LOAD FLOW ANALYSIS OF IEEE 14 BUS SYSTEMS IN MATLAB BY USING FAST DECOUPLED METHOD

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Abstract- This paper present simulation of IEEE-14 BUS system based on Decoupled method, that will ease the analysis of load flow problem. MATLAB software is used as a programming platform.

A modified fast decoupled method is introduced to improve performance over traditional power flow analysis methods. For a modified version of the Fast Decoupled method, both of the change in voltage magnitude and voltage angle are computed and applied in the same iteration so that the overall computation time is minimized.

Load flow analysis includes steady-state power flow and voltage analysis along with considerations for optimal power flow calculations. This recommended practice emphasizes the use of computer-aided analysis software with a list of desirable capabilities recommended to conduct a modern load flow study. It also presents examples of system data requirements and presents result analysis techniques. As there are methods for load flow analysis DC Load flow, Gauss-Siedel method, Newton-Raphson method and Fast-Decoupled method

The results will show that the proposed method is superior to the traditional methods in the number of iterations and computation time. Objective of this paper is to present result of simulation in MATLAB software to calculate voltage magnitude and phase angle, active power & reactive power at bus for IEEE 14 bus systems.

Index Terms- Power flow, Fast Decoupled load flow (FDLF) method.

I. INTRODUCTION

Load flow solution is a solution of the network under steady state operation subjected to certain inequality constraints under which the system operates. Load flow studies are important in planning and designing future expansion of power systems. The study gives steady state solutions of the voltages at all the buses, for a particular load condition. Different steady state solutions can be obtained, for different operating conditions, to help in planning, design and operation of the power system Generally, load flow studies are limited to the transmission system, which involves bulk power transmission. The load at the buses is assumed to be known. Load flow studies throw light on some at the buses, overloading of lines, overloading of generators, stability margin reduction, indicated by power angle differences between buses linked by a line, effect of contingencies like line voltages, emergency shutdown of generators, etc. Load flow studies are required for deciding the economic operation of the power system. They are also required in transient stability studies. Hence, load flow studies play a vital role in power system studies. Thus the load flow problem consists of finding the power flows (real and reactive) and voltages of a network for given bus conditions. At each bus, there are four quantities of interest to be known for further analysis: the real and reactive power, the voltage magnitude and its phase angle. Because of the nonlinearity of the algebraic equations, describing the given power system, their solutions are obviously, based on the iterative methods only.

II. POWER FLOW OVERVIEW

Aim of the whole paper is to develop a system that allow user to solve power flow problem. However the other objective that needed to complete are:

- The power sector is in its fast growing phase to meet the growing demand for electricity, with the integration of Distribution network (DN).
- Power grid is committed to provide good quality power to the consumer and maintain the stability of the network .
- To analyze the performance of the network ,load flow studies are very important .Based on the case studies, the results shows that fast decoupled method is more preferable for distribution system.

- The load flow solution gives the nodal voltages and phase angles and hence the power injection at all the buses and power flows through interconnecting power channels.
- It determines the voltage of the buses. The voltage level at the certain buses must be kept within the closed tolerances.
- The line flows can be known. The line should not be overloaded, it means, we should not operate the close to their stability or thermal limits.
- To study the performance of the transmission lines, transformer and generator at steady state condition
- an.

III.POWER FLOW ANALYSIS

Bus Classification

A bus is a node at which one or many traces, one or many masses and generators are related. In a power machine each node or bus is associated with 4 portions, which includes significance of voltage, phage angle of voltage, lively or actual strength and reactive strength in load go with the flow problem two out of those 4 quantities are special and ultimate 2 are required to be determined through the answer of equation. Depending at the portions which have been distinctive, the buses are categorized into 3 classes. For load waft studies it is assumed that the masses are steady and they're described through their real and reactive electricity consumption. The foremost objective of the burden flow is to locate the voltage magnitude of every bus and its angle whilst the powers generated and masses are pre-special.To facilitate this we classify the special buses of the power system shown in the chart underneath.

