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A Noble Approach for Load Flow Analysis by Using DG System N PSAT Software

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Abstract

Load flow analysis is the steady state analysis which determines the operationalstate-owned of the system for a given loading.Load-flow studies are very significantcharacteristicsproposed for planning future expansion of power systems as well as in determining the unbeatable operation of existing systems.By means of load-flow analysis, any identified load can complete the information about the total voltage, phase angle and magnitude of each bus and phase information trendy a power system for the actual power and voltage conditions.But as we can see, due to the increasing demand of electricity, other problems with power flow also increases, such as voltage unbalance and overloading. So, towards solving these snagsthere should be anbest method which can meet the prerequisite of continuation power flow in relation to the improvement in voltage profiles and dropping power loss.This paperdefines the idealusage of distributed generation or DG system to solve problems of load flow, which in turn improves the voltage magnitude profile and diminishes overall loss in line. This recommendedmethodology will be tested on the IEEE 14 bus testing system using the MATLAB Toolbox i.e. with PSAT or using the DG system and the results obtained are simulated in comparison to the software and comparisons.

Keywords: Load Flow Analysis, Distributed Generation, CPF, PSAT.

Introduction

At present, over and above thousands of generating stations and load centres are being interrelated over transmission line towards making the power system a huge network. So, for this reason, the need to study or analyze the load flows. Load flow analysis stands for an analysis whose purpose remains toward determining the voltage and voltage of the transmission line and the quantity, phase angles of the actual power flux in current and voltage, an active power system in a normal position. The purpose of this load flow analysis is towards detecting the information of the entire voltage and phase angle for each bus for any particular load and the voltage of the criteria and generator power in an electric system. Once this data is collected then generator reactive power generation can be easily determined with the power flowing in each branch.

The main device (practically) is the voltage profile given by the load flow. This tool drive aid towards avoiding enormous difficulties around the loss or failure of electricity and also related problems related to the transmission of real and reactive power.

In order to solve the problems of load flow, numerous proficient load flow methods have been introduced and practiced in the power system for a long time. Well known ways that are used are Newton-Raphson method, fast decoupled method and Gauss-Seidel method and so on. Between all these methods, Newton-Raphson method is the most popular method used for load flow studies. Basically, Newton-Raphson method is used in problems of load flow because it is the most suitable method to find important bus voltages. Aimed at the bestaction of the electrical system, the voltage amplitude profile improvement and reduction in electrical loss is very necessary. Among entirely these methods, distribution generation is chosen as the best procedure of the load flow analysis.

Distributed generation (or DG)is well-defined and trendy in numerous ways, but in general, it comes in the custom of a medium (usually 1 kW - 50 MW) electric power generator, next to a place of electricity The product that the customer has or we can say is safe as a power distribution system. Distributed generators include: Synchronous Generator, Induction Generator, Recruiting Engine, Micro Turbine and so on. For the improvement of the voltage generator profiles, the distributed generator can be introduced in an electrical power system and also reduces entire transmission losses in the power system.

Now this paper, offers an ideal distributed generation based approach to improve voltage profiles and dropping power loss in the system by means of MATLAB software i.e. the Power System Analysis Toolbox (PSAT), which is used in this paper, is an open source MATLAB toolbox cast-off for Simulation and study of IEEE 14 bus test system towards solving load flow disputes. In how many days, the PSAT is the best software among various other software such as MatEMTP, Matpower, PAT, PST, SPS, VST etc. Direct feedback for load flow problems about critical voltage profile on the software.

Power System Analysis Toolbox (PSAT)

The Power System Analysis Toolbox (PSAT) project was first launched in September 2001 by Federico Milano. The first public version of this software was released in November 2002 and after that it has been accessed independently by any user for its use. The PSAT standsas MATLAB built software that is used in power-driven system simulation and study. GNU Octave is the Command line version of PSAT. The foremost resolution of the expansion of PSAT is that the software for the power system education is required which should be user-friendly, easy to use and reliable and permitsoperators to make a single line diagram, displays results and time domain's Plot creates graphs and simulations The PSAT moves forward as a better version of the learning process for students. First of all, it seems for instancebe an accessible tool for students of the electrical system because it is created on MATAB. In addition, users or students implement MATLAB algorithms and programs on PSAT and alter it viacountingfurther features.

