificial Intelligence (AI) can be the mechanization of behavior that are combined with human considering, such as administrative, analytical, knowledge, perception and way of thinking. Artificial Intelligence (AI) plays an essential responsibility in every field accessible in the world and particularly in the field of sciences and in scrupulous in engineering region. Its consequence is apparent from the information that Artificial Intelligence (AI) efforts to recognize intellectual thing. The intellectual things are attractive and valuable. AI has manufactured many considerable and exciting results. It is understandable that computers with individual level intelligence would have an enormous impact on our on a daily basis survives and on future path of development. The Artificial Intelligence (AI) devices of awareness to the electric power group of people incorporate fuzzy logic (FL), artificial neural networks (ANNs), genetic algorithms (GAs), adaptive fuzzy logic (AFL) and expert systems (ESs). Expert systems are an effort to follow the human consideration procedure all the way through information demonstration and inference methods. The following are the kinds of AI: - fuzzy logic (FL), expert systems (ESs), and artificial neural networks (ANNs).

Expert System

An expert system is usually known as knowledge based system based on computer program that encloses the information and methodical skills of one or more human proficient associated to a definite area under discussion (George, 2001). The most frequent structure of an expert system is a computer program with the set of rules that examines information concerning a precise class of difficulties and suggests one or more ways of consumer accomplishment. The expert systems also make available mathematical investigation of the difficulty. It makes use of the way of thinking competence to accomplish on the terminations.

Fuzzy Logic

Computers are excessively consistent and they only arrangement in true or false, yes or no etc. Fuzzy logic permits a computer to contract in every day human language and essentially development expressions such as almost certainly, improbable, moderately, in close proximity to etc. Such expressions can take their position in computations such problem permitting the computer to reach your destination at confirmable consequences from fuzzy inputs. The logic employed is precisely demonstrable so consequences for the procedure can be believed. Fuzzy logic is originated from fuzzy set theory contracting with way of thinking that is estimated to a certain extent than accurately assumed from conventional predicate logic. It can be consideration of as the application area of fuzzy set theory contracting with well attention out real world proficient importance for a difficult problem.

Neural Network

Conventionally, the expression neural network had been exploiting to refer to a network or circuit of biological neurons. The current procedure of the expression frequently refers to artificial neural networks, which are created of artificial neurons or nodes. Thus the expression 'Neural Network' has two different procedures (Quyang)

- Artificial neural networks are made up of interrelating artificial neurons (programming creates that mimic the properties of biological neurons). Artificial neural networks may either be utilized to increase a recognizing of biological neural networks, or for solving artificial intelligence difficulties without essentially creating a representation of an authentic biological scheme.
- Biological neural networks are fabricated of actual biological neurons that are associated or functionally related in the peripheral nervous system or the central nervous system. In the field of neuroscience they are frequently recognized as groups of neurons that achieve a definite physiological function in laboratory examination.
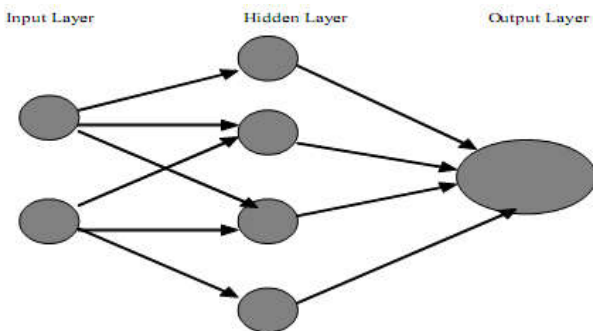
Fig.2. Simplified observation of an Artificial Neural Network

Within a bound area of information, ESs is proficient of decision making on a stage equivalent in feature to human experts. FL is a more controlling difference of hard logic; where information demonstration is additional intimately associated to the method humans consider. FL acquires the well-built deduction capabilities of expert systems with the influence of ordinary (linguistic) knowledge demonstration. FL has been effectively executed in control applications where

structure models do not subsist or where the representations are mathematically difficult and computationally concentrated. AFL is a fuzzy-logic-based standard that take hold of the knowledge capability of ANN or the optimization capabilities of GAs to improve the intellectual system's presentation using a priori knowledge (Belarbi, 2000). ANNs imitate the neural brain arrangement of humans. This arrangement consists of straightforward arithmetic units joined in extremely composite layer structural design. ANNs are proficient of representing difficult (nonlinear) functions, and they become skilled at these functions all the way through illustration. GAs uses the methods of human genetic development to produce optimal explanations. GAs may be measured as a multidimensional optimization method based on a genetically random search engine.