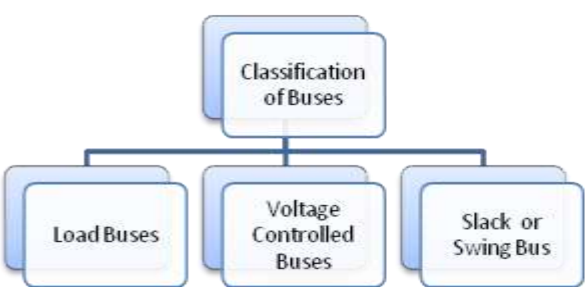


Fig. 1 Classification of buses.

Load Buses: In these buses, no generators are connected and hence the generated real power P_{Gi} and reactive power Q_{Gi} are taken as zero. The load drawn by these buses are defined by real power -P_{Li} and reactive power -Q_{Li} in which the negative sign accommodates for the power flowing out of the bus. This is why these buses are sometimes referred to as P-Q bus.

Voltage Controlled Buses: These are the buses where generators are connected. Therefore the power generation in such buses is controlled through a prime mover while the terminal voltage is controlled through the generator excitation. Keeping the input power constant through turbine-governor control and keeping the bus voltage constant using automatic voltage regulator, we can specify constant P_{Gi} and | V_i | for these buses.

Slack or Swing Bus: Usually this bus is numbered 1 for the load flow studies. This bus sets the angular reference for all the other buses. Since it is the angle difference between two voltage sources that dictates the real and reactive power flow between them, the particular angle of the slack bus is not important. However it sets the reference against which angles of all the other bus voltages are measured. For this reason the angle of this bus is usually chosen as 0 Furthermore it is assumed that the magnitude of the voltage of this bus is known.

IV. LOAD FIOW SOLUTION

In Power System Engineering, the load flow study (also known as power flow study) is an important tool involving numerical analysis applied to a power system. Unlike traditional circuit analysis , a power flow study uses simplified notation such as a one line diagram and per unit system , and focuses on various forms of AC power (i.e. reactive ,real and apparent) rather than voltage and current. It analyses the power systems in normal steady state operation. There exist a number of software implementations of power flow studies.

Load flow study is the determination of steady-state conditions of a power system for a specified power generation and load demand. The load flow problem is the computation of voltage magnitude and phase angle at each bus and also active and reactive flows in a power system. Load flow analysis is performed extensively both for system planning purposes, to analyze alternative plans of future systems operation and to evaluate different operating conditions of existing systems. In static contingency analysis, load flow study is used to assess the effect of branch or generator outages. In transfer capability analysis, repetitive power flow analysis is performed to calculate the power transfer limits.

In load flow analysis, it is normal to assume that the system is balanced and that the network is composed of constant, linear, lumped-parameter branches. In the most basic form of the power flow, transformer taps are assumed to be fixed. This assumption is relaxed in commercial load flow. Therefore, nodal analysis is generally used to describe the network. However, because the injection and demand at bus bars is generally specified in terms of real and reactive power, the overall problem is nonlinear. Accordingly, the load flow problem is a set of simultaneous nonlinear algebraic equations.

Fast Decoupled load flow (FDLF) method:

In FDLF method, the convergence is geometric, 2 to 5 iterations are normally required for practical accuracies, speed for iterations of the FDLF is nearly five times that of NR method or about two-thirds that of the GS method . Here Bii -Imaginary part of diagonal elements of Ybus ; Bij - Imaginary part of off-diagonal elements of Bus; θii-Angle of Yii element of Ybus ; B'-Imaginary part of Ybus of order (n-1) x (n-1) ; B''- Imaginary part of Ybus of order (n-1-npv) x (n-1-npv).