PSAT provides electricity flow, continuity power flow, and optimum power flow and small-signal stability analysis and time domain simulation equipment. Voguish the situation simulation essentially uses Newton Raphson Solver, in which the most important is the Trapezoidal Rule as the integration method on the voltage profile. In one day, PSAT is the most acceptable and used software for various software such as MatEMTP, Matpower, PAT, PST, SPS, SPS. And VST etc. because this one bidsnumeroustopographiessome what than the other software's like usual power flow (PF), continuation power flow and/or voltage security examination (CPF-VS), ideal power flow (OPF) , Small signal consistent quality examination (SSSA), time field re-enactment (TDS), graphical UI (GUI) and graphical system building (CAD).

In this paper, PSAT is used to emulate power flow problems on an IEEE 14 bus testing system, which is using PV generator or above the critical bus deprived of using PV generator for graphical simulation and outcomes obtained from both the simulations are compared and the best results are chosen from them.

Distributed Generation

Distributed generation is an approach that employs small-scale technologies to produce electricity close to the end users of power. DG technologies often consist of modular generators, and they offer a number of potential benefits. In many cases, distributed generators can provide lower-cost electricity and higher power reliability and security with fewer environmental consequences than can traditional power generators. It has the ability to operate parallel with utility delivery system. It has the utility system and the ability to work individually, also a load that can be fed by the utility electrical system. Sometimes it is referred to as a "generator".

For the improvement of the voltage generator profiles, the distributed generator can be introduced in an electrical power system and also reduces total transmission losses in the power system. When distributed generators are connected to the power system grid, it affects the various profiles of the system such as voltage regulation, continuous interruption, harmonics, sag, swells, etc. With different features, the DG includes a frequent function, which uses surplus heat from the production method as the energy to cool the space heating, process heating, dehumidification and cooling on the absorption refrigeration.

In this paper, Distributed Generation plays an important role in improving voltage magnitude profile and reducing power loss in the system with the help of PV generator. PV generator is a part of distributed generation which is connected to the most important bus on the IEEE 14 bus test system to improve the voltage amplitude profile and the results are simulated with the help of open source toolbox provided by MATLAB i.e. PSAT. The 14 bus test system is carried out without the use of the PV generator, and the results obtained are compared to that followed.

Table 1: System Parameters

Frequency Base (Hz)	50
Power Base (MVA)	100
Starting Time (s)	0
Ending Time (s)	20
PF Tolerance	1e-05
Max. PF Iteration	20
Dynamic Tolerance	1e-05
Max. Dynamic Iteration	20

The single line diagram of an IEEE 14 Bus test system in PSAT is shown below:

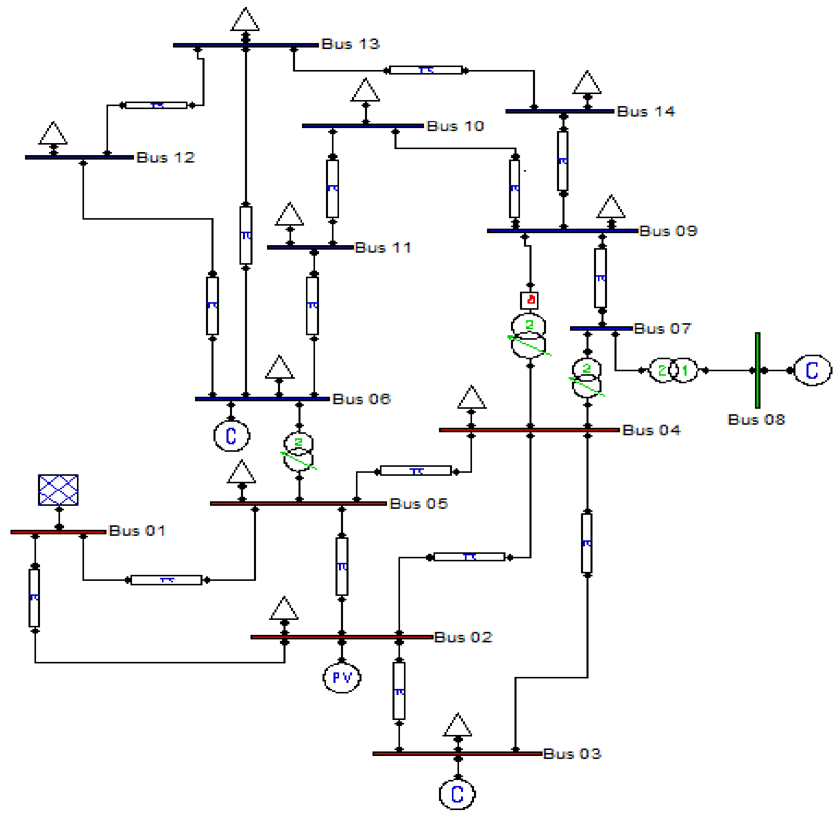

Fig.1: IEEE 14 Bus test system in PSAT

Simulation And Results

This paper describes the modelling of IEEE 14 bus testing system using the PSAT. Problems with load flow analysis are improved using the optimal distribution generation approach. The most important bus is identified and the results obtained with or without the use of PV generator are used to improve the voltage amplitude profile and reduce total power loss in line.

