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Solving Economic Dispatch Problems Utilizing Cuckoo Search Algorithm

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***Abstract*- This paper presents one of the latest nature-inspired meta-heuristics algorithms, namely Cuckoo Search (CS) algorithm to solve economic dispatch (ED) problems in power system. In order to obtain as close as to practical system, the effect of valve-loading effects together with the other constraints such as ramp rate limits, prohibited operating zones as well as generators operating limits have been taken into consideration in solving the most complex optimization problem. To show the effectiveness of proposed CS in solving ED problem, two test systems are utilized: TAIPOWER 40-units and 15-units systems and then the performance of proposed CS will be compared to the other recent techniques.**

I. Introduction

Economic dispatch (ED) in power system is the scheduling of the real power generation from the thermal power generators to meet the demand at the optimal operating costs while satisfying all the systems' requirements and constraints. Since the nonlinear nature of modern generating units' input-output characteristics and other constraints, the topic of ED problem is still becoming the main research interest in order to find for the better solution.

To date, nature-inspired meta-heuristic techniques become one of a popular choice to solve ED. Particle Swarm Optimization (PSO) is one of the techniques that has been applied in solving ED [1]. There are several variations of improvements of PSO that have been implemented to solve ED such as multi-agent based hybrid PSO (HMAPSO) [2], self-organizing hierarchical PSO [3], modified quantum-behaved PSO [4] and hybrid differential evolution-PSO [5]. Other than that, evolutionary programming (EP) [6], modified group search optimizer [7], cultural self-organizing migrating strategy (CSOMA) [8], firefly algorithm (FA) [9] and differential search (DS) algorithm [10] also have been tried to solve ED.

In this paper, the recent developed algorithm, viz. Cuckoo Search (CS) algorithm [11] has been applied in solving ED problems. Even though the similar approach has been proposed in [12], the different setting of the CS's parameter provides a better solution of ED problems.

The rest of this paper is organized as follows: Section 2 discusses the problem formulation of ED while the brief description of CS algorithm is presented in Section 3. It is followed by CS implementation in solving ED in Section 4. Section 5 presents the simulation results and discussion. Finally, Section 6 states the conclusion of the research.

II. Economic Dispatch Problems

The objective function of ED is to find the minimum cost of thermal power generation which normally expressed as polynomials function, as follows:

$$F_i(P_{Gi}) = a_i + b_i P_{Gi} + c_i P_{Gi}^2 \quad (1)$$

where P_{Gi} is the real power generation of generator i for dispatched hour, $F_i(P_{Gi})$ is the fuel cost function of generator i, and a_i, b_i and c_i are the coefficients of the fuel cost function for generator i. In order to make the operation of the generators close to the practical problem, the valve-points effect which introduces ripples in the heat-rate curve has been taken into account. Hence, the (1) is modified as follows:

$$F_i(P_{Gi}) = a_i + b_i P_i + c_i P_i^2 + \left| e_i \times \sin\left(f_i \times \left(P_{Gi}^{\min} - P_{Gi} \right) \right) \right| \quad (2)$$

where e_i and f_i are constants of the unit with valve-point effects. This effect is shown in Fig.1.

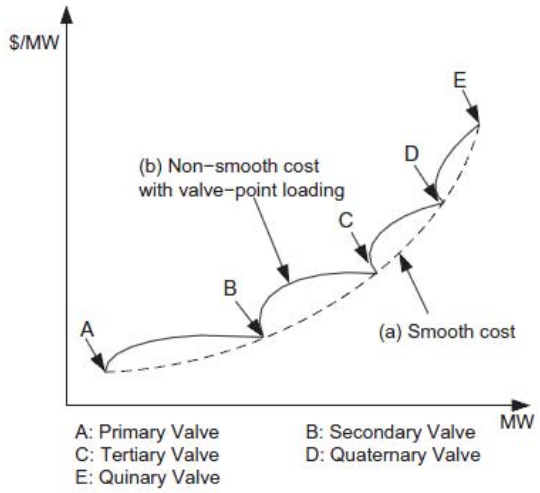

Fig 1. Cost function of a generator with and without valve-point effects [2]