The diagonal elements of J1 described by

$$\frac{\partial Pi}{\partial \delta i} = \sum_{j=1}^{n} |Vi||Vj||Yij|\sin(\theta ij-\delta i+\delta j) - |Vi|2|Yii|\sin\theta ii$$

Replacing the first term of the above equation with - Qi, as given by

$$\frac{\partial Pi}{\partial \delta i} = -Qi - |V_i|^2|Y_{ii}|\sin\theta_{ii}$$

$$= -Q_i - |V_i|^2 B_{ii}$$

$B_{ii} >> Q_i$, and $|V_i|^2 \approx |V_{ii}|$

$$\frac{\partial Pi}{\partial \delta i} = -|V_i|B_{ii}$$

Similarly,

$$\frac{Pi}{\partial \delta i} = -|Vi|Bij$$

The diagonal elements of J4 described by

$$\frac{\partial Qi}{\partial |Vi|} = \sum_{j=1}^{n} |Vi||Vj||Yij|\sin(\theta ij-\delta i+\delta j) - |Vi||Yii|\sin\theta ii$$

$$\frac{\partial Qi}{\partial |Vi|} = Qi - |Vi||Yii| \sin\theta ii \text{ since } Bii = Yii \sin\theta ii >> Qi$$

$$\frac{\partial Qi}{\partial |Vi|} = |Vi|Bii$$

Again, assuming θij-δi+δj ≈θij, yields

$$\frac{\partial Qi}{\partial |Vj|} = -|Vi|Bij$$

With these assumptions, now equation becomes

$$\frac{\Delta P}{\partial |Vi|} = -B'\Delta\delta \qquad -1$$

$$\frac{\Delta Q}{|Vi|} = -B''\Delta|V| \qquad -2$$

Now the value of Δδ and $\Delta|V|$ is obtained by

