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A NOVEL POWER QUALITY IMPROVEMENT FOR VOLTAGE SAG ASSESSMENT IN SMART GRID DISTRIBUTION SYSTEM USING UPFC

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Abstract

The power quality analysis involves modeling the electrical network and disturbance to determine the voltage sag which is used for planning studies to ensure adequate performance as well as diagnostically to investigate and understand events after they have been experienced. This presents a state estimator (SE) which is the reverse of the traditional analysis algorithm. The state estimator uses record the information and knowledge of the electrical network to identify the type of event and location of the source of the disturbance. Grids initiative being promoted worldwide In state estimation in the distribution system and improving with the help of FACTS device (UPFC). This has led to the Smart Grid concept as a pathway of increasing the smartness of the electrical grid.

Keyword: smart grid, estimator, estimation methods, box Jenkins model estimator

I. INTRODUCTION

State estimation is an essential tool in the operation of modern power systems. The objective of state estimation is to determine the most likely state of the power system. As the input, state estimation uses the system model, the topology status collected from substations, and the most recent available measurements, which can be redundant and contain noise .Having the system state and the system model, all the active and reactive power flows in the system can be computed, even if these flows were not measured originally. This information is either directly displayed to an operator supervising the power system or is further processed by other applications. Steps in measurement acquisition and role of state estimation are usually executed in regular time intervals, typically from a few seconds up to several minute. These methods based on static models assume that the system is in quasi steady state, which is necessary mostly due to the technological limitations of the measurement collection chain. However, underlying power system is in a permanent dynamic evolution of various time scales. State estimators shall determine instantaneous algebraic state of the power system. The state of a system is the important information to ensure that component of power system operation and can be used for improves the quality of power system. But monitor placement at all location in large power system is related to high instrumentation cost. Therefore, a state estimation technique to electric power system, it related to the set of voltage and current data from selected location and also related to computation of a state Vector at unmonitored location.

II. SYSTEM FRAMEWORK

The importance of power quality issues and the reduction in price of meters capable of measuring power quality indices being focused on extending the concept of state estimation techniques into power quality issues, is called power quality state estimation (PQSE).under this transient state estimation is used to analyze the consequences of a disturbance on a power system voltage, current etc.., It is a valuable tool to identify type and location of a disturbance in a power system. A Smart Grid is an electric power network that utilizes two-way communication and control-technologies to cost efficiently integrate the behavior and actions of all users connected to it – in order to ensure an economically efficient and sustainable power system with low losses and high levels of quality, security of supply and safety. It uses digital technology to improve reliability, security, and efficiency (both economic and energy) of the electric system from large generation, through the delivery systems to electricity consumers and a growing number of distributed-generation and storage resources. The Information networks that are transforming our economy in other areas are also being applied to applications for Dynamic optimization of electric system operations, maintenance, and planning. Resources and services that were separately managed are now being integrated and rebounded as we address traditional problems in new ways, adapt the system to tackle new challenges, and discover new benefits that have transformational potential.

III. STATE ESTIMATION

State estimator allows the calculation of these variables of interest with high confidence despite to the measurements that are corrupted by noise. To obtain the best estimate of the state of the system based on a set of measurements of the model of the system.

MULTI AREA STATE ESTIMATION

MASE in which microprocessor technology was not mature enough to handle the computational load of SE in very large interconnections and SE was to Implemented on multiprocessor computing architectures. Since the power grid is inevitably a large network, a centralized solution to the associated SE problem poses tremendous computational complexity. An alternative is to divide the large power in System into smaller areas, each equipped with a local processor to provide a local SE solution. As compared with a centralized SE approach, MASE reduce the amount of data that each state estimator needs to process (hence reduces complexity) and they Improve the robustness of the system by distributing the knowledge of the state. The implementation requires additional communication overhead and it comes with the time problem that results from asynchronous measurements obtained in different areas.

DISTRIBUTION SYSTEM STATE ESTIMATION

The SE functions at both transmission and distributions levels as well as their corresponding data acquisition and management systems. The distribution system is the counterpart at the distribution level of the system at the transmission level. At the transmission level, many functions of the EMS are based on the real-time modeling of the system generated by SE. One of the objectives in the development of DSSE is to make it comparable to the transmission level SE. However, the transmission level SE algorithms cannot be directly applied to distribution systems Since the operation and planning of the distribution systems are quite different from those in the transmission systems. In the current distribution systems, the major distinct features for DSSE are the number of existing telemeter devices that can provide real-time measurements is quite limited, and it is far from being sufficient to provide observability, not to mention bad data detection capability.