Results without using PV Generator are shown below:

After simulating 14 bus testing system in PSAT software, simulated results have been shown in the picture below, which states that the voltage dimension profile on bus number 8 is very important as the pre-defined limit according to the software, if a bus crosses the value 1.06 Then it is taken as an important or weak bus.

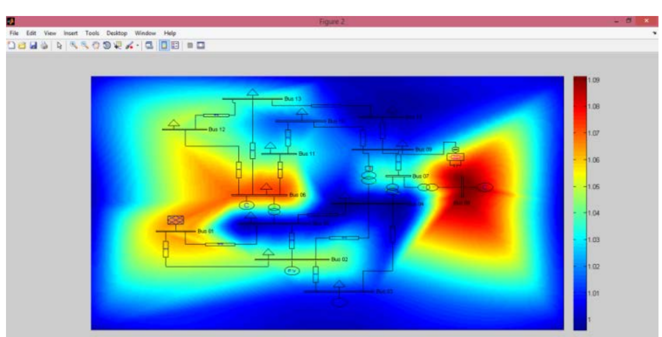

Fig.2: Simulation result of 14 bus system in PSAT for weak bus determination

Power flow using Newton-Raphson Method at each bus before connecting PV Generator at critical bus:

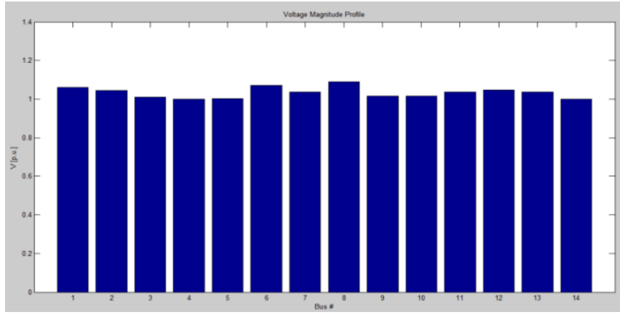

Fig.3: Simulation results of Voltage Profile at each bus without using PV Generator in PSAT

Fig.3shows per unit voltages at different buses without connecting the PV Generator using Power flow with NR Method.

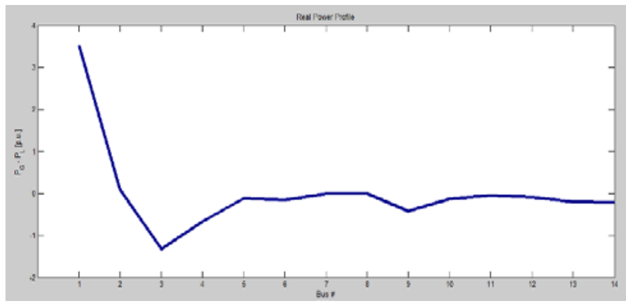

Fig.4: Simulation results of Real Power at each bus without using PV Generator in PSAT

Fig.4 shows per unit Real Power at different buses without connecting the PV Generator using Power flow with NR Method.

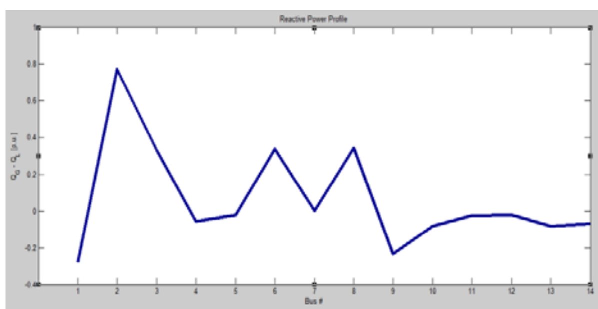

Fig.5: Simulation results of Reactive Power at each bus without using PV Generator in PSAT

Fig.5shows per unit Real Power at different buses without connectingthe PV Generator using Power flow with NR Method.

