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Load flow analysis of IEEE 14 Bus system by Newton Raphson Method

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***Abstract*—** *This Paper introduces the load flow analysis of the IEEE14 BUS system using the Newton-Raphson method, which simplifies the analysis of load balancing problems. The software used for the editing platform is MATLAB. This paper provides a brief overview of electrical and energy efficiency (real and efficient) under stable conditions. There are various ways to calculate the load. The gauss-seidel method is very popular in small systems due to its short calculation time. In the case of an increase in system calculation time in this case, the Newton-Raphson method is preferred. This project aims to improve the MATLAB system for calculating the power and energy efficiency of each bus in the IEEE 14 bus system. The MATLAB system is based on input data and the results are comparable..*

Keywords- Load flow studies, Newton-Raphson method, IEEE 14 bus system etc.

I. INTRODUCTION

In addition to providing realistic and efficient energy flow research it provides information about line loading and transformer (as well as losses) throughout the system and voltages at various points in the system to monitor and control the performance of power systems. The necessary research has already been done on the development of computer systems for analyzing the flow of load. Where a radiation system with a large number of buses is to be resolved, however, these conventional purpose systems may face complexity, requiring the development of a special radiation education program. Load flow analysis can be solved using a variety of methods. The N-R Technique is used to solve indirect arithmetic with numbers.

The method is called a repetitive root recovery scheme. This method aims to solve arithmetic such as, f (x) = 0. In such a scale, the solution would be called x *, and it is the root of the function f (x). Power flow statistics are usually obtained in the N-R order of the first order. As successive measurements are required to achieve a solution, it is repeated. Below is an overview of the process. To get started, guess the solution. Guessing it will be wrong, until & unless we are very lucky. In other words, we update the "old" solution with a "new" solution with the intention that the "new" solution is better than the "old" solution.

II. POWER FLOW OVER VIEW

This paper aims to create a program that allows users to solve energy flow problems. The objectives are:
1) The energy sector is in a rapidly growing phase to meet the growing demand for electricity, by integrating the Distributed Network (DN).
2) The power grid is dedicated to providing good quality power to the consumer and maintaining network stability.
3) Load flow studies are very important to analyze network performance. Based on case studies, the results show that the Newton-Raphson method is preferred in the distribution system.
4) The load flow solution determines the voltage across the various buses and phase angles, so the power injection in all buses and the power flow through the connecting power channels are calculated.
5) Determines the bus voltage. The level of electricity in some buses should be maintained within a closed tolerance.
6) The flow of the line is unknown. The line should not be overloaded, that is, we should not work near their stability or temperature limits
7) Study the operation of transmission lines, transformer, and generator in rigid conditions.

III. POWER FLOW ANALYSIS

Bus Classification:
A bus is a node where one or more lines are connected, one or more loads and generators. In the power system each node or bus is associated with a value of 4, such as magnitude, phage angle voltage, active or actual power and energy efficiency in the two load flow values of these 4 specified values and the remaining 2 are required to be determined by the solution of equation. According to the prescribed price,

buses are divided into 3 categories. Buses are classified according to the description of two of the four.

• ***Load bus***: No generator connected to the bus. In this bus real and effective power is specified. It is desirable to determine the voltage and phase angle using the load flow solutions. It is only necessary to specify Pd and Qd on the bus as in which the bus's electrical power may not be allowed to vary within the permitted values.
• ***Generator bus or voltage-controlled bus:*** Here the magnitude of the voltage corresponding to the electric generator and the actual power Pg corresponds to its specifications. It is necessary to find the effective power of Qg and the angle of the bus voltage section.

• ***Slack bus (swing):*** With the Slack bus, it is assumed that the maximum voltage | V | and the voltage Θ phase is known, while the actual and effective power of Pg and Qg is obtained by the load flow solution [5][6][7].

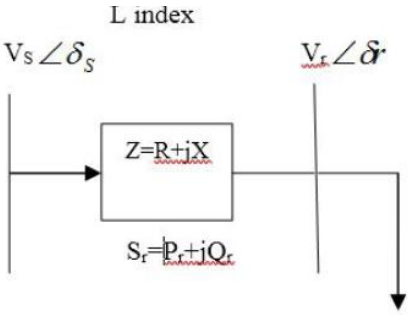


Fig. 1. Two bus system

The direction proposed by Moghavvemi in [8] is based on the single-line power model shown in Fig. 1 where the power system network can be reduced, where subindex S indicates end of transmission and subindex r means end of reception.

$$L_{mn} = \frac{4Q_r X}{[V_s \sin(\theta - \delta)]^2}$$

This Lmn value is used to determine the stability of each line connection between two bus bars on a connected network. As long as the Lmn values for all pairs are less than 1 the system is considered stable [7].

