

# A Modern Approach to Solve of Economic Load Dispatch using Group Leader Optimization Technique

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## ABSTRACT

Economic load dispatch plays an important role of power system operation & control by using different soft techniques that have been used to solve convex and non-convex economic load dispatch (ELD) problems. This paper presents a new global optimization algorithm to the economic load dispatch problems for minimization of fuel cost of generations with different constraints such as ramp rate limits, valve-point loading and prohibited operating zones of large-scale thermal plants. Power transmission loss has also been considered in few cases. Group leader optimization algorithm (GLOA) is a relatively new optimization technique. Mathematical models of this algorithm demonstrate the efficiency, quality of solution and convergence speed of the method and successful application of the algorithm on ELD problems. Simulation results found that the proposed approach outperforms several other existing optimization techniques in terms quality of solution obtained and computational efficiency. Results also be confirmed the robustness of the proposed methodology.

## KEYWORDS

Cross-over, Economic Load Dispatch, Group Leader Optimization Technique, Mutation, Prohibited Operating Zone, Quadratic Fuel Cost, Ramp Rate Limits, Valve-point Loading

## 1. INTRODUCTION

Economic load dispatch (ELD) is applied in electric power utilities is to provide high-quality, reliable power supply to the consumers at the lowest possible tariff. It can be defined in normal condition the operation of generation facilities is to produce electrical power at the lowest cost to reliably serve consumers, recognizing any operational limits of generation and transmission facilities. It is an important role in electrical power system operation for allocating generation among the committed units such that the constraints imposed are satisfied and the energy requirement. The characteristics of fuel for modern generating units are highly nonlinear with demand for solution techniques having no restrictions on to the shape of the fuel cost curves. For science and engineering, many optimization techniques are developed for used in ELD problem to accomplishment to the main goal. But the calculus-based methods (El-Keib, Ma, & Hart, 1994) are not fulfillment to solving ELD problems, as these techniques are required smooth, differentiable objective function. Another method which is Linear programming method (Fanshel & Lynes, 1964) is speedy and reliable but it has some drawback related with the piecewise linear cost approximation. Small improvements in the unit output scheduling can give to significant cost savings. So The dynamic programming approach, which is

proposed by Wood and Wollenberg (1984) to solve ELD problems but this technique does not impose any restriction on the nature of the cost curves, but suffers from the curse of dimensionality and larger simulation time. In current years, several attempts have been made to solve ELD with intelligent and modern technique which is meta-heuristic algorithm is helpful for solution of complex ELD problems they are Genetic algorithm (Walters & Sheble, 1993), particle swarm optimization (Gaing, 2003), Simulated Annealing (SA) (Renu Avinaash, Ravi Kumar, Anjaneya Bhargav et al., 2013), Artificial Neural Networks (Chagas, Martins & de Oliveira, 2012), Differential evolution (Tasgetiren, Bulut, Pan, et al., 2011), Tabu search (Darmawan, Priyana & Joseph, 2012), Evolutionary Programming (EP) (Jayabharathi, Jayaprakash, Jeyakumar, 2006), Ant colony optimization (Hou, Wu, Lu et al., 2002), Artificial immune system (AIS) (Panigrahi, Yadav, Agrawal, 2007), Bacterial Foraging Algorithm (BFA) (Mai & Li, 2012), Biogeography-based Optimization (BBO) (Bhattacharya, & Chattopadhyay, 2010), etc. This mentioned method may confirm to be very effective in solving nonlinear ELD problems without any restriction on the shape of the cost curves. They often provide a fast, reasonable nearly global optimal solution but these methods do not always assurance global best solutions, they often achieve a fast and near global optimal solution. In recent years, different hybridization and modification of GA, EP, PSO, DE, BBO like improved GA with multiplier updating (IGA-MU) (Chiang, 2005) directional search genetic algorithm (DSGA) (Adhinarayanan, & Sydulu, 2008), hybrid genetic algorithm (GA)-pattern search (PS)-sequential quadratic programming (SQP) (GA-PS-SQP) (Alsumait, Sykulski & Al-Othman, 2010), improved fast evolutionary programming (IFEP) (Sinha, Chakrabarti, & Chattopadhyay, 2003), new PSO with local random search (NPSO\_LRS) (Selvakumar & Thanushkodi, 2007), adaptive PSO (APSO) (Panigrahi, Pandi & Das, 2008), self-organizing hierarchical PSO (SOH-PSO) (Chaturvedi, Pandit, & Srivastava, 2008), improved coordinated aggregation based PSO (ICA-PSO) (Vlachogiannis & Lee Kwang, 2009), improved PSO (Park, Jeong, Shin et al., 2010), combined particle swarm optimization with real-valued mutation (CBPSO-RVM) (Lu, Sriyanyong, Song, 2010), DE with generator of chaos sequences and sequential quadratic programming (DEC-SQP) (Coelho & Mariani, 2006), variable scaling hybrid differential evolution (VSHDE) (Chiou, 2007), hybrid differential evolution (DE) (Duvvuru & Swarup, 2011), bacterial foraging with Nelder–Mead algorithm (BF-NM) (Panigrahi & Pandi, 2008), hybrid differential evolution with biogeography-based optimization (DE/BBO) (Bhattacharya & Chattopadhyay, 2010), etc. are being anticipated to solving ELD for search better excellence and fast solution. Recently some effective techniques (Bhattacharjee, Bhattacharya, & nee Dey, 2014a; Bhattacharjee, Bhattacharya, & nee Dey, 2014b; James & Li, 2016; Ghasemi, Taghizadeh, Ghavidel et al., 2016; Abdelaziz, Ali, Abd Elazim, 2016) also applied in power system applications and these are capable to prove the effectiveness of their ability. Population based bio-inspired algorithm are Evolutionary algorithms, swarm intelligence and bacterial foraging etc. But they have common disadvantages which is these algorithms are complicated computation, using many parameters. For that reason, it is also difficult to understand these algorithms for beginners.

In recent times, a new global optimization technique which is GLOA influenced by leaders in social groups is used as an inspiration for the evolutionary technique which is designed into group architecture. By this technique, populations for each group create randomly and calculate the fitness value for all members in all groups then each group determines the leaders. In next step mutation & recombination has played the vital role, by this step create new member by the old one and its group leader, a random element. If the generated new member has better fitness value then old one, then the replace the old one otherwise keep the old member. Then choose random members starting from the first group, and then transfer some parameters by choosing another random member from another group. If this transfer makes a member have a better fitness value then change the member, otherwise keep the original from. In this paper introduces a new global optimization technique to

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