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# Multi-Objective Hydro-Thermal Scheduling Problem Using Two Novel Optimization Techniques

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## ABSTRACT

This article describes an efficient and reliable strategy for the scheduling of nonlinear multi-objective hydrothermal power systems using the grey wolf optimization (GWO) technique. Moreover, the theory of oppositional-based learning (OBL) is integrated with original GWO for further enhancing its convergence rate and solution accuracy. The constraints related to hydro and thermal plants and environmental aspects are also considered in this paper. To show its efficiency and effectiveness, the proposed GWO and OGWO algorithms are authenticated for the test system consisting of a multi-chain cascade of 4 hydro and 3 thermal units whose valve-point loading effects are also taken into account. Furthermore, statistical outcomes of the conventional heuristic approaches available in the literature are compared with the proposed GWO and OGWO approaches, and these methods give moderately better operational fuel cost and emission in less computational time.

## KEYWORDS

Combined Economic Emission Dispatch, Economic Load Dispatch, Grey Wolf Optimization, Hydrothermal Scheduling, Prohibited Zone, Ramp Rate, Valve Point Loading

## INTRODUCTION

Hydrothermal scheduling (HTS) is an essential organizing task in power system operation. Generally, thermal system scheduling is less complex than that the optimal scheduling of hydrothermal power system. HTS is mostly a non-linear problem including non-linear objective function and a combination of linear and non-linear constraints. Purchaser load requirements in electric power systems are subject to differ because human accomplishments exhibit an agenda of 1 day or 1 week while satisfying several limitations on hydraulic and thermal power system network. Meanwhile, the marginal production cost of hydroelectric plants is negligible, but one of the manufacturing problems is well organized usage of available water. Maximum generation from hydroelectric plants decrease the cost of thermal generation considering the presence of nonlinearities, large number of decision variables and a set of constraints coupled in time periods. Economic load dispatch (ELD) is a significant technique in the process of a thermal power system. Conventionally, the hydrothermal power systems are worked in such a manner that the total fuel cost is diminished irrespective of emissions created. The problem

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