IV. NEWTON RAPHSON METHOD

There are a few positive aspects of Newton Raphson's approach: Meetings take place as soon as the initial speculation is near the right solution. Also, it can be converted to many sizes and can be used to polish roots obtained in other ways. In addition, it has a large meeting place. However, with the exception of the length of time required for the Newton Raphson method of repetition, the duration of the repetition process is shorter compared to the Gauss-Seidel method because there are fewer repetitions to be met. If not, there are a few negative aspects of Newton Raphson's approach: It takes a long time for each repetition.

In addition, it becomes even more difficult to create codes. Interim steps to implement the N-R approach:
1) Build Y Bus per unit
2) Start from the initial assumption of unknown size and voltage angle to start over
3) By repeating k, find the vector separated
4) By repeating k, find the matrix for Jacobian J - Identify the error vector
5) Using the multiplication number (k + 1), make sure that the power difference is acceptable, if so, you can proceed, otherwise, go back to the second step.
6) Calculate the effective and efficient power of Slack Bus
7) Calculate Line Flow.

V. OBJECTIVES OF THE PAPER

This paper aims to investigate the impact of using the Newton Raphson method in calculating power flow in the IEEE 14 bus system. In addition, this paper also aims to investigate the electrical profile at different nodes by calculating the magnitude of the voltage and the angle of the different nodes. It aims to analyze the real state of loss of energy and active energy loss in all the mentioned situations.

VI. REQUIRED CHARACTERISTICS OF LOAD FLOW SOLUTION METHOD

In order to be a good way to analyze the flow of load, it should find the following features:
1) High Calculation Speed: High calculation speed is required for effective results to deal with large power system networks, real-time performance, or multi-case data.
2) Low Computer Storage: A large computer memory is required to store data flow capacity of large power network networks and
can be gained through the use of small computers especially in online applications.
3) Reliability of Solution: It is very important that the results obtained after performing inventory calculations must be reliable and provide valid data.
4) Variability: The flexibility of the solution means the ability of the load flow system to handle common and special features.
Eg, transformer taps setting. The resulting load flow solution must be flexible.
5) Simplicity: When performing load flow calculations, the load flow method should provide easy coding.

VII. COMPUTATIONAL ALGORITHM FOR NEWTON RAPHSON LOAD FLOW METHOD

In order to perform the load flow analysis in the N-R manner, the required method is as follows: Step 1: Upgrade nodal admittance matrix (Yij).
Step 2: Take the bus power supply and set the bus n as a reference bus.
Vi = 1 ∠ 0º (on all PQ buses).

Step 3: find the real Power Pi;

$$P_i = G_{ii}|V_i|^2 + \sum_{j=1}^{n} |V_i||V_j|\left(G_{ij}\cos\theta_{ij} + B_{ij}\sin\theta_{ij}\right)$$

Step 4: find the reactive Power Qi;

$$Q_i = -B_{ii}|V_i|^2 + \sum_{j=1}^{n}|V_i||V_j|\left(G_{ij}\sin\theta_{ij} - B_{ij}\cos\theta_{ij}\right)$$

Step 5: Form the Jacobian matrix using sub-matrices H, N K, and L.

Step 6: Find the umehlukoPi power difference
And ΔQi for all i = 1, 2, 3 ... (n-1);
Pi = Pispec -Pical.,
Step 7: Set tolerance values.
Step 8: Stop Iteration if all and you are within tolerance levels.
Step 9: Review the values of Vi and usebenzisai using the equation.

A. Detailed Flow Chart of Newton-Raphson cargo flow pattern

In the context of the various steps involved in completing the load flow studies with the Newton Raphson methodology, the detailed flow chart that followed was designed.