Literature Survey

In this paper (Badar Ul Islam, 2011) author has proposed a new technique based on the shifting trends from vertical incorporated setup to the horizontal collapsed setup is enlightened in very easy method and values under novel circumstances which are developed in electric power system i.e. generation side and moderately on the approach in transmission and sharing network. The transmission scheme planning provides as a backbone in the electrical network scheme. All the constraints occupied in electrical network have distinctive consequence but in transmission system development, the consignment calculating is the most important feature to increase the constant, consistent and cost effective scheme.

All utilities are transient through the phase of breakdown globally; it is understandable that the same consequence is also positioning impression on the electrical power sector. This consequence is assigned as restructuring and competitive situation of public utilities. This precise approach signifies that the public now requires to split the monopolistic approach and would approximating that the open effectiveness must be controlled by public themselves but under umbrella of some regulatory body who can observe their attentions and legislate laws which helps the accumulations in getting the enhanced service than that they have. A comprehensible evaluation is also accessible between the past/existing set performs with the future method of transmission system planning. It also proposes (Badar Ul Islam, 2011) that essential analysis may also be done on computer by using different models and with the use of AI and ES system is measured to be the most excellent with its characteristics for transmission system planning. To facilitate acquire the enhanced effects, the use of AI is made and an algorithm is develop in ES, in order to have improved load calculated figures which helps to map the system in enhanced way and in less time.

Here author (Neha Jain, 2014) has presented a case study application of fuzzy logic to a power quality issue. The power quality (PQ) requirement is one of the most significant issues for power companies and their consumers. The power quality interruptions are voltage sag, swell, notch, spike and transients etc. The voltage sag is very rigorous problem for a manufacturing customer which requires vital

consideration for its reimbursement. There are different techniques for the reimbursement of voltage sag. One of the most accepted techniques of sag return is fuzzy logic method for PQ disturbance analysis which is employ in both low voltage and medium voltage applications. In this paper author has the widespread analysis of various items the advantages and disadvantages of each promising pattern and organize methods be appropriating to fuzzy logic are offered. It explains the computer-based load sensitivity to voltage sags, by using fuzzy sets and IF-THEN inference laws. This type of sensitive load has an intrinsic improbability, i.e., power quality acceptance varies according to variations in tools manufacturers, machine application, and so on.

A fuzzy inference scheme is experimentally executed for these cases, showing the common process of how to use this assumption. It become visible that fuzzy set theory can play a significant responsibility in identifies power quality troubles. And hence it can propose approaching towards the approval of the requires of manufacturers, services and clients. Experimental results show the potential of intelligent system methods for analyze power quality interruptions, giving answers to the requires of producers, utilities, and electric energy clients. There are many studies about harmonic distortion with methods to get better power quality and reimburse distorted signal. Typically, when a passive LC (Inductor and Capacitor) power lter is joined in parallel with the load of parallel or series resonances for the reason that of which the passive filter cannot make available a complete solution it is employed to remove current harmonics. This reimbursement apparatus has some deficiencies mainly associated to the emergence (Salmeron, 1923).