TRANSIENTSTATE ESTIMATION

The state of a system is one of the important information to ensure that component of power system operation is used for improves the quality of power system. But monitor placement at all location in large power system is related to high instrumentation cost. Therefore, a better technique is to combine partial measurements at optimal location with state estimation to collect completed knowledge of the system states. When applied state estimation technique to electric power system, it related to the set of voltage and current data from s elected location and also related to computation of a state vector at unmonitored location. In case of switching event, lost of load or system disturbances which concern with the transients are also used state estimation techniques to estimate Instantaneous value called Transient State Estimation (TSE) by NIS estimator. When a fault has occurred in a large power system, it is usually a difficult task to determine the fault position. Regardless of whether it occurred at transmission or load level, all customers that are connected to it will be affected to some degree. It is important the fault position is quickly identified so appropriate action can be carried out. Due to the measurement cost, complete monitoring of the system to determine the fault event is impractical.

IV. STABILITY IMPROVEMENT

In the proposed method the improvement in transient stability is obtained by the UPFC which is modeled as dependent current injection model. Calculation of injected Currents has been carried in such a way that it simplifies the inclusion transient stability program. The transient stability and damping of power oscillations are evaluated with UPFC. Dynamics of the system is compared with and without presence of UPFC in the system. It is clear from the considerable improvement in the system performance with the presence UPFC. The effect of UPFC is dominant when the controller is placed near heavily disturbed generator.

• The effect of UPFC is more effective when the then placed at remote locations.

• UPFC helps in improving transient stability by improving critical clearing time.

• The transient stability is improved by decreasing first swing with UPFC.

The Power systems are subjected to various types of disturbances which cause the problem of losing stability. The problem of transient stability is a crucial problem. Transient stability evaluation of large scale power systems is an extremely intricate and highly non-linear problem. The main causes of transient stability may be due to transmission system faults, sudden fault changes, loss of generating units and line switching. So the enhancement of transient stability is essential for a secure power system operation. Transient stability of a system refers to the stability when subjected to large disturbances such as faults and switching of lines. Transient stability of the system can be improved by increasing the system voltage, increasing the X/R ratio, increasing the number of parallel lines between points and placement of the FACTS devices. The FACTS controller can improve the voltage stability, steady-state and transient stability of a power system.

IMPROVEMENT IN POWER QUALITY

The power quality is a concept of powering and grounding electronic equipment in a manner that is suitable to the operation of that equipment and compatible with the premise wiring system and other connected equipment. Increasing energy costs, price volatility and electricity related reliability issues are expected to continue for the foreseeable future. Businesses, institutions and consumers are becoming more demanding and expect a more reliable and robust electrical supply, particularly with the installation of diverse electrical devices. Compatibility issues may become more complex as new Energy sources and programs, which may be sources of power quality problems, become part of the supply solution. quality issues on the "customer side of the meter" are the responsibility of the customer. The main purpose of SE is to estimate the power flow of the whole network from limited synchronized measurements. Ideally, an accurate SE requires:

1. Accurate modeling of the system topology.
2. The system to be fully observable for the given set of measurements (i.e. over-determined system).
3. Absence of bad measurements.

Consider a general measurement system which relates the measurement vector *z* to the state variables *x* expressed in

$$Z = [H]x+\varepsilon$$

Where ε is the error vector and [] *H* is the measurement matrix. To build up the measurement system, rows are picked from the differential equations for the corresponding measurements. In the case where field measurements data are absent, measurement data. The procedure of the SE can be described as follows:

1. Establish appropriate state model for linear and non linear system components, such as transformers and transmission lines.
2. Equate complete differential and algebraically equations for the power system. Euler's formula is used to discrete these equations in this case.
3. Read off-line and on-line measurements from selected measurement locations.
4. Build up the measurements equations by adding rows of dynamics equations which relate the measurements to the state variables.

