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Load Flow Analysis Using Particle Swarm Optimization

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ABSTRACT*:* Here, an attempt has been made to carry out load flow analysis of electrical power using PSO . Load flow is an important tool in planning and operation of power system. Usually conventional techniques like newton-rapson and guass-siedal are utilized to find Swarm Optimization technique (PSO) to solve the Problem.
The technique is implemented in MATLAB environment. PSO is applied to find out the optimum solution. Program is tested on IEEE 14,30 bus system and results are compared with conventional method.

KEYWORDS: Load Flow, ,particle swarm optimization.

I.INTRODUCTION

The load flow studies involve the solution of the power system network under steady state conditions. Power demand is increasing day by day which needs for the requirement of availability of power all the time, for which proper planning and operation of power system is necessary. Almost all the functions performed in power system depends on the load flow study in steady state condition, which involves the calculation of bus voltages, load angles, power generation in generator bus and line power flow. As the load flow problem is non-linear and can be solved by numerical technique. Different methods are available like Gauss-Siedel. Generally newton-Raphson method is applied as it has good convergence characteristics however there are certain issues like complexity of calculations and Jacobian matrix inverse calculation which depends on initial estimated values. In this work first load flow problem is taken, and optimization function is formulated taken into consideration of real power mismatch, reactive power mismatch and voltage mismatch.
The main focus is to solve the load flow problem for IEEE 5, 14 and 30 bus systems using PSO and compare the results with that of obtained from conventional method like newton Raphson.

II.PARTICLE SWARM OPTIMIZATION

Particle Swarm Optimization (PSO) is a relatively new evolutionary algorithm that may be used to find optimal (or near optimal) solutions to numerical and qualitative problems. Particle Swarm Optimization was originRussell Eberhart in 1995, and emerged from earlier experimenally developed by James Kennedy and ts with algorithms that modeled the flocking behavior seen in many species of birds[25].In simulations, birds would begin by flying around with no particular destination and spontaneously formed flocks until one of the birds flew over the roosting area. Due to the simple rules the birds used to set their directions and velocities, a bird pulling away from the flock in order to land at the roost would result in nearby birds moving towards the roost. Once these birds discovered the roost, they would land there, pulling more birds towards it, and so on until the entire flock had landed. The PSO algorithm for solving the OPF problem with an objective function of Minimization of generation fuel cost is shown in fig 1.[26]. PSO can solve problems with high quality solutions within shorter calculation time and stable convergence characteristics [29].

III.OBJECTIVE FUNCTION

The mathematical formulation of the OPF problem is a well known optimization problem. In general this can be formulated as follows :
Minimize $f(u,x)$
Subject to $g(u,x)=0$
$h(u,x) \le 0$
where u is the set of controllable variables in the system; x is the set of dependent variables called state variables; objective function f(u,x) is a scalar function that represents the power system's operation optimization goal, which could be the total generation cost, total network loss, corridor transfer power, total cost of compensation and so on [24]; g(u,x) is a vector function with conventional power flow equations and other special equality constraints such as the limit of the number of potential VAR compensators; h(u,x) is a vector of inequality constraints that are physical and

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operational limits of the power system. The control variables may include generator active power output, regulated bus voltage magnitude, variable transformer tap settings, phase shifters, switched shunt reactive devices, and load to shed in special conditions. The state variables may include voltage magnitudes at load buses, voltage phase angle at every bus, and line flows.

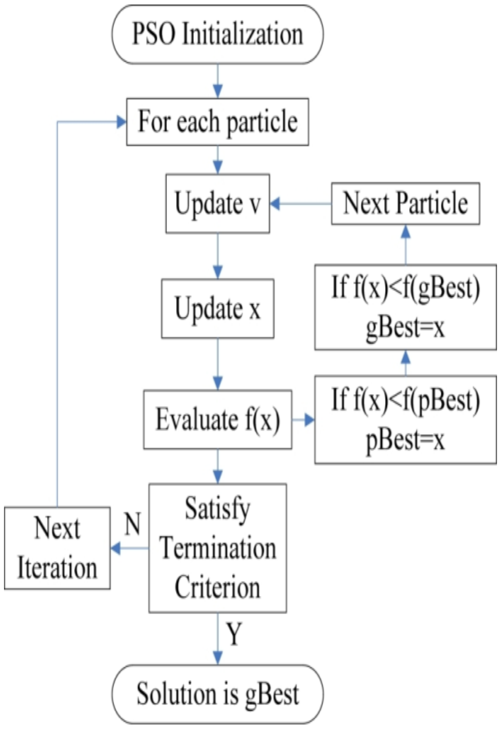

Fig.1 PSO Algorithm

IV.NEWTON RAPSON METHOD

Newton-Raphson method This method is a powerful technique to solve load flow problem which includes firstderivative information in computing bus voltages. Generally 3-5 iterations are required to solve load flow problem irrespective of the size of the system. This is the most commonly used method to solve load flow problem.

V. RESULT AND DISCUSSION

Table 1: COMPARISION BETWEEN PSO AND NR FOR IEEE 14 BUS SYSTEM

IEEE 14 bus system	PSO	NR
No. Of Iterations	51	5
Total Power Loss(MW)	11	13.47

Table 2: COMPARISION BETWEEN PSO AND NR FOR IEEE 30 BUS SYSTEM

IEEE 30 bus system	PSO	NR
No. Of Iterations	105	4
Total Power Loss(MW)	20	17.599

Voltage at different buses after optimization using PSO is shown in fig.4. It can be seen that the voltage is remaining within a narrow range of levels.