For removing harmonic pollution in power systems, the active power filter (APF) is an extremely appropriate implement. APF has to take action immediately and effort with far above the ground control accuracy in existing tracking, in view of the fact that the load harmonics may possibly be very complex and transform indiscriminately and rapidly. Many progressed manage and signal-processing methods have been useful for example hysteresis band current control (HBCC), sliding-mode control, fuzzy-logic control, pulse width modulation (PWM), neural-network theory, and adaptive signal processing and etc. (Xia *et al.*, 2011). This paper (Paresh J. Shah, 2012). provides an unusual signal processing methods which are extensively used for improving effectiveness of power supplies. There are numerous amounts of power quality troubles in power supplies, for example voltage sag, high harmonic currents, voltage swells, power-quality troubles a broad spectrum of harmonic components etc. Here in this paper author (Paresh J. Shah, 2012), suggests unusual artificial intelligence approaches to advance signal processing methods for progressing the power quality. Nowadays electronics methods are frequently created of mixed analog and digital elements. With the aim of simulate the complete scheme many kinds of software should work mutually and co-simulation is essential for power drivers.

These methods possibly measured as enhanced choices to power quality enhancement, because of concentrated amount of the largely power supplies, advanced efficiency and lower charge and improved consistency. As being utilized to provide

responsive loads for example computers, communication tools and manufacturing manage procedure, medical tools, dimension and estimation is also done. Also replicating method has been extended for predictable power supplies using simulink. Replicas were obtained for the reimbursement network and other elements of controller. Experimental analysis shows that long-interval simulations can be accepted out to acquire the transient reply of the scheme. Also FPGA component for PWM generator is accessible with its benefits. Thus simulink needs less CPU run time and memory space. This modeling method could simply be broadened to other power electronics purposes. This paper describes the structured approach involved in the development of Intelligent Autonomous (self-driving, unmanned, driverless or robotic) Vehicles.

In which autopilot with artificial intelligence are critical subsystems whose growth needs multidisciplinary move toward along with synchronized engineering to create a better, safer and reliable future? We have studied and implemented a miniature scale model with outcome of satisfactory results of supporting realistic vehicular mobility simulation using concepts of swarm technology discussed in this paper. Our Model must be equipped with a variety of instrumentation and controls depending upon the mission of the target vehicle. Mechatronics, Systems Engineering (SE), Control Systems (CS), Swarm Technology, Artificial Intelligence, Image Processing Cloud Computing, Virtualization with caching, Fuzzy Logic and Neural Networks has a potential scope of design for the prototype needed to be developed that will navigate to a desired location with obstacle avoidance. In this design of autonomous vehicles have access to information about their surroundings gathered from its several sensors such as Radar, GPS including a very important component of this system Infrastructure Unit which is connected virtually with Vehicle's Operating System, mapping and direction system is discussed broadly. Here, Infrastructure Unit plays a major role in routing the traffic to maintain free flow and accident avoidance, by provides information such as Routes, Traffic, Time, Directions to Vehicles and maintains constant speed for all vehicles to achieve an efficient autonomous transportation reducing accidents to zero. To improve the response time and storage of V2I Communication a new approach of caching and virtualization are encapsulated with a better and faster hardware such as Solid State Technology. This study has various applications in Space Science, Oceanography, and Automation in Traffic control which can effortlessly meet the necessity, scalability of future Generation.

Conclusion

Electrical power being such an essential condition of all the sectors and needs to be expanded, from its generation sector to the distribution end, that it should be expanded in a more decision-making approach then at present by using Artificial intelligence techniques. A lot of effort has already been done in the field of making and the sharing part but the transmission sector still delays behind than the afterward. This paper distinctively focuses about the transmission system arrangement, with an open reason to the problems usually happens during transmission arrangement by the transmission planners. Here in this paper presents a review of various

literatures for applications of intelligent models like fuzzy logic, expert systems, neural networks, and genetic algorithms in electrical power system.

REFERENCES

Andreotti, A., Bracale, A., Caramia, P. and Carpinelli, G. 2009. "Adaptive Prony method for the calculation of power-quality indices in the presence of non-stationary disturbance wave-forms" IEEE transactions on Power Delivery, vol. 24, no. 2, pp. 874-883, April.

Andreotti, A., Bracale, A., Caramia, P. and Carpinelli, G. 2009. "Adaptive Prony method for the calculation of power-quality indices in the presence of non-stationary disturbance waveforms" IEEE transactions on Power Delivery, vol. 24, no. 2, pp. 874-883, April.