$$Z = [H]x+\varepsilon$$

5. Solve the measurement system for current time-step.

$$x = ([H]^T[H])^{-1}[H]^T$$

6. Calculate dependent variables
7. Record estimation
8. Repeat 2-7 for the next time-step.

V.BOX JENKINS MODEL ESTIMATOR

Box Jenkins modeling of time series data can be improved and simplified to contemporary modeling procedures. In this technique many recent advances have been made at the identification, estimation and diagnostic check of model development. parameters can be estimated more efficiently by employing the modified technique. At the estimation stage it is possible to obtain the maximum estimate for box power transformation. When checking for model adequacy, knowing the distribution of the residual auto correlation allows for a sensitive test for residual witness. Transient response analysis is a step- and impulse-response analysis gives information on dominating time constant, time delay, and stationary gain. It is also possible to recognize non-minimum phase properties of the system from these experiments. An indication of the disturbances acting on the system may also be obtained. It would be beneficial to use a Box-Jenkins model which provides a parametric model with errors being modeled separately from the first term that is related to the system dynamics. The error term properties are modeled by a rational transfer function H(q) with both numerator and denominator is expressed as follows

$$Y[k]= x[k]\ K+H[q]\ e[k]$$

$$H(q)= \frac{1+c_1q^{-1}+c_2q^{-2}+\ldots+c_{nc}q^{-nc}}{1+d_1q^{-1}+d_2^{1}+\ldots+d_{nd}^{nd}}$$

This model is known as a Box-Jenkins (BJ) model and is denoted by BJ (nc,nd).

METHODS OF SMART GRID STATE ESTIMATION

The smart grid state estimation is mainly deals with the transmission system and distribution system in the smart network. The central purpose of smart grid is to maximize the utilization degree of electricity networks and electricity production capacity by leveraging the latest information technology, two way communication and system intelligence operational margins become smaller. State estimation is an important part of any network control system. The smart grids bring more measurements are being installed in disconnected stations, distributed generators, distribution substation and even on customer connection points. In radial network load flows will be calculated using backward/forward sweep method instead of the more complex iterative method used for meshed networks.

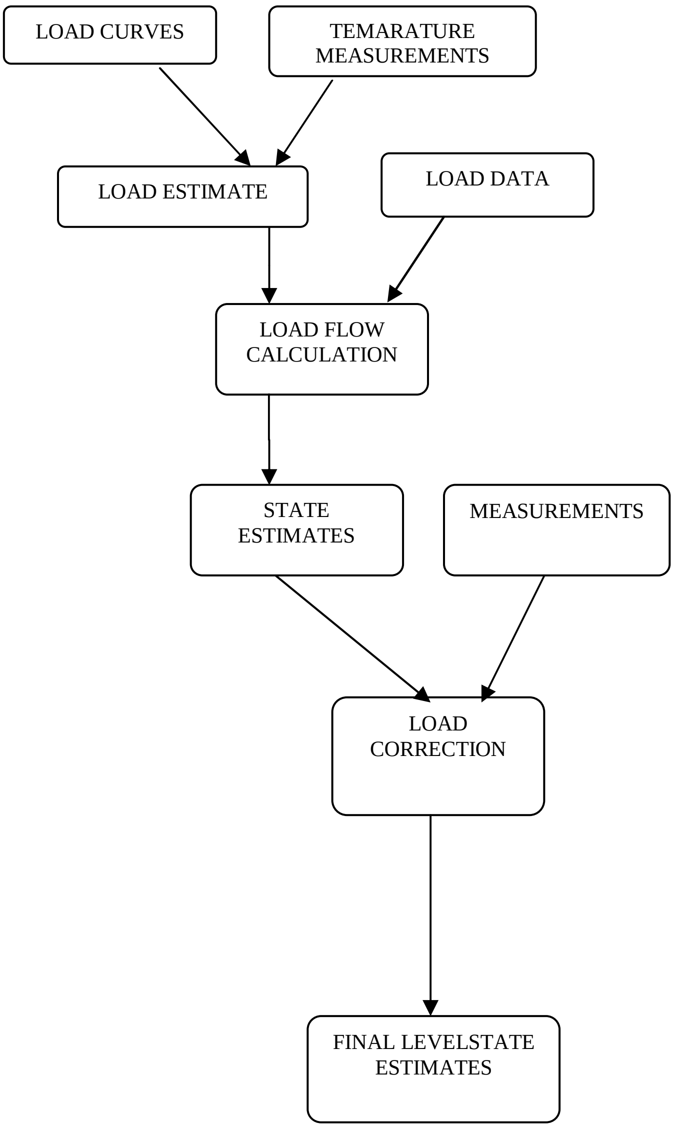

Fig 1. FLOWCHART OF ESTIMATION

These phenomena are generally strongly non linear. They are caused by important disturbances, and characterized by the type of resulting instabilities in programs exist, based on more or less detailed models of the power system. They range from general purpose power system dynamic simulation packages, down to simplified models and approaches for the study of a particular sub problem. These equations describe the interconnection between the RLC branches and the state variables.