Results by using PV Generator are shown below:

Power flow using the NR Method at each bus after connecting PV Generator:

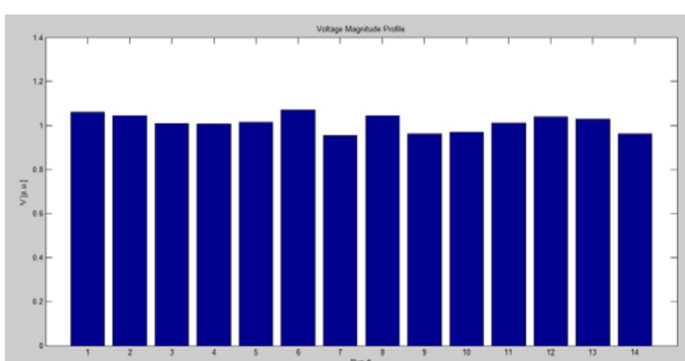

Fig.6: Simulation results of Voltage Profile at each bus using PV Generator in PSAT

Fig.6 shows per unit voltages at different buses after connecting the PV Generator using power flow with NR Method

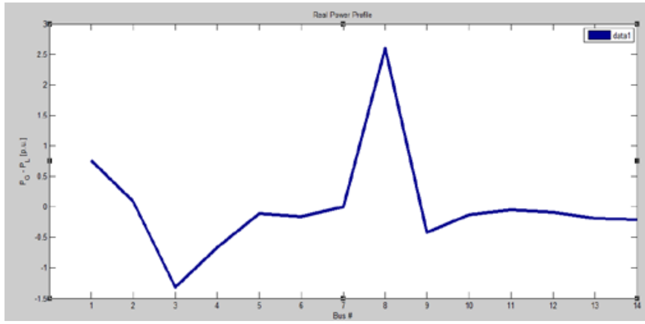

Fig.7: Simulation results of Reactive Power at each bus using PV Generator in PSAT

Fig.7 shows per unit Real Power at different buses after connecting the PV Generator using Power flow with NR Method.

Table 1: Power Flow using NR Method having trapezoidal rule as Integration Method without PV Generator

Bus	V	Phase	P gen	Q gen	P load	Q load
	[p.u.]	[rad]	[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 01	1.06	0	3.520522998	-0.27899	0	0
Bus 02	1.045	-0.1355	0.4	0.95134	0.3038	0.1778
Bus 03	1.01	-0.33145	2.22045E-15	0.59796	1.3188	0.266
Bus 04	0.99858	-0.26363	2.39808E-14	4E-15	0.6692	0.056
Bus 05	1.00293	-0.22745	-5.82867E-16	4.4E-14	0.1064	0.0224
Bus 06	1.07	-0.37854	8.49321E-15	0.44264	0.1568	0.105
Bus 07	1.03738	-0.35426	-1.08708E-15	2.4E-15	0	0
Bus 08	1.09	-0.35426	4.57967E-16	0.34242	0	0
Bus 09	1.01648	-0.4021	-1.04361E-14	3.6E-15	0.413	0.2324
Bus 10	1.01501	-0.40495	2.47025E-15	2.9E-15	0.126	0.0812
Bus 11	1.03692	-0.39461	3.95517E-15	-4.2E-16	0.049	0.0252
Bus 12	1.04652	-0.40045	-9.15934E-16	-1E-15	0.0854	0.0224
Bus 13	1.03697	-0.40236	1.63758E-15	3E-15	0.189	0.0812
Bus 14	0.99917	-0.42813	2.55351E-15	-3.7E-16	0.2086	0.07

Table 2: Shows the values of voltage magnitude, phase angles, total generated Real Power and Reactive Power and total load connected to the system.

Bus	V	Phase	P gen	Q gen	P load	Q load
	[p.u.]	[rad]	[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 01	1.06	0	0.758019	0.199072	0	0
Bus 02	1.045	-0.03015	0.4	0.486771	0.3038	0.1778
Bus 03	1.01	-0.15191	8.88E-16	0.578051	1.3188	0.266
Bus 04	1.006801	-0.01575	1.2E-14	-4.6E-15	0.6692	0.056
Bus 05	1.015468	-0.02578	4.58E-15	5.82E-15	0.1064	0.0224
Bus 06	1.07	-0.07871	1.69E-15	0.756675	0.1568	0.105
Bus 07	0.954282	0.248121	-1.9E-14	3.02E-14	0	0
Bus 08	1.045	0.725289	2.6	1.17054	0	0
Bus 09	0.96286	0.082775	1.57E-14	7.66E-15	0.413	0.2324
Bus 10	0.970038	0.045054	4.19E-15	8.88E-16	0.126	0.0812
Bus 11	1.013469	-0.02074	1.82E-15	1.01E-15	0.049	0.0252
Bus 12	1.040205	-0.08997	-6.2E-16	-1.1E-15	0.0854	0.0224
Bus 13	1.029044	-0.07856	5.55E-16	-2.2E-15	0.189	0.0812
Bus 14	0.961867	-0.0178	3.41E-15	-2.4E-15	0.2086	0.07

