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A Comparative Study of Meta-heuristics Algorithms in evaluation of Economic Load Dispatch Problems in Power Generating Station with Matlab Codes

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Abstract

This paper presents a comparative study of metaheuristics algorithms in evaluation of economic load dispatch problem in power generating station with MATLAB codes. In this paper, the formulation of the ELD problems using mathematical illustrations and MATLAB codes were presented. This consists of the ELD cost model, Model calculations, cost function and parse solution. It also presents the application of some metaheuristics algorithms (solution algorithms) such as ACSA and PSO in solving ELD problem with MATLAB codes. The ELD problem was modeling using Egbin thermal power station, Nigeria as our case study.

Keywords: Economic Load Dispatch (ELD); Ant Colony Search Algorithms (ACSA); Particle Swarm Optimization (PSO); MATLAB codes

Introduction

Economic Load Dispatch (ELD) is the reduction of the total cost of power generation (which includes fuel consumption and operational cost) of power generating plants while meeting the various loads demand and power losses in the power transmission system. The objective is to apportion the total load demand and total loss among the various generating units at the same time satisfying the system constraints with reduced generation costs. With Economic Load Dispatch, it is expected that the power utilities plan and forecast optimal load dispatch. Several considerations are made during energy scheduling, these amongst others are to find out the existing generating units, the distance between load centers and the generating units, identifying the operating limits of each generating units such as the ramp rate limits, maximum and minimum generation level, prohibited zones [1].

Economic Load Dispatch

Economic load Dispatch is to determine the real and reactive power scheduling in power system this is the minimization of the cost function of different generating units. For economic operation of the power system, the total load demand must be optimally shared among all the generating units with an objective to reduce the total generation cost [1]. This is also to find out the power outputs of all generating units in power system so that the total cost of generation of the system is minimized, while meeting the load demand, system equality and inequality constraints. The essential operation constraints are the power balance constraint, that is, the total generated power must be equivalent to the load demands plus the transmission losses on the power system, and the power limit constraints of the generating units [2-6]. The problem of economic operation of a power system is the allocation of the load (MW) among the various units of generating stations in such a way that, the overall cost of generation for the given load demand is minimum. This is an optimization problem which needs to be resolved as quick as possible. For a given load demand, power flow study can be used to calculate active and reactive power generations, line flows and losses. The study also furnishes some control parameters such as the magnitude of voltage and voltage phase differences. The economic load dispatch problem is the results of various power flow studies, where a particular power flow study result is considered more appropriate in terms of cost of generation. The solution to this problem cannot be optimal unless otherwise all system constraints are met. The problem of economic operation of the power system involves two sub-problems, namely, unit commitment (UC) and economic dispatch (ED). While unit commitment (UC) is an off-line problem, economic dispatch (ED) is an area of online concern. The commitment decisions are made many weeks or months in advance. The decision to commit a generating unit to be able to produce electricity means that the power utility is willing to incur fixed costs related to unit startup in order to have that generating units ready and available to generate electricity in real time. Large turbine or nuclear plant generators with large start-up costs cannot run optimally if their output is determined using a single-period analysis (a "period" in the electric power industry usually refers to a length of time of about an hour). Instead, their operation must be scheduled over a longer period of time, usually weeks or months. A power utility would need a forecast of demand weeks in advance before turning on a generator with a long minimum run time [3]. They would need to study the demand forecast over that period of time and decide the lowest-cost mix of generation units that would meet the demand needed. While the procedure of all ocating committed generating units to satisfy customer load demands within a given operational conditions is referred to as "economic dispatch" or "optimal power flow."

Economic Load Dispatch are usually influence by factors such as high operating cost (fuel cost) and transmission losses. The Economic Load Dispatch requires the generation facilities to plan and forecast optimal energy dispatch. Hence the concept is the optimal selection of the generating units in such an economic manner that the total cost of supplying the dynamic requirements of the system is minimized [4].

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