$$\Delta\delta = -B'\frac{\Delta P}{|V|} \qquad -3$$

$$\Delta|V| = -[B']\frac{\Delta Q}{|V|} \qquad -4$$

A flow chart giving FDLF algorithm is presented in fig.2

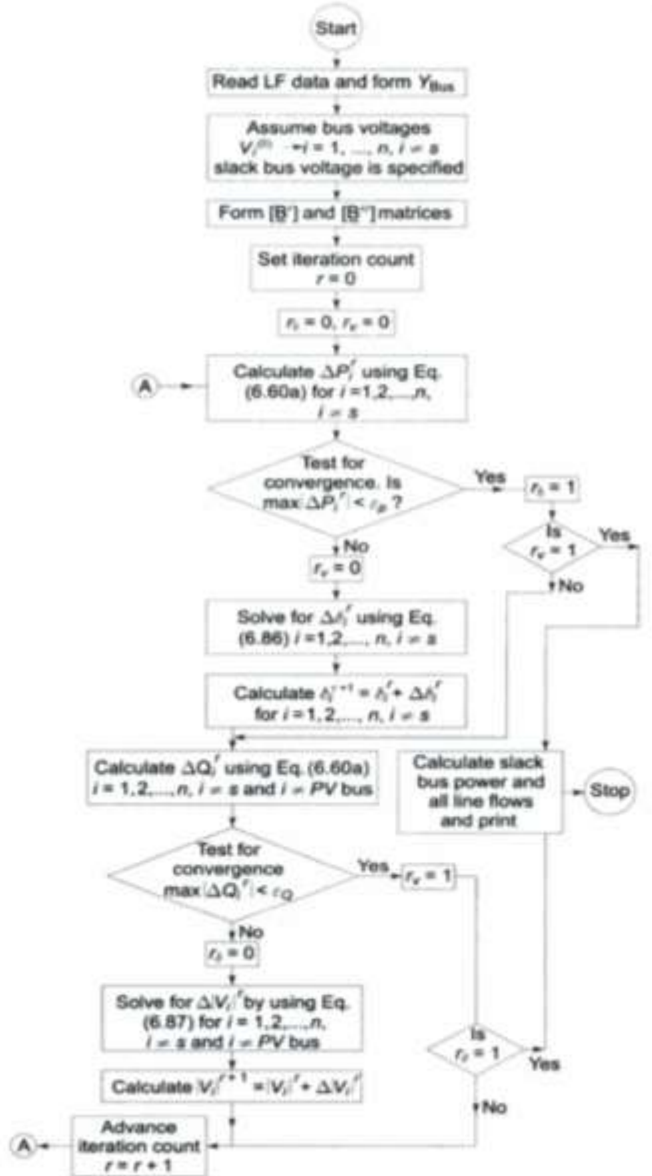
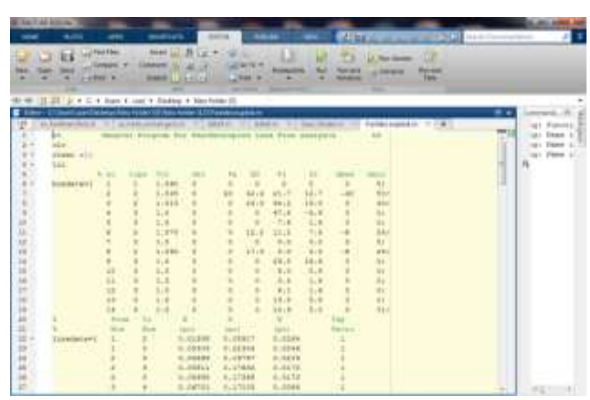
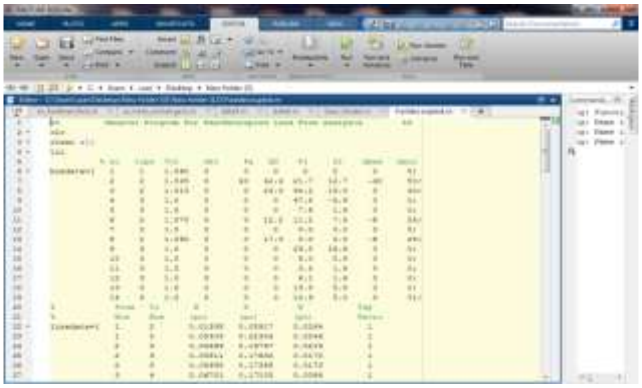
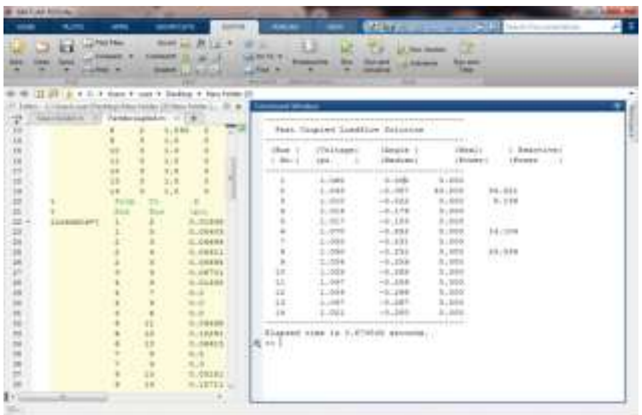


Fig.2 Algorithm of FDLF

RESULT:







Fast Decoupled Loadflow Solution				
Bus No	Voltage p.u	Angle in (Radian)	Real power	Reactive power
1	1.060	0.000	0.000	-
2	1.045	-0.087	40.000	34.221
3	1.010	-0.222	0.000	8.136
4	1.014	-0.179	0.000	-
5	1.017	-0.153	0.000	-
6	1.070	-0.252	0.000	14.104
7	1.050	-0.231	0.000	-
8	1.090	-0.231	0.000	24.539
9	1.034	-0.259	0.000	-
10	1.033	-0.263	0.000	-
11	1.047	-0.259	0.000	-
12	1.054	-0.266	0.000	-
13	1.047	-0.267	0.000	-
14	1.021	-0.280	0.000	-
Elapsed time is 0.674549 seconds.				

V. CONCLUSION

Fast Decoupled method gives the approximately same result as obtained by NR method with least no of iteration .Fast decoupled method converges very reliable and fast in 2-5 iterations, a good approximate solution is obtain after first or 2nd iteration

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