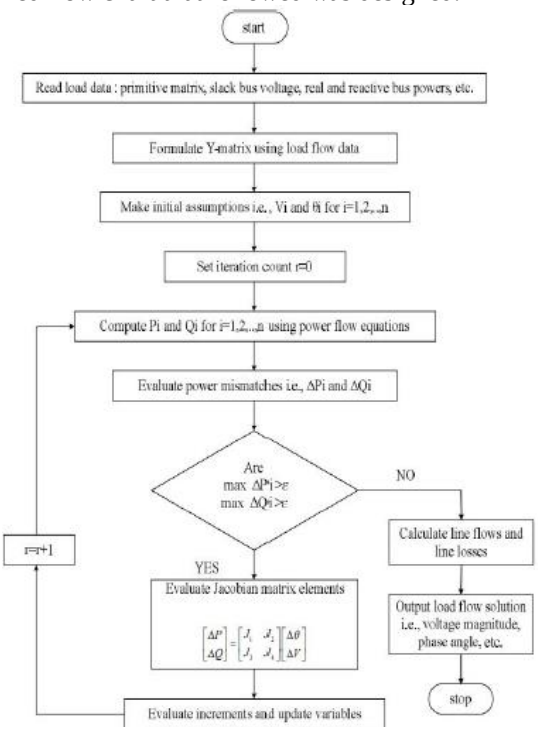


Fig 1).Detailed flowchart of Newton Raphson method

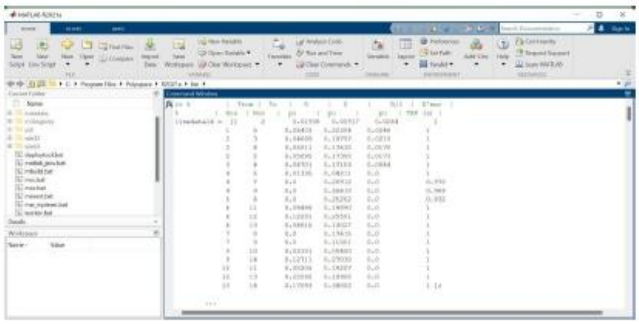
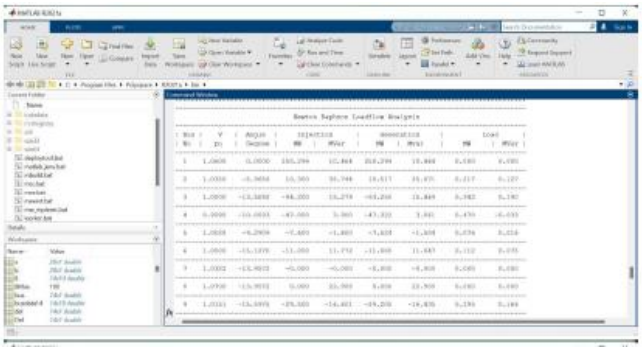


Fig.2) MATLAB Code For Newton-Raphson Method



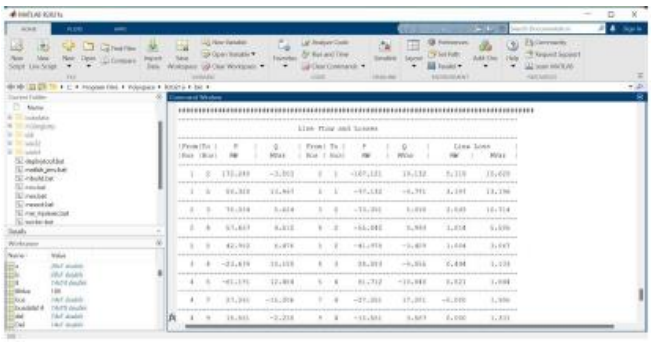


Fig.3) Results obtained from MATLAB Code

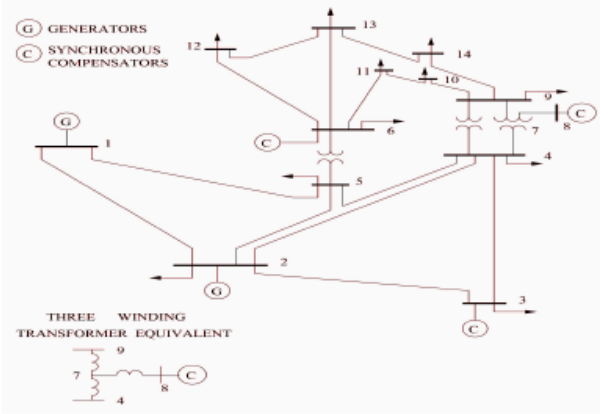


Fig.4) IEEE 14 Bus System

VIII. CONCLUSION

This paper suppressed the Newton-Raphson Method of Load flow analysis. A comparison was made between the results obtained and the expected and the algorithm found to be effective. The result is obtained by 3 to 5 repetitions. This method is found to be the best to use for proper load flow studies.

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