Comparison of the results obtained for an IEEE 14 bus test system in PSAT with or without using PV Generator:

The results obtained from both the conditions conveyed that by using PV Generator in the system improves the voltage magnitude profile on the critical bus and also reduces the total losses. The compared results for the same are shown below in the table 4:

Table 3: Comparison of results in terms of real power and reactive power with or without using PV generator.

	Real Power (p.u.) without PV generator	Reactive Power (p.u.) without PV generator	Real Power (p.u.) with PV generator	Reactive Power (p.u.) with PV generator
Total Generation	3.9205	2.0553	3.7580	3.1911
Total Load	3.626	1.1396	3.626	1.1396
Total Losses	0.2945	0.9157	0.1320	2.0515

Conclusion

This paper describes the optimal use of distributed generation-based approach for analysing load flow problems using the Newton-Raphson Solver with the help of the MATLAB based software i.e. the Power System Analysis Toolbox (PSAT), which highlighting the simulations on IEEE 14 bus tests System with a PV generator, which is one of the types of DG system, is responsible for the most significant bus on the 14 bus testing system to improve the voltage amplitude profile and reduce total loss in the system. Important, the 14 bus system simulation is carried out without using the PV generator or with it and the results obtained are compared to this later.So, basically what we get is? The voltage profile is improved at critical bus i.e. bus number 8 and the active power losses are also improved up to 44.8% in comparison of without using PV Generator.

Reference

1. DivyaAsija, PallaviChoudekar, K.M.Soni, S.K. Sinha, "Power Flow Study and Contingency status of WSCC 9 Bus Test System using MATLAB",International Conference on Recent Developments in Control, Automation and Power Engineering (RDCAPE),pp. 338-342, March, 2015.
2. L. Vanfretti, F. Milano, "Application of the PSAT, an Open Source Software, for Educational and Research Purposes", pp. 1-7, 2007
3. Federico Milano, Power System Analysis Toolbox Quick Reference Manual for PSAT, version 2.1.2, June 26, 2008.
4. Umar Naseem Khan," Distributed Generation and Power Quality".
5. Guido Pepermans, Driesen J., Dries Haeseldonckx, Ronnie Belmans, William D'haeseleer," Distributed Generation: Definition, Benefits and Issues", pp. 2-20, August 2003.
6. Thomas Ackermann, Go¨ranAndersson, LennartSo¨der," Distributed generation: a definition", Electric Power Systems Research, pp. 196-204, December 2000.
7. Chongru Liu, Anjan Bose, Fellow, Minxiao Han and Xiuyu Chen, "Improved Continuation Power Flow Method for AC/DC Power System", IEEE Electrical Power and Energy Conference, pp. 192-198, 2011.
8. Ping Yan and ArunSekar, "Study of Linear Models in Steady State Load Flow Analysis of Power Systems", Member, IEEE, pp. 666-671, 2002.
9. El FadilZakaria, Kamal Ramadan and Dalia Eltigani, "Method of Computing Maximum Loadability, Using Continuation Power Flow", International Conference on Computing, Electrical and Electronic Engineering (ICCEEE), pp. 663-667, 2013.
10. Mohamed E. El-Hawary, "Introduction to Electrical Power Systems", IEEE Press Series on Power Engineering, Series Editor, A John Wiley & Sons, INC., Publication.
11. P. S. Bhowmik, D. V. Rajan, S. P. Bose, "Load Flow Analysis: An Overview", International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering, Vol: 6, No: 3, pp. 263-268, 2012.
12. An Open Source Power System Analysis Toolbox, Federico Milano, Member, IEEE.
13. F. Milano, "Power System Analysis Toolbox Documentation for PSAT version 2.0.0", February 14, 2008.
14. Prabha Kundur,"Power System voltage stability and Control", McGraw- Hill.
15. Carson W. Taylor, "Power System voltage stability and Control", McGraw-Hill, Inc.1993.