Badar Ul Islam, Syed Amjad Ahmed, "Transmission System Planning in Competitive and Restructured Environment using Artificial Intelligence" *IJCSI International Journal of Computer Science* Issues, Vol. 8, Issue 6, No 3, November 2011.

Balabhadruni, S.K. 2015. "Intelligent traffic with connected vehicles: intelligent and connected traffic systems "International Conference on Electrical, Electronics, Signals, Communication and Optimization (EESCO).

Belarbi, K. and Titel, F. 2000. "Genetic algorithm for the design of a class of fuzzy controllers: An alternative approach," IEEE Trans. Fuzzy Syst., vol. 8, pp. 398–405, July

Carlos, A. Duque, Moisés, V. Ribeiro, Frederico R. Ramos, and Jacques Szczupak, "Power quality event detection based on the divide and conquer principle and innovation concept" IEEE Transactions on Power Delivery, Vol. 20, No. 4, pp.2361-2369, October 2005.

Gadanho, S. and Hallam, J. 2001. Emotion2 triggered learning in autonomous robot control. *Cybernetics and Systems: an international journal*, V. 32, pp.531-559.

George F Luger. 2001. "Artificial Intelligence Structures and Strategies for Complex Problem Solving" Fourth Edition, July 2001.

Gosbell, V. J., Perera, B. S. P. and Herath, H. M. S. C. 2002. "Unified power quality index (UPQI) for continuous disturbances," in Proc. 10th Int. Conf. Harmonics Quality Power, Oct. 6–9, vol. 1, pp. 316–321.

Ibrahim, W. R. A. and Morcos, M. M. 2002. "Artificial intelligence and advanced mathematical tools for power quality applications: A survey," IEEE Trans. Power Del., vol. 17, no. 2, pp. 668–673, Apr.

Mahmoud El-Gammal, Amr Abou-Ghazala and Tarek El-Shennawy, "Detection, localization, and classification of power quality disturbances using discrete wavelet transform technique" *Alexandria Engineering Journal*, Vol. 42, No. 1, pp. 17-23, January 2003.

Neha Jain, Devendra Mittal, "Analysis of Power Quality Improvement in Voltage Sag and Load Sensitivity Using Fuzzy Logic" *International Journal of Engineering Research & Technology* (IJERT) Vol. 3 Issue 2, February – 2014.

Paresh, J. Shah, Rakesh Saxena, M. P. S. Chawla, 2012. "Artificial Intelligence Approaches to Advance Signal Processing and Simulation Methods for Efficient Power Supplies" *Electrical and Electronic Engineering*, 2(4): 217-225 DOI: 10.5923/j.eee.20120204.07.

Petta, P. and Trappl, R. 2001. Emotions and agents. Multi-agents systems and applications. Springer-Verlag: New York, NY, USA, pp. 301 - 316.

Quyang, Z., and Shahidehpour, S.M. "A Multi Stage Intelligent System for Unit Commitment" by Department of Electrical and Computer Engineering, Illinos, Institute of Technology, Chicago.

Rajat, K. Deb, Pushkar Wagle, and Rafael Emmanuel A. Macatangay, "Generation and Transmission Investments in Restructured Electricity Markets", 2005. Available http://www.energyonline.com.

Ribeiro, C. A. Duque, and J. M. T. Romano, 2004. "An improved method for signal processing and compression in power quality evaluation," IEEE Trans. Power Del., vol. 19, no. 2, pp. 464–471, Apr.

Salmeron, P. and Litran, S.P.A. 2010. "control strategy for hybrid power filters to compensate four-wire three-phase systems", Power Electronics, IEEE Transactions on, Vol. 25, pp. 1923-1931.

Santoso, S., Powers, E. J., Grady, W. M. Lamoree, J. and C. Bhatt, S. 2000. "Characterization of distribution power quality events with Fourier and wavelet transforms," IEEE Trans. Power Del., vol. 15, no. 1, pp. 247–254, Jan.

Xia, L., Taihang, D. and Shengxue, T. 2011. "A fuzzy logic variable hysteresis band current control technique for three phase shunt active power filter", In Control, Automation and Systems Engineering (CASE), IEEE, *International Conference* on, pp. 1-4, July.

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