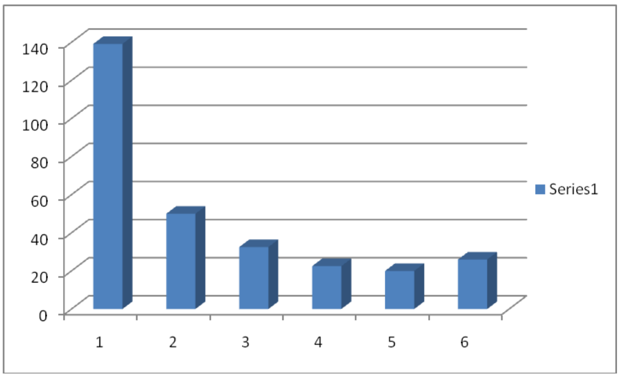

Fig. 2 Generation of IEEE-30 bus generating units

The best generation of IEEE-30 bus generating units is presented in the Fig.2.

VI.CONCLUSION

In this work, the formulation and implementation of solution methods to optimize the objective function of thermal generating units in IEEE 14 and IEEE 30 bus system using Newton-Rapson and Particle Swarm Optimization is carried out. Particle swarm optimization can be used to solve many of the same kind of problems. PSO algorithm is easy to apply and simple since it has fewer number of parameters to deal with comparing to other modern optimization algorithms. It is Efficient in global search. The effectiveness of the developed program is tested for IEEE 14 and IEEE30 bus system. The results obtained by these methods are compared with each-other. The scope of work after studying optimal power flow in is to extend the problem for congestion management or to investigate including Facts devices. Even the location of the Facts devices in the system for economic load dispatch can be worked out. The problem can even be extended for large number of units like 90 or even higher.

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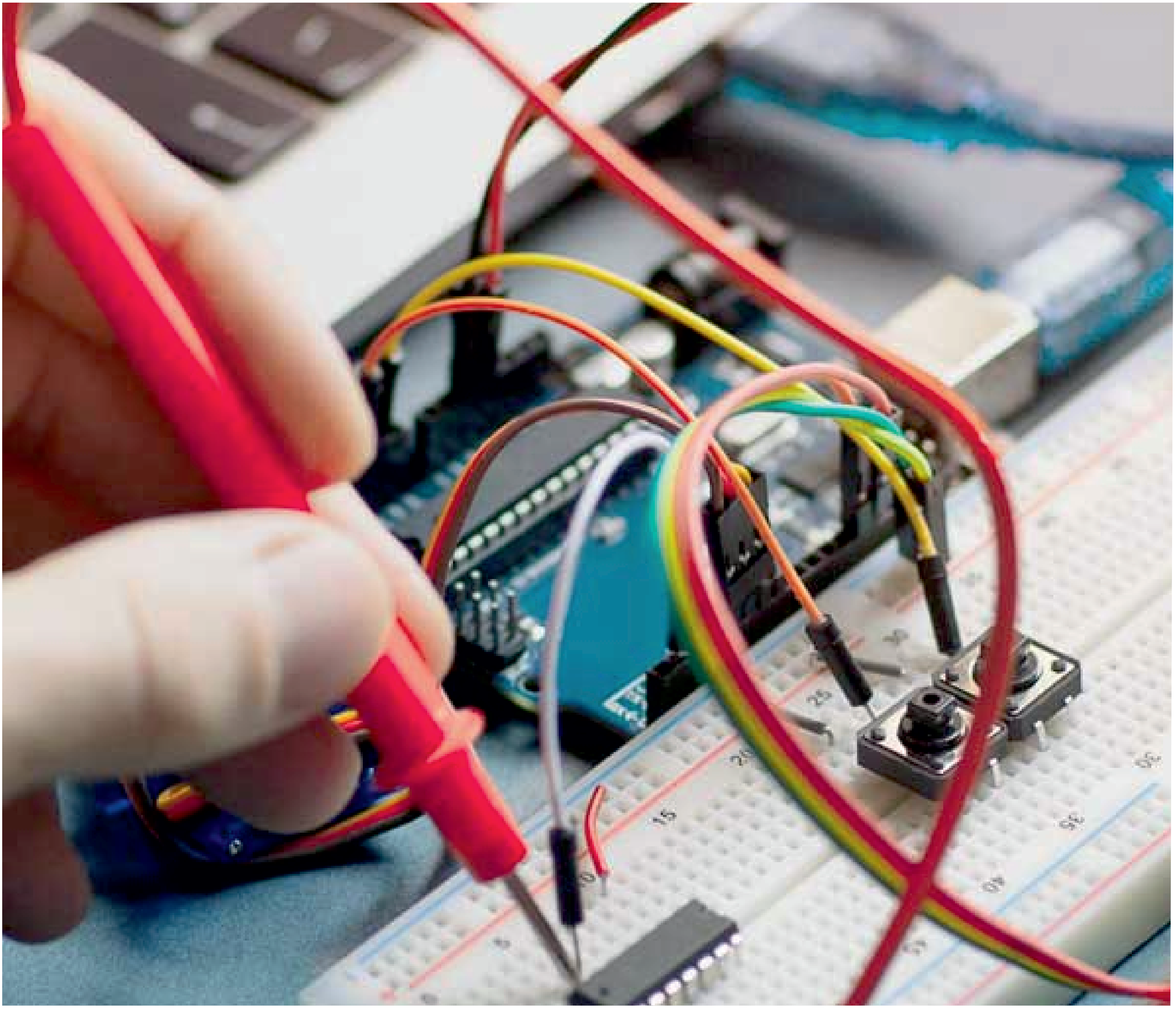

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