The relevant system components are modeled as follows as Generators are modeled by a voltage source with their equivalent R-R//L impedance. In Transformer they are represented using two windings model depending on the type of magnetic circuit and on the connections of the terminals and the neutrals. Core losses are represented internally with an equivalent shunt resistance across each winding in the transformer. Transmission lines are modeled by the three-phase PI models and hence capable of incorporating non symmetric condition. Loads are the real and reactive power components are represented by its equivalent resistance and inductance respectively.

VI. RESULTS &DISCUSSION

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include are Math and computation, Algorithm development, Modeling, simulation, and prototyping. It supports linear and non linear systems, modeled in continuous time, samples time, or a three stage of the two systems can also be multi rate, i.e., have different parts that are sampled or updated at different rate Simulink is a graphical extension to MATLAB for the modeling and simulation of systems. In Simulink, systems are drawn on screen as block diagrams. The simulink modeling and the results show the amount of sag in the distribution system are estimated with the help of the estimator.

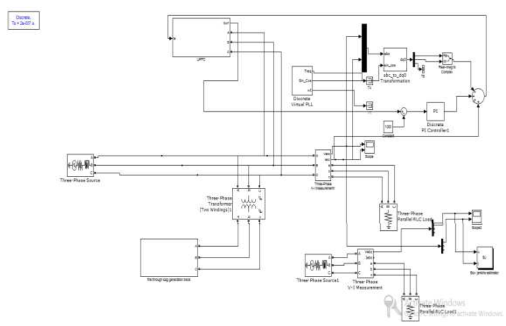

Fig 2. SIMULATION MODEL

SIMULATION RESULT

The output waveform shows the actual output verses the simulated model output waveform to identify the amount of disturbances in the system in Fig 3. It shows the amount of error in the simulated model in Fig 4

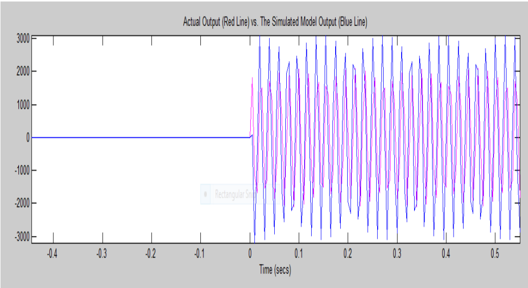

Fig (3)

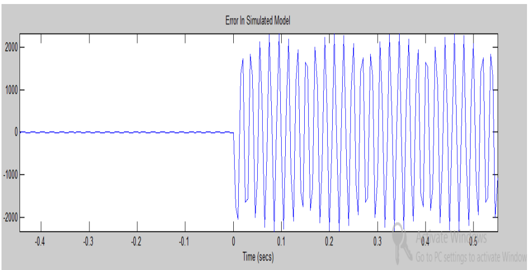

Fig (4)

VII. CONCLUSION

The simulation at the measurement points are then fed to the developed state estimator (SE) and the estimated quantities at the unmonitored locations are compared to the simulation results. In this method the voltage sag are estimated through estimator and the estimated quantities at the unmonitored location are rectified by using the FACTS device UPFC to control the voltage sag by the Box Jenkins Estimator to obtain a better estimation. They provide a time domain estimation it can be used to assess voltage sag as well as identify the cause of voltage sag by inspecting the estimated quantities are estimated by box Jenkins model estimator to obtain an estimated value to an unmonitored location.

REFERENCES

1. "A Study Of Numerical Integration Techniques For Use In The Companion Circuit Method Of Transient Circuit Analysis” ECE Technical Reports. Paper 297. (1992).

