DISSERTATION: **ARTIFICIAL INTELLIGENCE BASED METHODS FOR HYDROTHERMAL SCHEDULING PROBLEMS**

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ABSTRACT

The study presents the application of four artificial interlligence based methods for solving short-term hydrothermal scheduling (STHTS) problems. The objective of these problems is mainly to minimize total electricity generation fuel cost at thermal plants while neglecting the cost at hydropower plants so that all equality and inequality constraints of the system including power balance constraint considering transmission line, upper and lower limits on power generated by thermal and hydro plants, and hydraulic constraints at hydropower plants such as boundaries of water discharge, boundaries of reservoir volume, avaialbe water, initial volume as well as end volume. In addition, constraints in transmission lines such as transmission capacity of lines, voltage at buses, tap setting, etc. are also taken into consideration. The complicated level of the considered constraints is increased and ranged from the first problem to the final one as follows.

1) Fixed-head short-term hydrothermal scheduling problem neglecting reservoir volume constraints and considering a single fuel cost objective.

2) Fixed-head short-term hydrothermal scheduling problem neglecting reservoir volume constraints and considering both fuel cost and emission objectives.

3) Fixed-head short-term hydrothermal scheduling problem considering reservoir volume constraints and considering a single fuel cost objective.

4) Variable-head short-term hydrothermal scheduling problem with a single fuel cost objective.

5) Hydrothermal optimal power flow problem.

The five problems are solved by applying four following methods.

1) Conventional Cuckoo Search Algorithm (CCSA).
2) Modified Cuckoo Search Algorithm (MCSA).
3) Adaptive Cuckoo Search Algorithm (ASCSA).
4) Augmented Lagrange Hopfield Network (ALHN).

Among the applied Cuckoo search algorithms, conventional Cuckoo search algorithm is the original one, which has been successfully applied for recent years since it was first developed in 2009 meanwhile Modified Cuckoo search algorithm has been developed based on the original one. On the contrary, ASCSA is first developed and applied in the study. In addition, Augmented Lagrange Hopfield Network is also a strong method which has been developed and successfully applied for solving electrical engineering problems.The performance of these methods are tested on several systems according to each kind of problem and there is a fact that not every applied method is applied for solving all considered problems because their different applicabilities on considered problems. In fact, the three CSA methods are run on all the problems but ALHN is only applied for the first problem where water head of reservoir is fixed and reservoir volume constraints are not taken into account. As a result, the comparison among these methods with many existing methods indicates that the methods are effecitve and robust for solving the short-term hydrothermal scheduling problems because they obtains better solution quality and shorter execution time than most methods available in the report. Among the methods, ALHN is very effective for the first problem where valve point loading effects of thermal units are not considered but it must stop working when the effects are taken into account. On the contrary, the three CSA become more effective for the problems with valve point loading effects. Among the three CSA methods, Adaptive Selective Cuckoo search is the most efficient method whereas the effectiveness between CCSA and MCSA has a trade-off for different problems. MCSA is more effective than CCSA for the first and the final problems; however, the figure is opposite for the rest of the problems.

In summary, the first contribution of the study is to successfully solve different problems associtated with the cooperation of thermal plants and hydropower plants by using three applied methods including CCSA, MCSA and ALHN and one proposed method, ASCSA. The obtained results from the four methods compared to those from other existing methods published in many research articles indicate that the four methods are superior to most the methods in terms of optimal solution quality and convergence speed. The second contribution of the study is to successfully develop a new method, ASCSA, which is better than CCSA and MCSA. The third contribution of the study is to successfully solve the STHTS problem in which constraints from transmission lines are taken into consideration.