2. Pirjo Heine, Member, IEEE, and Matti Lehtonen “Voltage Sag Distributions Caused by Power System Faults” IEEE Trans. Power systems, vol.18, No. 4, Nov 2003

3. K. K.C. Yu, Student Member, IEEE and N. R. Watson, Senior Member, IEEE “Identification of Fault Locations using Transient State Estimation” International Conference on Power Systems Transients (IPST’05) in Montreal, Canada on June 19-23, 2005 Paper No. IPST05 - 064

4. J.Mahseredjia, S.Dennetire, L.be,B. Khodabakhchian, L. Gerin-Lajoie “On a new approach for the simulation of transients in power systems” International Conference on Power Systems Transients (IPST’05) in Montreal, Canada on June 19-23, 2005 Paper No. IPST05 - 139

5. T. S. Sidhu, Fellow, IEEE, M. Tamije Selvy, Student Member “A New Concept for Enhanced Simulation of Power Systems” International Conference on Power Systems Transients (IPST’05) in Montreal, Canada on June 19-23, 2005 Paper No. IPST05 - 223

6. Seungwon An, Member, IEEE, John Condren, Member, IEEE, and Thomas W. Gedra, Member, IEEE“An Ideal Transformer UPFC Model, OPF First-OrderSensitivities, and Application to Screening for Optimal UPFC Locations” IEEE Transactions On Power Systems, Vol. 22, No. 1, February 2007

7. NIST Special Publication 1108, “NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0,” Jan. 2010.

8. Jamal BEIZA, Seyed Hussein HOSSEINIAN, Behrooz VAHIDI “Fault detection and identification for voltage sag stateestimation in power systems” Turk Journal Elec Eng & Comp Sci, Vol.18, No.4, Jan 2010

9.D. Saxena, K.S. Verma and S.N. Singh “Power quality event classification: an overview and key issues” International Journal of Engineering, Science and Technology, pp. 186-199, Vol. 2, No. 3, June 2010

10. T. Nireekshana “Modelling and Control Design of UnifiedPower Flow Controller forVarious Control Strategies” International Journal of Engineering Science and Technology Vol. 2(11), July 2010

11.D. Murali and Dr. M. Rajaram “Active and Reactive Power Flow Control using FACTSDevices” International Journal of Computer Applications Volume 9– No.8, November 2010

12. Shahrokh Shojaeian, Jafar Soltani, Member, IEEE, and Gholamreza ArabMarkadeh “Damping of Low Frequency Oscillations of Multi-Machine Multi-UPFC Power Systems, Based on Adaptive Input-Output Feedback Linearization Control” IEEE transactions on power systems may 2011

13. Marcos Pereira and Luiz Cera Zanetta, Senior Member, IEEE“A Current Based Model for LoadFlow

Studies With UPFC” IEEE Transactions On Power Systems July 2011
14. Marija Zima-Bockarjova, Member, IEEE, Marek Zima, Senior Member, IEEE, and Goran Andersons, Fellow, IEEE “Analysis of the State EstimationPerformance in Transient Conditions” IEEE Transactions On Power Systems, Vol. 26, No. 4, November 2011
15.U. Arumugam, N. M. Nor, and M. F. Abdullah “A Brief Review on Advances of Harmonic State Estimation Techniques in Power Systems” International Journal of Information and Electronics Engineering, Vol. 1, No. 3, November 2011
16. J. Schoukens, Y. Rolain, G. Vandersteen, R. Pintelon “User friendly Box-Jenkins identification using Non parametric noise models”50th IEEE Conference on Decision and Control andEuropean Control Conference (CDC-ECC)Orlando, FL, USA, December 12-15, 2011
17. Lashkar Ara, Member, IEEE, A. Kazemi, and S. A. Nabavi Niaki, Senior Member, IEEE “Multi objective Optimal Location of FACTSShunt-Series Controllers for Power SystemOperation Planning” IEEE Transactions On Power Delivery, Vol. 27, No. 2, April 2012
18. K. Manoz Kumar Reddy “Transmission Loss Minimization Using Advanced Unified Power Flow Controller (UPFC)” IOSR Journal of Engineering May. 2012, Vol. 2(5) pp: 1049-1052
19. Rajesh Kr Ahuja, Mukul Chankaya “ Transient Stability Analysis of Power System With UPFC Using PSAT” International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 2, Issue 12, December 2012)
20. Satyendra Kumar, Dr.Upendra Prasad, Dr.Arbind Kumar Singh “EMPLOYING FACTS DEVICES (UPFC) FOR TRANSIENT STABILITY IMPROVEMENT” International journal of electrical engineering & technology, pp. 188-199,Volume 4, Issue 3, May - June (2013)
21. Anu Rani Sam, P.Arul “Transient Stability Enhancement of Multi-machine Power System Using UPFC and SSSC” International Journal of Innovative Technology and Exploring Engineering ISSN: 2278-3075, Volume-3, Issue-5, and October 2013

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